UNIVERSITY OF ECONOMICS IN BRATISLAVA

Faculty of Business Manament

Department of Business Economy





The conference was held on the occasion of the 70th anniversary of the founding of the Faculty and aims to bring together researchers and practitioners to present their research ideas and discuss topics related to economics, management and entrepreneurship in the digital age.

19th October 2023 Bratislava, Slovak Republic

ORGANIZED BY

UNIVERSITY OF ECONOMICS IN BRATISLAVA, Faculty of Business Management

EDITED BY

Ing. Vladimír Hojdík, PhD.

Ing. Radka Lešková, PhD.

HEAD OF SCIENTIFIC BOARD

Assoc. prof. Anita Romanová, PhD.

Dean, Faculty of Business Management, University of Economics in Bratislava, Slovakia

MEMBERS OF SCIENTIFIC BOARD

Dr. h. c. prof. Peter Markovič, Ph.D. DBA

Vice-Dean for Science and Doctoral Studies, Faculty of Business Management, University of Economics in Bratislava, Slovakia

Prof. Rainer Wehner, Ph.D.

Faculty of Economics and Business Administration, Technical University of Applied Sciences Würzburg-Schweinfurt, Germany

Assoc. prof. Ladislav Tyll, MBA, Ph.D.

Vice-Dean for International Relations, Faculty of Business Administration, Prague University of Economics and Business, Czech Republic

Prof. Katarzyna Mroczek-Dąbrowska, Ph.D.

Chair of International Competitiveness, Poznań University of Economics and Business, Poland

Prof. Katarzyna Piwowar-Sulej, Ph.D.

Department of Labor, Capital and Innovation, Wroclaw University of Economics and Business, Poland

Assoc. prof. Ivana Načinović Braje, Ph.D.

Faculty of Economics and Business, University of Zagreb, Croatia

Assoc. prof. Nikolina Dečman, Ph.D.

Faculty of Economics and Business, University of Zagreb, Croatia

Assoc. prof. Mateja Brozović, D.Sc.

Faculty of Economics and Business, University of Zagreb, Croatia

Assoc. prof. Lenka Ližbetinová, Ph.D.

Department of Transportation and Logistics, Institute of Technology and Business, Czech Republic

Prof. Ľudomír Šlahor, CSc.

Faculty of Management, Comenius University Bratislava, Slovakia

Prof. Helena Majdúchová, CSc.

Head of Department of Business Economy, Faculty of Business Management, University of Economics in Bratislava, Slovakia

Prof. Nadežda Jankelová, Ph.D.

Head of Department of Management, Faculty of Business Management, University of Economics in Bratislava, Slovakia

Assoc. prof. Marián Smorada, Ph.D.

Head of Department of Business Finance, Faculty of Business Management, University of Economics in Bratislava, Slovakia

HEAD OF ORGANIZING COMMITTEE

Assoc. prof. Nora Grisáková, Ph.D.

Vice-Dean for Development and Social Care of Students, Faculty of Business Management, University of Economics in Bratislava, Slovakia

ORGANIZING COMMITTEE

Assoc. prof. Jana Blštáková, Ph.D.

Vice Dean for International and Public Relations, Faculty of Business Management, University of Economics in Bratislava, Slovakia

Assoc. prof. Vladimír Bolek, Ph.D.

Vice Dean for Education, Faculty of Business Management, University of Economics in Bratislava, Slovakia

Assoc. prof. M.Sc. Gabriela Dubcová, Ph.D.

Faculty of Business Management, University of Economics in Bratislava, Slovakia

Assoc. prof. Ing. Katarína Remeňová, Ph.D., MBA

Vice-Dean of the Faculty for Information and Public Relations, Faculty of Business Management, University of Economics in Bratislava, Slovakia

M.A. Mária Kmety Barteková, Ph.D.

Faculty of Business Management, University of Economics in Bratislava, Slovakia

Vladimír Hojdík, Ph.D.

Faculty of Business Management, University of Economics in Bratislava, Slovakia

Radka Lešková, Ph.D.

Faculty of Business Management, University of Economics in Bratislava, Slovakia

The Faculty of Business Management of the University of Economics in Bratislava organized the international scientific conference "Economics, Finance and Business Management 2023 - Economics, Management and Entrepreneurship in Digital Age 2023", which took place on 19 October 2023 under the patronage of the Rector of the University of Economics. Held to mark the 70th anniversary of the Faculty, the conference aimed to bring together researchers and practitioners to present their research ideas and discuss topics related to economics, management and business in the digital age.

The condition of publishing the paper in the proceeding is its originality, its contribution, presentation of empirical knowledge both at home and abroad. International scientific conference EFAM 2023 focused on following fundamental topics:

- Economics and corporate finance
- Business management and decision-making
- Entrepreneurship, start-ups and scale-ups
- Human resource management in Industry 4.0
- Information management, information and data security
- Digital innovation and digital transformation
- Artificial intelligence in business
- New trends in consumer behavior and their impact on business strategies
- New approaches in logistics with a focus on corporate sustainability and environmental management
- Creative industries and specific forms of entrepreneurship
- New trends in marketing and sales strategies
- Application of quantitative methods in decision-making and entrepreneurship
- Economics and economic theories

SCIENTIFIC REVIEWERS:

prof. Ing. Majtán Štefan PhD. doc. Ing. Mojmír Kokles, PhD.

EDITORIAL AND COMPILATION WORKS:

Ing. Radka Lešková, PhD.

Contributions have not undergone language and editorial editing. The articles have been reviewed. The authors are responsible for the content and level of individual contributions.

Approved by the Pedagogical and Editorial Committee of the University of Economics in Bratislava in the editorial program for the year 2023 as a peer-reviewed collection of scientific works.

Publisher EKONÓM, Bratislava 2023 Number of pages, 516 ISBN 978-80-225-5058-1

CONTENT

APPLICATION OF ARTIFICIAL INTELLIGENCE IN PRODUCTION WITH FOCUS ON FORECASTING AND PRODUCTION MANAGEMENT FOR AN AUTOMOTIVE SUPPLIER				
Andreas Rükgauer				
LSP (3PL, 4PL) INNOVATIVENESS IN THE LOGISTICS SERVICE OF SUPPLY CHAINS – SELECTED RESULTS OF CASE STUDY RESEARCH1				
Iwona Wasielewska-Marszałkowska1				
DIGITALIZATION IN EDUCATION2				
Anikó Barcziová, Monika Bálintová and Renáta Machová2				
TRENDS AND TENDENCIES IN LABOR MARKET IN V4 COUNTRIES IN LIGHT OF AN EMPIRICAL RESEARCH3				
József Poór, Zsuzsanna Szeiner, Zdeněk Caha, Marzena Stor, Łukasz Haromszeki, Tímea Juhász 3				
FINANCIAL HEALTH OF CONSTRUCTION COMPANIES IN THE CZECH REPUBLIC ASSESSED USING BANKRUPTCY MODELS4				
Simona Činčalová, Jaroslav Jánský and Roman Fiala4				
CENTRAL BANK DIGITAL CURRENCY - CHALLENGES AND EXPECTATIONS FROM THE PERSPECTIVE OF CENTRAL BANKS5				
Kitti Hajmási, Imrich Antalík and Renáta Machová5				
CHALLENGES OF THE CORPORATE SECTOR IN TIMES OF TURBULENT CHANGES - FOCUS ON CUSTOMERS6				
Enikő Korcsmáros, Renáta Machová and Bence Csinger				
INTELLECTUAL PROPERTY RIGHTS IN THE KNOWLEDGE ECONOMY: CRITICAL ISSUES AND POTENTIAL SOLUTIONS6				
Helena Majduchová and Daniela Rybárová				
CURRENT STEPS IN STRENGTHENING SCIENTIFIC INTEGRITY AND ETHICS IN SLOVAKIA				
Sylvia Bukovová, Katarína Grančičová7				
SOCIAL MEDIA IN HR MANAGEMENT8				
Benita Beláňová and Anna Hamranová				
FIRMS AND SOCIAL RESPONSIBILITY: MAINTAINING SUSTAINABILITY THROUGH ESG9				
Andrea Čambalíková, Boris Rumanko, Branislav Zagoršek9				
SOFTWARE TOOLS FOR IT SERVICE MANAGEMENT10				
Diana Bednarčíková10				
SUSTAINABILITY OF PUBLIC FINANCES OF THE SLOVAKIA - PANDEMIC AND POST-PANDEMIC PERIOD11				
Radka Lešková, Peter Leško				
SUPPORTING ORGANIZATION ENTITIES OF THE CIRCULAR ECONOMY THROUGH ENVIRONMENTAL ELEMENTS IN TRANSPORT TAXATION12				
Ivona Ďurinová				

INSIGHTS INTO HR ANALYTICS: UNRAVELING THE NEXUS WITH HRM PRACTICES IN DYNAMICS	
Soňa Ďurišová, Jana Blštáková	
WORK ENGAGEMENT OF UNIVERSITY LECTURERS AS A PREREQUISITE FOR THE QUOT HIGHER EDUCATION IN SLOVAKIA	
Nadežda Jankelová, Zuzana Joniaková	142
APPLICATION OF INFORMATION SYSTEMS IN THE NEW TECHNOLOGIES-BASED FIIGHTON GROWTH FACTORS QUALITATIVE RESEARCH	
Veronika Bednárová, Štefan Slávik	151
STARTING POINTS FOR THE APPLICATION OF NEW TRENDS IN WASTE MANAGEM	ENT166
Júlia Rakovská	166
INDUSTRIAL ORGANIZATION: AN ASSESSMENT OF CURRENT SITUATION WITHIN SLOVAK ADVERTISING SECTOR	174
Vladimír Hojdik, Miroslav Uhliar	174
INTEREST RATE DEVELOPMENT AND THEIR IMPACT ON BUSINESS DECISION-MAK	ING.182
Anna Polednáková	182
DOES GREEN PUBLIC PROCUREMENT IMPACT SUSTAINABILITY?	189
Brigita Boorová	189
TRENDS IN WASTE MANAGEMENT AS PART OF THE CIRCULAR ECONOMY OF THE SLOVAK REPUBLIC	195
Slavka Šagátová	195
FOSTERING TRANSNATIONAL WINE TOURISM IN THE DANUBE REGION AS THE KEELEMENT OF THE SUSTAINABLE TOURISM STRATEGY	
Kristián Kalamen, Mária Kmety Barteková	203
CREATIVE CLUSTERS IN TEXTILE INDUSTRY WITHIN THE EU COUNTRIES	213
Denisa Gajdová	213
MAPPING THE SUSTAINABLE DEVELOPMENT IN ENTERPRISES OF THE ELECTRONIC	
ELECTRICAL COMPONENTS INDUSTRY IN SLOVAKIA	
Patrik Richnák	
HOW EDUCATION IN SCHOOLS PREPARES SLOVAK WOMEN IN DIGITAL SKILLS	
Róbert Hanák, Nina Kocúrová	
FACTORS INFLUENCING THE LEVEL OF DIGITAL SKILLS OF SLOVAK WOMEN	
Nina Kocúrová, Róbert Hanák	
PRICE DIFFERENTIATION IN TRANSPORT SERVICES	
Iveta Kufelová	
THE IMPORTANCE OF BUILDING SMALL HYDROPOWER PLANTS IN THE CONCEPT (CIRCULAR ECONOMY	
MILAN KUBICA, MIROSLAV UHLIAR	249
EVALUATION OF THE SUGAR COMPANIES IN THE CZECH REPUBLIC	255
Elena Moravčíková, Eduard Hyránek	255

PHENOMENAL FORMS OF ETHICAL BEHAVIOUR OF ECONOMICS ENTITIES	260
Gabiela Dubcová, Jana Kissová	260
USAGE OF VIRTUAL REALITY IN SLOVAKIA IN THE EDUCATION AND HEALTHCARE	
SECTOR AND POTENTIAL OF ITS IMPACT ON BUSINESS REPUTATION	
Martin Novysedlák and Peter Dorčák	
THE DEVELOPMENT AND CURRENT SITUATION OF MERGERS AND ACQUISITIONS A THEIR SYNERGIES	
Anna Harumová	
BUSINESS CONDITIONS IN CONTEMPORARY GEOPOLITICS	
ALENA TÓTHOVÁ	
FUNCTIONING ETHICAL MANAGEMENT PRESENTED ON THE BASIS OF THE CREDIBI	
UNIVERSITY	
Gabiela Dubcová, Ľubica Foltínová	301
THE INFLUENCE OF PERCEIVED VALUE FACTORS ON OVERALL CONSUMER SATISFA	CTION
	313
Dana Hrušovská	313
CULTURE AND CREATIVE INDUSTRY. POTENTIAL AND GROWTH, INNOVATION, SUSTAINABILITY	320
Natália Tarišková	320
SMALL AND MEDIUM-SIZED ENTERPRISES IN THE DIGITAL DECADE	331
Anikó Töröková	331
STRATIFIED LANDSCAPES OF WASTE MANAGEMENT IN THE EUROPEAN UNION: AN	
Peter Štetka and Nora Grisáková	
THE POSITION OF THE SLOVAK PRINTING INDUSTRY IN THE INDUSTRY 4.0	
Monika Soľavová, Vladimír Bolek	
ENTERPRISE SOCIAL MEDIA	
Anna Hamranová, Benita Beláňová	362
INTERNET OF THINGS AS AN USEFUL BUSINESS TOOL	
Peter Zahradník	
MAPPING THE EVOLUTION OF LEADERSHIP 4.0: A BIBLIOMETRIC ANALYSIS	
Zuzana Skorková, Katarína Procházková	
FACTORS AFFECTING THE LEVEL OF DIGITIZATION IN SLOVAKIA	
Filip Stovíček, Lucia Čerňanová and Vanda Čirčová	
DOES ORGANIZATIONAL COMPLEXITY DRIVE GREEN INNOVATION AND SO THE GROWTH OF COMPETITIVENESS THROUGH EMPLOYEE MOTIVATION TOOLS?	
Branislav Zagoršek, Andrea Čambalíková and Martin Novysedlák	
MAPPING THE LANDSCAPE OF EDUCATION 4.0: A VOSVIEWER BIBLIOMETRIC ANAL	
MAFFING THE LANDSCAFE OF EDUCATION 4.0: A VOSVIEWER BIBLIOMETRIC ANAL	
Zuzana Skorková, Hana Gažová-Adamková, Kristína Korytinová	400

SOME TRENDS IN BOOK PUBLISHING41	10
Miroslav Tóth	10
DIGITAL TECHNOLOGIES IN RELATION TO TAX SYSTEMS42	20
Katarina Vavrová	20
ALTERNATIVES TO A PROGRAM FOR SUPPORTING THE DEVELOPMENT OF ETHICS42	29
Jana Kissová, Gabriela Dubcová	29
COMPARISON OF THE COMPETITIVENESS OF THE BRICS COUNTRIES AND THE USA43	39
Lenka Kalusová and Marián Smorada 43	39
MEDIA, CULTURE AND PUBLISHING: ASSESSING THE CURRENT STATE OF THE SECTOR IN SLOVAK REPUBLIC44	J 48
Vladimír Hojdik, Jakub Kintler44	48
FIME PREDICTION OF REACHING THE NEXT BITCOIN TOP AND BOTTOM BASED ON ANALYSES OF PREVIOUS CYCLES45	55
Peter Badura	55
FURTHER PROFESSIONAL ON-THE-JOB TRAINING OF EMPLOYEES IN POST-PANDEMIC FIMES AND A PERIOD OF TRANSFORMATIONS46	63
Marta Matulčíková, Tatiana Hrivíková46	63
PSYCHOLOGICAL DETERMINANTS OF OCCUPATIONAL ACCIDENTS IN THE CONTEXT OF CURRENT CHANGES IN THE WORKING ENVIRONMENT47	
Natália Matkovčíková, Nadežda Jankelová47	72
POST-PANDEMIC MANAGEMENT FUNCTION OF ORGANIZING47	78
Juraj Mišún47	78
SUSTAINABILITY OF INNOVATIVE ENTERPRISES IN SLOVAKIA48	88
Ivana Mišúnová Hudáková, Jozef Kovács	88
TT SERVICE MANAGEMENT AS THE SUPPORT FOR DIGITAL TRANSFORMATION IN THE	98
Jana Filanova and Matej Cerny	98





Application of Artificial Intelligence in Production with Focus on Forecasting and Production Management for an Automotive Supplier

Andreas Rükgauer 1

Professor, Faculty of Economics and Business Administration, Technical University of Applied Sciences Würzburg-Schweinfurt, Würzburg, Germany; andreas.ruekgauer@thws.de

Abstract: Practical use of artificial intelligence in forecasting and production planning and scheduling for an automotive supplier is investigated. First, standards and peculiarities of production planning in an automotive supply chain are being discussed and the management challenges are explained on a practical business case. Two main research questions are then derived: How can artificial intelligence improve forecasting in the automotive supply chain, and how can artificial intelligence help replace existing planning routines and provide better solutions? Time series analysis for better forecasts using a LSTM model is conducted and its performance is assessed. Based on this, a more complex hierarchical model is proposed for further research. A simplified simulation model as digital twin of the real plant is developed and validated, to be used as learning environment for reinforcement learning of a planning agent. Finally, the reinforcement learning architecture is proposed for further analysis.

Keywords: production planning, automotive parts forecasting, time series analysis, LSTM, reinforcement learning

1. Introduction

This paper presents a discussion of the specific challenges in forecasting demand and planning production accordingly within the automotive industry supply chain, and potential solutions based on the use of artificial intelligence (AI). The automotive industry is a complex and economically significant sector with demanding operational challenges. Meeting consumer demands, and reducing operational costs are vital concerns. Specifically, two separate paths of action are being discussed below: Application of neural networks for better forecasting of intermittent time series, and an infrastructure for future use when building production planning agents by way of reinforcement learning. Both approaches are important building blocks for management to reducing cost, and risk, and improving customer fulfillment even further. First, the business situation is explained, and the two relevant research questions are being derived. Then each question is being discussed separately, either starting with a theoretical study, followed by some practical analysis, and discussion.

2. Business Case and Research Questions

Efficient production planning (PP), scheduling (PS), forecasting (FC), and inventory management (IM) are fundamental to maintaining competitiveness in the automotive supply chain (SC). Effective and efficient PP, PS, FC, and IM are an ever-challenging endeavor due to the tremendous complexity of the overall SC from suppliers of small components to the final customer with intermittent demand often resulting in bullwhip effects along the SC. On top of these challenges, the recent past posed additional challenges from structural breaks such as a pandemic with shutdowns on either side of the SC, new trade barriers due to changes in the political climate between nations, and even downright wars between countries, whose inhabitants would usually generate demand, and whose industries would normally serve as supply base for certain classes of supply.

Managing supply and demand within the SC has thus become a very challenging task. On one side, supply cost must be considered: The automotive industry always expects perfect delivery performance within its SC, meaning that all demands must always be met timely and at full amount. This

generates inventory cost, and operational and managerial expenses. It is typically up to the supplier to balancing off the cost of holding excess inventory and the cost of inability to fulfill given inventory limitations. It is no secret that many suppliers struggle with the challenge and often give up.

2.1. Ordering and Fullfillment within the Automotive Supply Chain

Optimizing supply performance under tremendous cost pressure has led to its special solutions for the automotive industry. This has immediate impact on planning procedures. Within supply chain management (SCM) in the automotive industry, ordering follows worldwide standards. VDA 4984 for instance specifies a call-off including immediate demand for immediate fulfillment and future demand FC for further supply planning, see VDA (2022). This implies that any supplier involved receives for every product supplied every day a call-off amount, and forecast amounts for the next future (typically, 90 days out). The call-off amount must be supplied the next day at all costs, and the forecast is to be used for preparation of future supply.

2.2. The Reality of Automotive Ordering and Forecasting

For the business case investigated here, daily call-offs are received, including demand FC for the next 180 days, which are subject to permanent revision, even including demands planned to be shipped within the next 48 hours, which are sometimes cancelled altogether. The time series of a typical long term true demand pattern over time ("day forecasted", dfc) is shown in Figure 1. It can clearly be seen that the pattern shows intermittent behavior and heavy fluctuations. Thus, it is not easy to extrapolate and build forecasts from past data.

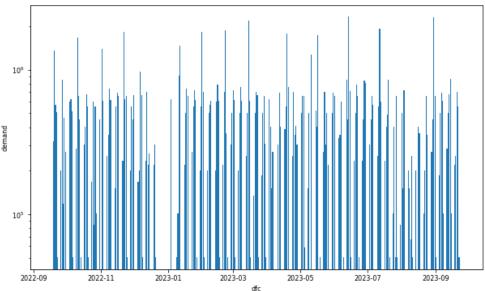


Figure 1. All order amounts over time dfc for a select product.

Source: Own representation

Given the above VDA procedure, every shipment is not only defined by date and amount, but also by a trail of 180 prior days ("forecasting days", fcd) of past FC amounts for this shipment, all provided by the customer and reflecting their past assessment of the future, as shown in Figure 2 for a select dfc arbitrarily chosen. The graph shows that the forecast amount (blue) for the dfc wildy fluctuates with an amplitude of almost 100% of the final, actual amount (red). Only the final approximately 50 fcd show a somewhat more accurate forecast in this concrete example, in other cases for other dfc even this is often not the case.

2.3. Production Planning and Scheduling Tasks

There are numerous tasks to be considered within PP and PS, see e.g., Hopp and Spearmann (2011). The replenishment cycles are usually too long for build-to-order, so suppliers typically cope with this challenge by producing to stock and fulfilling call-offs from inventory. For the sake of simplicity and in line with other literature, see e.g., Lorenz, Krauz, Wolf, Feuerriegel, and Netland (2022), the PP and PS processes covered for the scope of this work as shown in Figure 3 are limited to:

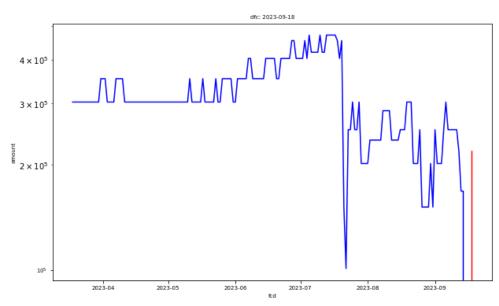


Figure 2. Example of actual order amount (red bar) vs. long term FC (blue line) for shipment on dfc = 2023-9-18 over 180 days fcd.

Source: Own representation

- 1. Reorder point (ROP): Time and amount for new supply to inventory;
- 2. Economic order quantity (EOQ): production job batch size for optimum tradeoff between setup and storage cost;
- 3. Sequencing (SEQ): The proper order of production jobs to optimize business targets as for instance yield rate.

As a result of these above experiences for the given case, the specialists responsible for PP and PS will solely focus on delivery performance and always try to maintain a 4-week market rate of demand on inventory. Given the poor quality of the data provided, and the challenges of permanent disruptions which are normal for a production environment, PP and PS is largely managed by intuition. As a result, management is confronted with a serious inventory overstocking problem and is at the mercy of its specialists.

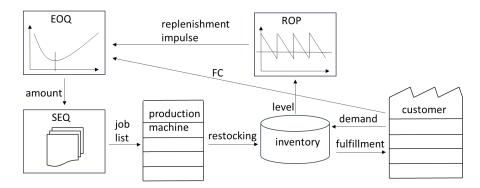


Figure 3. PP and PS processes covered herein.

Source: Own representation

2.4. Research Questions and Research Design

As the above discussion indicates, management faces at least two challenges to be investigated: As can clearly be seen in Figure 1, demand fluctuates heavily from day to day with strong intermittent property. Though a long time series of FC is supplied for every dfc, Figure 2 shows that these numbers are not very trustworthy, and the FC is largely useless. Lorenz et al (2022) indicate for PP the need for

valid FC. So, the question is: Can the FC be improved, only observing past real demand and changes in future demand estimates? It is quite complex to study trends in adjustments. Here, the application of AI is studied, trying to generate better FC based on both past real demand as shown in Figure 1 and past FC data as shown in Figure 2 (blue line).

All the PP and PS processes are difficult to manage properly, see e.g., Rükgauer (2021) for a ROP discussion. The methods typically employed are based on heuristics and simplifications not reflecting reality well, which then leads to overstocking or material shortages and tremendous planning efforts from continuous replanning. Hence practical research should be conducted analyzing how and how well AI can improve or even replace ROP, EOQ, and SEQ altogether, making planning easier, more accurate, faster, more independent from human performance, and more refined in such that either inventory constraints, and material shortages are prevented simultaneously.

Answering these two research questions asks for data-centric work with a corresponding project approach like CRISP-DM, see e.g., Shearer (2000). Along with some introductory study, the overall research design reads as follows:

- 1. Literature study and semi formal expert interviews
- 2. Business process analysis and data collection and analysis
- 3. FC optimization:
 - a. Data understanding and preparation
 - b. Modelling and validation
- 4. PP and PS optimization:
 - a. Data understanding and preparation
 - b. Modelling and validation

This introductory paper covers sections 1, 2, 3a, 4a, some aspects of section 3b, and the necessary prerequisites for section 4b. It describes the challenge, discusses the research goals and methods, and indicates the implementation approach by way of first results, thus laying out the next steps to be taken and research to conducted. For introductory study, 5 interviews have been conducted with specialists from data analytics and AI, both from industry and from academia and either with focus on application or algorithm and technology. The findings are incorporated below. The most relevant findings from the business process and data analysis have been included above.

3. Neural Networks for Improved Forecasting

First the use of AI for improved FC is being discussed and analyzed, starting with a definition and theoretical investigation, then with some experimental study and discussion for further work.

3.1. Theoretical Background

A very good overview of AI applications in production and SCM is given by Helo and Hao (2022). It shows that numerous authors have covered a wide range of SCM tasks quite successfully, including FC, PP, and PS. They are stressing the fact that artificial neural networks (ANN) and machine learning (ML) allow for acceptable accuracy by expedited execution. Lorenz et al (2022) consider the FC task a time series analysis (TSA) or Markov decision problem with medium implementation effort. All experts interviewed considered the task a regression problem (RP) with autoregressive (AR, dependent on itself) data as typical for TSA. Thus, methods like vector autoregressive (VAR) family of algorithms, see e.g., Gregorová, Kalousis, and Marchand-Maillet (2017) or ARIMA ("autoregressive integrated moving average"), see e.g., Huang and Petukhina (2022) have been suggested, also allowing for analysis of autocorrelation (AC, delayed copies of themselves) within the data. As a more modern approach, recurrent neural networks in the form of long-short-term-memory (LSTM) were mentioned as particularly well suited for time dependent problems, see e.g., Goodfellow, Bengio, and Courville (2016). It was suggested to identify seasonal patterns, but it was also stressed that the benefit of highly complex over simplistic methods would most likely be marginal. Other authors have dealt with TSA of intermittent data, even regarding automotive forecasting, though with focus on spare parts demand. It can safely be assumed that those findings can be applied to the series production case here. Ma, Zhang, and Wang (2021) compare different advanced ANN topologies for automotive spare parts TSA and FC. They show the superiority of LSTM over other ANN topologies as for instance, Convolution ANN (CNN), see e.g., Goodfellow et al (2016), and they show the superiority of advanced ANN over other ML methods.

Oukassi, Hasni, and Layeb (2023) follow a similar route based on a special encoder-decoder based LSTM topology which outperformed an ARIMA algorithm. To date, LSTM seems to offer the most promising approach.

Interestingly, there was a disagreement among the experts interviewed on the value of using a project process model as CRISP-DM. The closer the experts were to customers the more they advocated the use of such models and vice versa. By and large there was consensus that data is more important than level of sophistication of the algorithms employed. Some practitioners stressed the need of close collaboration with end users for better acceptance. Some researchers cautioned that sophisticated algorithms would usually not outperform simplistic classic algorithms.

3.2. Methods and Methodology

TSA is self-contained, only looking at the past and trying to extrapolate into the future, different from classic regression models that try to understand the drivers ("regressors"). Here, there are two time series to be observed, the past actual demand as shown in Figure 1, and the series of FC as shown in Figure 2, which on top of AR and AC properties most likely also show some cross-correlation (similarity). For the time being, only past demand is being analyzed, neglecting FC data altogether, and looking ahead just one day, based on a lookback of 30 days past data. Overall, 343 past demand data points have been considered. The first 80% of the data were used for training, and the final 20% of the data were used for testing purposes.

For comparison, an exponential smoothing algorithm (or exponential moving average, EMA) is being used as a reference, see Winters (1960). EMA algorithms are very popular for TSA in FC, though they are not well equipped for intermittent behavior.

Given the above findings, an LSTM model seems in order. After some initial hyper parameter variations, a model with one LSTM input layer with one input, followed by two fully connected layers with 500 parameters each and an output layer with one FC output as multilayer perceptron (MLP) is being utilized. All fully connected layers are ReLU activated, and no dropouts are being used. For training, an Adam optimizer is used in connection with a root mean squared error (RMSE) loss function at a learning rate of 0.002 and 6.000 epochs. A current notebook with GPU running PyTorch is perfectly fine for the analysis performed so far, see e.g., Gridin (2022) for similar applications. Original plans to migrate to a commercial cloud platform have been disregarded.

3.3. Results

FC data has bot been used for modelling yet It should be stressed that data preparation, including declaration of required data, collecting, importing, interpreting, building an effective data structure, among other tasks, takes much longer than expected and regardless of most careful initial business analysis, misunderstandings between providers and consumers of data will occur and delay the process. The FC data used herein showed unrealistically high peaks in 2022 and these data were disregarded. There are still early peaks remaining in the data, reflecting a bad habit by customers' planners, who will enter monthly lump sum amounts early on to generate long term demand, subject to later replacement by smaller daily numbers at their discretion. There was also a misconception about the forecast data such that the open amounts were exported, which are however subject to work-in-progress, so that in the end, the FC was always close to zero as the order was finished. This required a complete redesign of the data structure with extra data from shipments to be used for actual demand. Given that one cannot a priori know when the shipping department will start packing the order, a safe corridor of 10 final days prior to shipping day dfc has been agreed upon, which is very disappointing, as with FC, usually the most recent data is the most relevant.

As a reference, an EMA model was fitted utilizing a Holt-Winters algorithm, see Winters (1960). A comparison of real past demand data vs. EMA approximation is shown in Figure 4. As mentioned earlier, the EMA model is not well equipped to handle the intermittent behavior well.

Figure 5 shows the test results for the LSTM model: (a) the actual time series and (b) the learning rate by way of the RMSE error decreasing over epochs. It is obvious that the LSTM model implements the intermittent property much better than the EMA model. The LSTM model resembles the training data set reasonably well, the performance on the test data set is not as good. Also, convergence is not yet very good as the numbers in graph (b) of Figure 5 show.

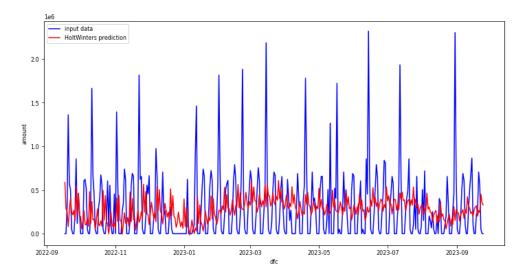


Figure 4. EMA approximation of past demand data.

Source: Own representation

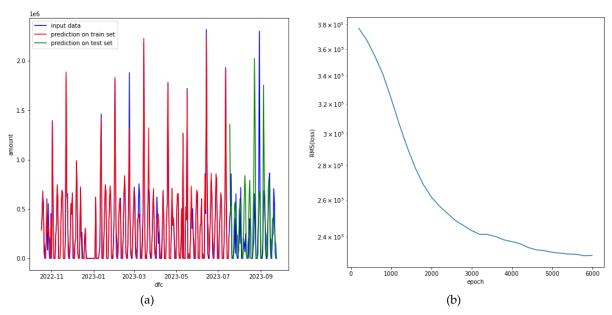


Figure 5. Test results from a first LSTM model utilizing only past demand data, (a) input vs. model output on training and test data, (b) model conversion over learning epochs.

Source: Own representation

The performance on the test set indicates some overfitting: Table 1 shows a comparison of the LSTM model on training and test data separately, compared to the EMA model by way of RMSE and mean average error (MAE), RMSE being more sensitive to outliers. On the training data the LSTM model performs much better than the EMA model. On the test data, this is partially true on average, but not on the outliers, as the poor RMSE value indicates.

In general, it turns out the model is very sensitive to changes in hyper parameters which must be selected very carefully.

3.4. Discussion

The above first results are just a starting point asking for more in-depth analysis and further refinement. The LSTM results are promising, but the model must be fine-tuned in order to show better performance on the test data and better convergence.

Model	RMSE	RMS vs. EMA %	MAE	MAE vs. EMA%
EMA	425.773		310.224	
LSTM on training data	141.866	33%	65.602	21%
LSTM on test data	436.883	103%	225.424	73%

Table 1. RMSE and MAE for classic EMA compared to LSTM model.

Source: Own representation

So far, only past demand data has been explored. As Figure 5 and Table 1 show, even this simple LSTM model can be fit well to the demand data. Nonetheless there are numerous shortcomings, on top of overfitting and convergence issues. It suffers from myopia with its limitation to looking just one day ahead. Also, past FC data for past future times is completely neglected. One could argue that real demand data is better than FC data which contains a lot of wishful thinking. However, such FC data will project into the future, and given the history of 180 days of adjustments to the FC, one can assume that it implicitly includes a lot of wisdom about future demand expectations beyond the simple demand number. Therefore, a hierarchical model is proposed for further analysis, see Figure 6. Such a model will allow for optimized model approaches for both demand and FC streams, each resulting in an intermedia solution. Both can be mixed and integrated into an improved FC with a third model, all trained together in one step.

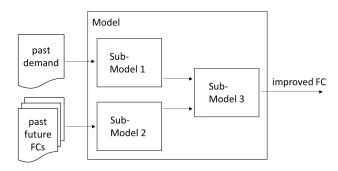


Figure 6. Proposed hierarchical FC model for future analysis.

Source: Own representation

It remains to be seen if a LSTM model with its inherent ability to support sequences is superior to other approaches like a CNN model allowing for better feature extraction, more straightforward MLP model with its robustness and its ability to generate multi-step FC, see e.g., Huang and Petukhina (2022), or a numerically more efficient topology like gated recurrent unit (GRU) as proposed by Ma, Zhang, and Wang (2021). Maybe it is even beneficial to use different models for demand and FC analysis.

4. Neural Networks for Improved Planning

Next, the use of AI as a replacement of human planning is considered. Again, first some theoretical aspects are being discussed and some methodology is defined, and some initial results are shown and discussed. Here, the focus is on the training environment only.

4.1. Theoretical Background

Lorenz et al (2022) discuss the need for proper SEQ both in job-to-machine as well as in job-to-job matching and consider this a problem of nonlinear, potentially genetic optimization again requiring medium effort. The experts interviewed to a certain degree viewed the task as an optimization problem only, by way of goal programming or genetic algorithms. An approach based on artificial neural networks (ANN), to be trained utilizing a digital twin (DT) as simulation model was considered unique and promising though complex yet a promising approach for this kind of task. Min, Lu, Liu, Su, and Wang (2019) are coping with AI in production control utilizing a DT, and they also discuss the literature background of the task. Here, machine learning is being used to develop the simulation model of a DT to test classic sequential PP and PS optimization algorithms against. A very thorough analysis of such

applications is presented by Panzer, Bender, and Gronau (2021), focusing on the actual agent and broader application including shop floor coordination. They are pointing out the need and challenge of simulation for transfer. Esteso, Peidro, Mula, and Diaz-Madronero (2023) also present a thorough analysis of the research field. It turns out that PS is the most popular of several classes of application areas for reinforcement learning (RL). They argue that for PS, value-based approaches are most frequently used, among which Q-learning and Q-network variants being most popular. The reliability of deep RL (DRL) is being discussed by Waubert de Puiseau, Meyes, and Meisen (2022). The studies seem to agree about the suitability of context-free agents. Yet it remains unclear how an agent is being trained effectively. Reflecting upon expert inputs and literature, it is proposed to train an AI model representing PP and PS, replacing ROP, EOQ and SEQ. This model is to be trained by a DT of the plant which requires a simulation model, and some sort of reinforcement training.

4.2. Methods and Methodology

A stochastic, event-driven simulation model as DT of the real production to be utilized for RL in the future has been developed. Of the approximately 100 products produced daily, only 8 have been selected for data collection. Of these 8, only two have been selected for the DT: a small volume, high volatility niche product and a large volume, low volatility mass product. For the sake of simplicity and limited to the proof-of-concept, a simplistic model was chosen with only one production machine serving both demand streams. The model operates build-to-stock and fulfills from inventory. It implements ROP, EOQ, and SEQ, machine breakdowns, and process fluctuations. Past experience, see Rükgauer (2021), indicted performance and accuracy problems with a professional factory simulation environment, so the whole implementation was done in Python utilizing the SimPy event model which proved very elegant and powerful, see e.g., Fuchs, Enslin, Samsonov, Lütticke, and Schmitt (2022) for a similar, more elaborate approach. All PP and PS routines reside within a ProdPlan class, which can easily be replaced by an AI algorithm in the future.

Both product demand patterns are discrete in time and amount and are alike the one shown in Figure 1 with fluctuations in both dimensions. Such pattern can be represented by a compound stochastic process with two independent Poisson distributions for time and amount, see Adelson (1966). For both products, the relevant Poisson parameters have been extracted and included in the simulator, and the product Demand classes not only provide daily demand streams, but also a noisy FC of 180 days like the real-world application.

4.3. Results

Some first simulation results are shown in Figures 7 and 8: The inventory development over time nicely shows the expected ROP shape. It shows that after some 65 cycles and again after some 110 cycles the niche product (a) must wait for the mass product job (b) to be finished first. This immediately leads to some temporary backlog for the niche product, shown in Figure 8 by the green line. Figure 7 also shows the generated demand pattern which can be compared to the real pattern from Figure 1. A real inference test is not possible currently, as real planning is largely conducted by intuition, leading to different results. In fact, the model will serve as the base for future inference tests with the trained algorithms. The different elements of the model have been validated individually.

4.4. Discussion

The above simulation results proof the concept of the simulator only. Now it needs to be put into use for the development of better PP and PS approaches by way of trained models. PP and PS elements like ROP, EOQ, and SEQ usually require generalizations and a high level of standardization certainly not always optimal for all demands, products, times, and machines. Here lies a huge opportunity for AI algorithms capable of identifying and exploiting finest nuances of patterns, thus maybe resulting in a much more refined solution with much better outcomes. Also, state-of-the-art optimization approaches like genetic algorithms turn out to be too complicated to apply and even after tedious and expensive implementation are still not powerful enough for real world conditions, and yet overly complex. There resides another opportunity for AI in conjunction with DT based RL approach, promising less cost and better outcomes. PP and PS poses a multi-criteria optimization challenge with deferred outcome, as many properties like customer delivery rate or inventory levels are affected in the long run only. Often,

this leads to a sub-optimum, as in the case being analyzed here, where delivery rates are perfect, but overall inventory levels are too high.

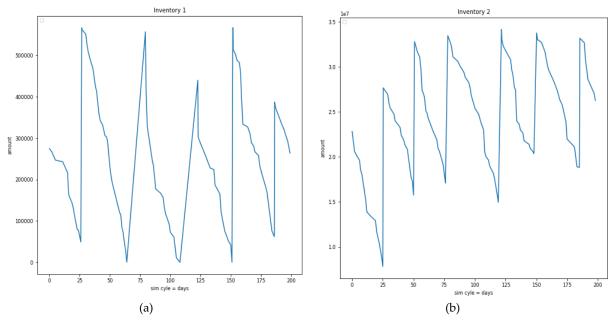


Figure 7. Simulation results: Inventory development over simulation cycles or days, (a) for niche product, (b) for mass product.

Source: Own representation

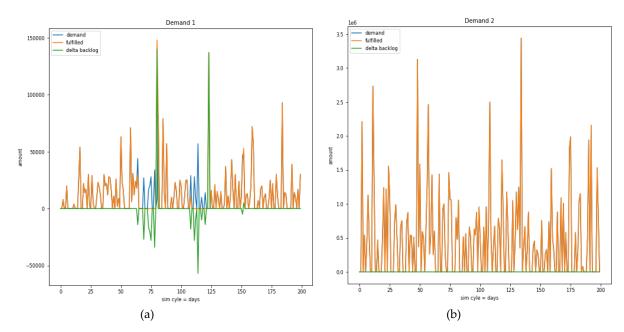


Figure 8. Simulation results: Demand, backlog, and fulfillment over simulation cycles or days, (a) for niche product, (b) for mass product for which demand and fulfilled amount are identical.

Source: Own representation

A RL infrastructure is proposed in Figure 9. A model reads demand and FC data, generates production job data, predominantly, time and amount per product, a plant executes the resulting job list on an ongoing basis, the resulting plant performance to be measured by fulfillment rates, inventory levels, or other parameters as a deferred outcome. The RL agent will require some reward for further improvement of the algorithm through learning. The reduction of a multi-criteria problem to a singular reward number must be carefully designed. Given the above literature findings, a context-free Q-learning or Q-network agent seems to be appropriate. Finally, a model architecture must be crafted such that

it can operate the plant effectively, either by generating one job at a time as shown in Figure 9, or by replacing the complete list every time. Then, the agent can experiment with the above simulation model and learn effective PP and PS.

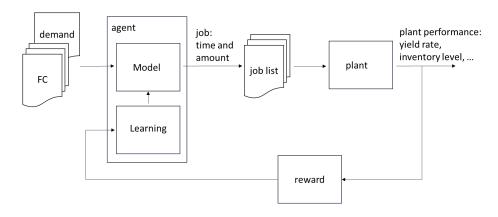


Figure 9. Proposed RL architecture for future analysis.

Source: Own representation

5. Conclusions

It has been shown above that LSTM based forecasting works, and a path for further improvement has been described. So, it can be assumed that the first research question can soon be confirmed, and based on it, management can be provided with better, timelier, and more accurate forecasts.

It has also been shown that agent-based production planning is already done successfully, and with the above work, an environment for risk-less experimentation by way of RL has been made available. The next step is to be conducted now, selecting a learning strategy and a model structure and get it trained on the simulation model. Then the second research question can finally be answered and ideally, management be supplied with a planning agent, able to accomplish better overall performance at lower operational long-term cost.

Funding: This research was supported by the German Federal Ministry of Education and Research (BMBF), Directive for the promotion of measures for the recruitment and development of professorial staff at universities of applied sciences in accordance with Section 4 Paragraph 2 of the agreement between the federal and state governments "FH Personnel" of 11 February 2020, translated into the corresponding THWS program "ProPere".

The author is grateful for the support from ITW Fastener Products GmbH, Creglingen, Germany as industrial partner, providing business case, data, and access to its processes.

References

- 1. Adelson, R. (1966): Compound Poisson Distributions. The Journal of the Operational Research Society, Vol. 17 (1), p. 73–75, https://doi.org/10.1057/jors.1966.8.
- 2. Esteso, A., peidro, D., Mula, J. & Diaz-Madronero, M. (2023): Reinforcement learning applied to production planning and control. Intl. J. of Production Research, Vol. 61, 16, p. 5772–5789, https://doi.org/10.1080/00207543.2022.2104180.
- 3. Fuchs, T., Enslin, Ch., Samsonov, V., Lütticke, D. & Schmitt, R.H. (2022): ProdSim: An Open-source Python Package for Generating High-resolution Synthetic Manufacturing Data on Product, Machine and Shop-Floor Levels. Procedia CIRP, Vol. 107, p. 1343-1348, https://doi.org/10.1016/j.procir.2022.05.155.
- 4. Goodfellow, I., Bengio, Y. & Courville, A. (2016): Deep Learning. MIT Press, http://www.deeplearningbook.org.
- 5. Gregorová, M., Kalousis, A. & Marchand-Maillet, S.: Learning Predictive Leading Indicators for Forecasting Time Series Systems with Unknown Clusters of Forecast Tasks. In: Proceedings of Machine Learning Research 77, p. 161-176, 2017, https://doi.org/10.48550/arXiv.1710.00569.
- 6. Gridin, I. (2022): Time Series Forecasting using Deep Learning: Combining Pytorch, RNN, TCN, and Deep Neural Network Models to Provide Production-Ready Prediction Solutions. BPB Publications.

- 7. Helo. P. & Hao, Y. (2022): Artificial intelligence in operations management and supply chain management: an exploratory case study, Production Planning & Control, 33:16, p. 1573-1590, DOI: 10.1080/09537287.2021.1882690.
- 8. Hopp, W.J. & Spearman, M.L. (2011): Factory Physics (3rd Ed.). Waveland Press.
- 9. Huang, Ch. & Petukhina, A. (2022): Applied Time Series Analysis and Forecasting with Python. Springer, https://doi.org/10.1007/978-3-031-13584-2.
- 10. Lorenz, R., Kraus, M, Wolf, H., Feuerriegel, S. & Netland. T.H. (2022): Selecting advanced analytics in manufacturing: a decision support model, Production Planning & Control, DOI: 10.1080/09537287.2022.2126951.
- 11. Ma, Z., Zhang, Z. & Wang, C. (2021): Deep Learning Algorithms for Automotive Spare Parts Demand Fore-casting. 2021 International Conference on Computer Information Science and Artificial Intelligence (CISAI). DOI: 10.1109/cisai54367.2021.00075.
- 12. Min, Q., Lu, Y., Liu, Z., Su, C. & Wang, B. (2019): Machine Learning based Digital Twin Framework for Production Optimization in Petrochemical Industry. International Journal of Information Management 49, p. 502–519, https://doi.org/10.1016/j.ijinfomgt.2019.05.020.
- 13. Oukassi, H., Hasni, M. & Layeb, S. (2023): Long Short-Term Memory Networks for Forecasting Demand in the Case of Automotive Manufacturing Industry. 2023 IEEE International Conference on Advanced Systems and Emergent Technologies (IC_ASET), DOI: 10.1109/IC_ASET58101.2023.10150543.
- 14. Panzer, M., Bender, B. & Gronau, N. (2021): Deep Reinforcement Learning In Production Planning And Control: A Systematic Literature Review. In: Herberger, D.; Hübner, M. (Eds.): Proceedings of the Conference on Production Systems and Logistics CPSL 2001. Hannover: publish-Ing., p. .535-545, DOI: https://doi.org/10.15488/11238.
- 15. Rükgauer, A. (2021): Analytical and Empirical Study of Proper Parameters for Theory of Constraints under Uncertainty. In: Franke, J., Schuderer, P. (Eds., 2021): Simulation in Produktion und Logistik. Cuvillier, p. 237-246.
- 16. Shearer, C. (2000): The CRISP-DM Model: The New Blueprint for Data Mining. Journal of Data Warehousing, 5, p. 13-22.
- 17. VDA (2022). VDA 4984 Data Transfer of Delivery Instructions V3.0 2022-03. https://www.vda.de/dam/jcr:82f13ac0-1c71-42ca-a95a-164fd48d0a7f/VDA-4984-Delivery-Instructions-with-EDI-V3p0-2022-03.zip.
- 18. Waubert de Puiseau, C., Meyes, R. & Meisen, T. (2022): On reliability of reinforcement learning based production scheduling systems: a comparative survey. J Intell Manuf 33, p. 911–927, https://doi.org/10.1007/s10845-022-01915-2
- 19. Winters, P.R. (1960): Forecasting Sales by Exponentially Weighted Moving Averages. Management Science. 6 (3), p. 324–342. doi:10.1287/mnsc.6.3.324.

LSP (3PL, 4PL) innovativeness in the logistics service of supply chains – selected results of Case Study Research

Iwona Wasielewska-Marszałkowska1*

- ¹ Faculty of Economic Sciences and Management, Department of Logistics, Nicolaus Copernicus University in Torun, Torun, Poland, <u>iwasielewska@umk.pl</u>
- * Correspondence: <u>iwasielewska@umk.pl</u>

Abstract: The dynamic changes in the market environment, as well as growing customer expectations, motivate LSPs (3PL, 4PL) to create and implement innovations in logistics services for supply chains, nowadays. The conducted research adopted a multi-stage approach. In the first stage, a systematic literature review was conducted using the procedure proposed by Tranfield, Denyer, and Smart (2003). The results of the literature analysis showed that there is a deficit of empirical research covering this issue. The next stage focused on conducting empirical research using the Delphi and Case Study research methods. The article will present the results of the Case Study, indicating the identified types of innovations introduced by LSPs. The study results show that innovations implemented by LSPs in logistics services for supply chains contribute to strengthening their competitive position and also guide the improvement of activities in the implementation of innovations for companies from the logistics services industry wanting to reach a higher level of implementing and offering services. The findings presented in this area can be treated as new research results, and thus a voice in the discussion opens the possibility of further, deeper exploration and conclusions (Wasielewska-Marszałkowska, 2023). The article also indicates limitations and directions for further research.

Keywords: innovations, innovativeness, innovative logistic services, logistics service providers (LSPs) (3PL, 4PL), supply chains

Introduction

The dynamics of changes in contemporary economic processes, instability, and growing uncertainty of the functioning of entities in a turbulent environment are elements of the reality of modern management. In the face of increasing globalization and changing conditions of the political and economic environment, the dimension of competitive struggle has shifted its center of gravity from competition between individual enterprises to competition between supply chains. In this respect, 3PL operators and 4PL logistics integrators and their activities related to the implementation of innovative solutions play an important role in the logistics service of supply chains. The results of the literature analysis showed that there is a deficit of empirical research covering the issues of implementing innovations and innovativeness of logistics service providers. For example, the study by Flint et al., (2005). The authors emphasize that knowledge about innovation in logistics is relatively small, hence we know little about the innovativeness and innovativeness of logistics service providers (Flint et al., 2005). They indicate that a logistics innovation is "all logistics-related services, from basic to comprehensive, that is perceived as new and helpful to a specific group of recipients (business partners or internal recipients)". They also signal that logistics innovations can be very simple or very complex and may concern both small improvements in processes or services, as well as the development of new services (Grawe, 2009). Similarly, Wallenburg and Lukassen point to the need for more intensive research in this area (Wallenburg, Lukassen, 2011). On the other hand, Wagner and Sutter (2012) emphasize that research on innovations in logistics services is still at an early stage of exploration. The article presents selected results of the Case Study, covering innovations implemented by logistics service providers (3PL, 4PL). The

article is divided into several parts, the first one presents the research methodology. The second part presents the results of the Case Study, while the last part summarizes the results and indicates research limitations and directions for future research.

1. Methodology

The research procedure involved the use of several research methods, by the principle of triangulation (Czakon, 2015, Tashakkori and Creswell, 2007). Bearing in mind the different positions of both supporters and critics of the use of triangulation in scientific research, he shares the views of Jick (1979), who emphasizes the benefits of triangulation. Because triangulation increases the completeness and accuracy of research and also allows for capturing what is common in data from different sources, thus reducing or limiting the inference error, it was decided to introduce triangulation of research methods into the research procedure.

In the theoretical part, for a reliable description of issues, theories, paradigms, and concepts, the method of systematic literature review was used, which became the basis for further empirical research. The procedure of systematic literature review proposed by Tranfield, Denyer, and Smart (2003) was adopted, which indicates its three basic stages. In the first stage, a detailed literature review plan was defined, which indicated the purpose of the research and formulated research questions. The second stage focused on selecting primary literature, selecting publications for analysis, and creating a database of publications. This step focused on the following activities, e.g., selecting digital full-text databases and defining the scope of database searches (full-text databases selected included DOAJ, Emerald Insight, JSTOR, ScienceDirect, Scopus®, Springer Nature Journals, and Wiley). Publications available in the Polish BazEkon and CeON databases were also analyzed, and the EBSCO Discovery Service tool was used to search for publications to improve the research process. The stage of bibliometric analysis, including the analysis of the number of publications and the analysis of citations, was carried out using tools available in selected full-text databases: Springer (Citations.Springer.com), Scopus® (CiteScore) and the scholar.google.com database. The third step is to present the results of the review (treated as a report). In the systematic literature review, the time range of the analysis of publications from 1990-2021 was adopted (Wasielewska-Marszałkowska, 2023). After the literature review, the research problem and existing research gaps were identified. Research objectives were adopted, and hypotheses and research questions were formulated. Then, research tools were developed for each of the adopted research methods.

The empirical research included a quantitative study, conducted using the CATI method, N=201, among enterprises from the transport, forwarding, and logistics industry. The quantitative research enabled the selection of the target research sample in the Case Study. All research was preceded by a pilot study. However, qualitative research using a case study was the next stage of research and was more explanatory than conclusive. Taking into account the different approaches, both methodological and definitional of the case study presented in the literature, the concept proposed by Yin (2015) was adopted, both in terms of methodological and definitional case study.

1.1. Case study methodology - theoretical background

Qualitative research using the case study method was more explanatory than conclusive (Yin, 2015). In the literature, you can find many different definitions of the case study method. For example, one of them is the two-part definition of a case study proposed by Yin (2015), wherein the first part, he treats a case study as an empirical study exploring a contemporary phenomenon ("case") in the context of reality, especially when the boundaries between the phenomenon and the context are not completely obvious." In the second part of the definition, Yin (2015) emphasizes that a case study concerns a technically recognizable situation in which there are many more variables of interest to the researcher than data points and therefore he draws evidence from many sources and confirms convergence of data using the triangulation method, and when collecting and analyzing data, it refers to previously formulated theoretical assumptions. Table 1 presents selected interpretations of the case study method.

Author	Interpretation
K.M. Eisenhardt (1989)	The case study is a research strategy focusing on understanding the dynamics occurring in single conditions, emphasizing that in a case study, the author of the research may focus on many aspects of their analysis, and may also cover a single or several cases. A case study can be used to explore a range of topics and purposes, but the essential condition for using a case study is the individual's motivation to illuminate and understand complex phenomena
LM. Ellram (1996)	It is also worth emphasizing the position of LM. Ellram, emphasizes that there are excellent opportunities to use the case study research methodology in many areas of logistics (), case studies are excellent at providing detailed explanations, therefore "best practices"
E. J. Wilson, R.P. Vlosky (1997)	The use of the case study method offers the researcher a broad perspective of analysis. Moreover, the authors claim, it contributes to improving the quality of research by enabling conclusions based on observations from practice
J.W. Creswell (2007)	The case study is a method in which a researcher explores a bounded system (case) or multiple bounded systems (cases) over time through a detailed, indepth collection of data from multiple sources of information and produces a case description and case-based themes
J. Dul, T. Hak (2008)	A case study is a study in which one case (single case study) or a small number of cases (comparative case study) is selected and set in their real context, and the results obtained from these cases are analyzed in a qualitative way

Source: Own study.

From the perspective of Yin (2014) and Eisenhardt (1989) it is justified to use the case study method in the following circumstances:

- when there is little knowledge about a given phenomenon,
- available cognitive perspectives seem inappropriate due to insufficient empirical justification,
- available knowledge is characterized by contradictions,
- looking for answers to questions like how? or why? a given phenomenon occurs,
- the researcher has very limited possibilities of controlling variables (events, circumstances) due to
- their location in the real context,
- the process aims to examine the phenomenon in its actual conditions of occurrence (Dondajewska, 2016).

Although critical opinions of researchers can be found in the literature on the case study method, including its treatment in a "scientific" context, it plays an important role in the empirical research undertaken and implemented. Therefore, a researcher conducting research using the case study method should plan a sequence of steps with specific activities, as well as indicate the (Baxter & Jack, 2008) research tools and techniques adopted in the research procedure. Taking into account the various methodological and definitional approaches to case study methods presented in the literature, the author adopted the concept proposed by Yin (2015), both in the methodological and definitional approach of the case study. It was decided to carry out single case studies. Several stages were adopted in the case study method research procedure. They are presented in Figure 1.

STAGE 1 - DEFINING AND DESIGNING A CASE STUDY

Defining the research topic and setting research questions and goals

Selection of cases

Design of the case study protocol (including development of data collection tools)

STAGE 2 -PREPARATION, COLLECTION, ANALYSIS

Conducting case studies of logistics service providers (first, second and subsequent case studies)

Preparation of a report on each individual case conducted

Data analysis (including using IT tools for data analysis)

STAGE 3 - APPLICATION - SHARING RESULTS

4

Formulating conclusions and generalizations

Closing the study, i.e. preparing the final case study report

Figure 1. Diagram of stages of the case study procedure.

Source: Own study.

In the first stage of the case study design, the following research topic was defined: Innovative forms of logistics service in modern supply chains. Research objectives were defined and research questions were asked. Due to the limitations of the number of pages of the article, the results will be presented about one research question: what innovations are most often implemented by operators (3PL) and logistics integrators (4PL)?

Then, cases were selected and it was decided that this would be a purposive selection (purposive sampling), (non-random, non-probabilistic selection). It resulted from the adopted research objectives. The subjective scope included logistics service providers (3PL operators and 4PL logistics integrators, i.e. enterprises from the TSL sector, i.e. Transport-Forwarding-Logistics, department H according to the Polish Classification of Activities). The following criteria (K) were identified in the targeted selection of logistics service providers:

- K1: branches file in countries: Europe, Asia, America, Africa;
- K2: scope of offered and implemented logistics services (including transport, warehousing, services of a logistics operator, logistics integrator, other services: special services, e.g. support for retail chains);
- K3: minimum 10 years of activity in Poland.

The basis for the purposeful selection was the enterprises surveyed in the quantitative study (N=201). Therefore, an invitation to participate in the case study was sent electronically (e-mail) to these enterprises. The invitation indicated the topic, research objectives, and data of the researcher. Moreover, it was ensured that only respondents who consented to participate in the study would be contacted again. The invitation was accepted by 6 enterprises, of which one enterprise was subjected to a pilot study, therefore it was excluded from further studies.

Based on specific selection criteria, as well as taking into account the topic and adopted research objectives, 5 logistics service providers took part in the case study (3 logistics integrators – 4PL model, 2 logistics operators – 3PL model). Eisenhardt, clearly suggests that there is no "ideal" number of cases to indicate in a case study (...) as the author emphasizes, a justified number allowing for drawing scientific conclusions in a case study is a number ranging from 4 to 10 cases (...) if fewer than four cases are included in the analysis, it is difficult to generate a theory of high complexity, and its empirical justification is likely to be unconvincing unless it includes several mini-cases (...). However, "with more than 10 cases, it is very difficult to cope with the complexity and volume of data" (Eisenhardt, 1989). The respondents representing selected enterprises were people specializing in logistics services for supply chains and innovation, holding managerial positions.

The next step taken to increase the reliability of the case study research was the development of a case study protocol. The protocol was treated by the investigator as a manual containing instructions for collecting data in case studies. The protocol, following the concept proposed by R.K. Yin (2015), contains four parts. Part one, part (A) covers the general characteristics of the case study. It outlines fundamental information relating to: the topic and research objectives, the subjective scope, the method of sample selection and sample size, as well as information about respondents, the time scope of the research, and the sources of secondary data. The second part of the protocol (B) contained detailed instructions on the data collection procedure. It specifies issues relating to the preparation of a list with contact details of respondents, i.e. representatives of enterprises; establishing contact, and setting an individual interview schedule. It was assumed that the research technique used in the case study method would be individual in-depth interviews (IDIs). Hence, an important task was to develop research tools i.e. an individual indepth interview scenario (interview guide) and an in-depth interview questionnaire (IDI, individual in-depth interviews). The developed IDI scenario included instructions for the interviewer (author of the dissertation) and consisted of three parts. Part I includes an introductory part with instructions for the interviewer and contains the interviewer's data, date, start and end time of the interview, information about the GDPR clause, details about the examined company, and the respondent's data. Part II indicates the thematic areas and information sought, as well as questions for the respondent along with auxiliary questions. The last part is a thank you and the end of the interview. Due to the ongoing SARS-CoV-2 pandemic and restrictions related to the lack of possibility of direct contact with respondents, it was decided to develop another research tool, which was an in-depth interview questionnaire. The questionnaire was sent electronically (e-mail) to the respondents so that they could keep track of the questions asked during the interview and thus be able to freely provide answers and return to the content of the questions. The interview questionnaire included the topic, research goals, thematic areas, and questions for the respondent, including personal details questions. Legal aspects regarding the GDPR clause have also been added. The individual stages of the interviews conducted using the IDI in-depth interview technique are presented in Figure 2.

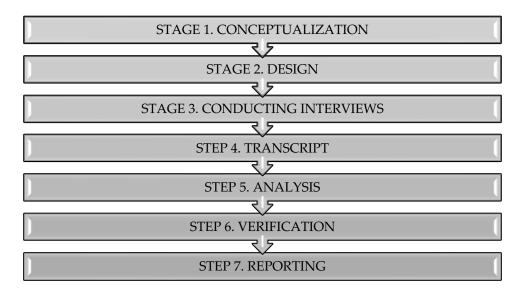


Figure 2. Stages of conducting interviews.

Source: Own study.

At the first stage, the focus was on conceptualization, i.e. defining the topic and goals of the research. In the second stage, interviews were designed, where the interviews were planned taking into account individual and convenient dates for the respondents. An interview schedule was also developed, including dates agreed with the respondents. Activities related to technical verification of tools dedicated to recording the interview (dictaphone, MS Teams, voice recorder) were also planned, including tests of connections with respondents to avoid potential technical problems. The third stage is to

conduct the interviews according to the agreed schedule. The interviews were conducted between May 2021 and June 2021, and their detailed schedule is presented in the case study protocol. Because in an in-depth interview the essence of the respondent's freedom of expression, it was assumed that the interview time would not exceed 1 hour, hence the duration of the interview ranged from 50 minutes to 1 hour.

The interview was conducted with 1 to 2 company representatives. In the fourth stage, the interview was transcribed from the materials recorded during the interviews, where text records were created in WORD format. The recorded material was listened to several times to capture additional information and to verify whether the transcription was correct. Then, in the stage 5, the collected material was analyzed in terms of its connection with the adopted research objectives. The next (6th) stage is verification, which focuses on checking the reliability and accuracy of the collected material. In the last (reporting) stage, the focus was on presenting the research results, interpreting them, and presenting the research conclusions. The analysis of qualitative data obtained in the study was based on the NVivo tool, MAXQDA, which enables categorization, coding, analysis and visualization of data, and reporting. This allowed for the presentation of identified phenomena and the connections between them, which were included in the conclusions and summary.

The instructions included in Part B of the case study protocol also indicate the need to analyze documentation, i.e. available publications, reports, and archival materials. A documentation review schedule was also adopted. This part of the protocol also included aspects relating to the identification of issues and information sought in the case study.

Part C of the case study protocol included the questions formulated at the data collection stage. The questions were based on a structure of five levels of questions, according to the methodology proposed by Yin. The last part (D) of the protocol contained guidelines dedicated to developing a case study report. It was planned that the report would be prepared based on a linear-analytical structure. The report's recipients were identified and the report's components were clarified, dividing it into three parts. The first part presents the issues and a review of the literature related to the research topic. The second part indicates methodological issues, including the research topic and objectives, the selection of cases and their characteristics, and a summary of the collected data with a description of the analysis performed and the identified limitations of the research. Part three of the report contains conclusions and a summary of the case study.

Based on the prepared case study protocol, further stages of the case study of logistics service providers were carried out. Hence, in the second stage of the case study procedure, research began. The examination of each case was carried out following the established schedule and adopted research tools and techniques described earlier. The obtained data were analyzed and a report was prepared separately for each examined case.

The last stage (third) in the adopted case study procedure (Figure 1) included work related to summarizing, presenting conclusions, closing the research, and preparing a comprehensive case study report.

2. Innovations implemented by logistics service providers – selected results of the case study

The case study involved 5 logistics service providers (three logistics integrators – 4PL, two logistics operators – 3PL model). Among the cases covered by the study, there were enterprises operating on a global and international scale, meeting the selected selection criteria. Respondents, i.e. representatives of the interviewed companies (they were indicated to be represented and the companies by the top management) made a self-assessment and assigned the represented company adequately to a specific model of implemented and offered logistics services.

In the case study, following the adopted case study methodology, proposed by Yin (2015), documents were also analyzed, including available reports and publications of the companies participating in the study. Innovations were divided according to the Oslo methodology into four types (kinds) of innovations: product innovations, process (technological) innovations, organizational innovations, and marketing (market) innovations (Oslo Manual, 2005). Figure 3 presents the adopted division of types of innovations.

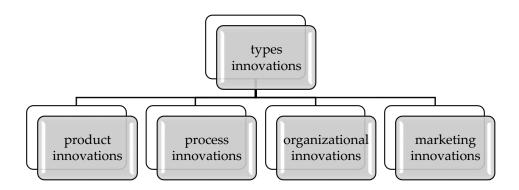


Figure 3. Types of Innovation.

Source: Own study based on Oslo Manual, 2005

Figure 4 presents process innovations implemented by 3PL and 4PL.

4PL logistics integrators

process innovations

5G technologies, Big Data, IoT (Internet of Things), bar codes, QR codes, Digitization, platforms with "low code" and "no code", technologies", RFID – aimed at increasing miniaturization, IT and ICT technologies, use of artificial intelligence (AI) for forecasting, drones for transporting goods

3PL logistics operators

process innovations

GS1, autonomous trucks, IT technology and dedicated systems to support logistics processes, a system of integrated IT solutions designed for the transport of high-value and highrisk goods, robotization of administrative processes using a "bot", WMS, ERP, TMS systems, electronic data exchange with the customer's systems, the ability to control the process by the customer via the Internet interface

Figure 4. Process innovations implemented by 3PL and 4PL - case study results.

Source: Own study based on the conducted research.

Among **product innovations**, 4PL (logistics integrators) implement, for example:

- AGV (automated guided vehicle),
- packaging services,
- supply chain management,
- contract logistics,
- removable containers.
- customs services using the latest IT solutions,
- tracking shipments in real-time thanks to implementing IT solutions,
- autonomous robots automating logistics processes in warehouses,

- smart gloves (pick-by-up), smart glasses (pick-by-vision) dedicated to the goods picking service,
- co-packing,
- supply chain management,
- contract logistics,
- customs services using state-of-the-art IT solutions,
- real-time shipment tracking thanks to implemented IT solutions
- no circulation of documentation in paper form electronic circulation.

At the same time, 3PL (logistics operators) indicated the following solutions among **product innovations**:

- voice-picking (voice system) dedicated to picking goods requiring storage at low-temperature,
- automatic sorting of goods in the warehouse in the picking process dedicated to the service of picking goods at low temperatures,
- co-packing, labeling,
- supply chain management,
- contract logistics,
- autonomous inventory of goods in the warehouse with drones,
- robotization of processes,
- automatic sorters and machines for packing goods,
- smart glasses (pick-by-vision) dedicated to picking processes.

The identified **organizational innovations** implemented by 3PL logistics operators and 4PL integrators are presented in Figure 5.

individual solutions for specific/industry supply chain management, value-**4PL logistics** added services (VAS): picking, labeling, picking, assembly, dedicated integrators service, logistics consulting - processes managed with the use of IT tools, reconfiguration, sequencing, and sub-assembly services, quality control, copacking, labeling, returns handling, recovery logistics, Kaizen, Lean organizational Management and Agile, Certificate of compliance with IFS Logistics, BIO innovations Certificate by REG (EU) No. 834/2007, SQAS (Safety&Quality assessment system), Authorized Economic Operator (AEO-C), Standards: ISO 9001, ISO 14001, ISO 27001, ISO 45001, self-managed teams without a hierarchical structure, GDP certificate (Good Distribution Practice) individual solutions for industry supply chain management (food, **3PL logistics** pharmacology, logistics services for retail chains - on domestic, international, operators and global markets), (FMCG, electronics, automotive), value-added services (VAS): co-packing, labeling, quality control, automatic marking line, automatic foil machines for wrapping goods, packaging lines (including organizational refrigerated goods), marking, labeling, co-packing, quality control, innovations Standards: ISO 9001, ISO 14001, ISO 50001, HACCP, BS OHSAS 18001, IFS Logistics, Green Management certificate, Kaizen, ISO 28000, Authorized Economic Operator (AEO-C)

Figure 5. Organizational innovations implemented by 3PL and 4PL - case study results. **Source:** Own study based on the conducted research.

The last type of innovation asked about in the case study was **marketing innovation**. Among them, 4PL (logistics integrators) mentioned the following implemented innovations:

- innovation in the field of environmental protection – emission-free deliveries, cargo bicycles, cars powered by electric or hydrogen solutions – in the case of means of transport, green warehouses: photovoltaic panels in warehouses, ecological solutions: collecting rainwater, LED lighting, minimizing printing and paper circulation documentation,

- energy from renewable sources and, the use of swap containers (swap bodies) enables the reduction of annual CO₂ emissions by over 20%, terminals certified (6 terminals in Poland) with the BREEAM Certificate (Building Environmental Research Establishment Assessment Method),
- marketing tools, social media, and internet marketing.

Among the implemented marketing innovations, 3PL (logistics operators) indicated:

- innovation in the field of environmental protection (for example certified green warehouses, LED lighting, and the use of renewable energy sources: photovoltaic panels, geothermal energy, lighting and maintaining a low temperature in warehouses, heating office spaces, restoring greenery and supporting greenery maintenance/planting projects,
- Internet marketing, social media.

As it result of the findings, a large group of innovations was indicated in technological (process) innovations. This means that logistics service providers are part of the observed trend of progressive technological development. Enterprises are focused on process and technological innovations with particular emphasis on the desired digitization and automation in the logistics service of supply chains. This type of innovation is the mainstream that allows for the implementation of product innovations, opening the possibility of modifying existing services or introducing a new service (for example, delivery of goods by drone, improving the logistics of warehouse processes with the use of smart gloves or glasses). A slightly less numerous list of innovations were product and organizational innovations Implemented solutions in the field of organizational and market (marketing) innovations, from compliance with the guidelines of the adopted ISO-certified systems, the Kaizen principles, and the Lean Management to "green management". Objectives and actions taken to protect the natural environment become extremely important for the surveyed enterprises, among which innovations include: the use of energy from renewable sources to heat the lighting of offices and warehouse halls, recycling or restoring greenery, and support for greenery maintenance/planting projects. These initiatives are coherent with the adopted goals of sustainable management in the scope of serviced supply chains and CSR policy in the surveyed enterprises.

According to research findings, logistics service providers face many new challenges that cover many areas of their business. The constant increase in technological progress, political changes, and changes in market trends are key solutions for logistics service providers to implement innovations in response to changes in the market environment.

3. Discussion

Although research on innovation, innovativeness of logistics services for supply chains, as well as the role of the most developed models providing this service (3PL operators, 4PL logistics integrators), has been ongoing for several decades and is becoming increasingly popular among many researchers, this area is not fully explored. Other researchers also drew attention to this aspect, e.g. Flint, Larsson et al. (2005).

The dynamics of phenomena, and ongoing globalization, including new trends in the economy, force constant research and concentration of researchers around this issue. Regardless of positions and views, it seems reasonable to say that research on innovation should be further developed and deepened, both in theoretical considerations and empirical exploration.

Research conclusions should be sought in the presented results of empirical research and in the results of literature studies, which showed the concentration of previous research by other authors on selected types of innovations implemented by logistics service providers, e.g.: technological innovations or innovations related to customer relations, open innovations, etc. (e.g. research by Evangelista et al., 2012). The results of the conducted research allowed for the identification and qualification of individual types of innovations implemented by logistics service providers. This area has been developed in empirical research taking into account all key types of innovations (process, product, organizational, and marketing innovations).

The summary should also highlight the identified limitations of the empirical research conducted and directions for further research. The main limitation of the conducted research is the fact that the research sample included logistics service providers from one country only – Poland. Another limitation worth pointing out is the period of research conducted during the SARS-CoV-2 pandemic. Therefore,

the generalizability of the results is limited. Therefore, as a direction for further research, it is advisable to repeat them and even expand them to new contexts. These could be, for example, different geographical locations that cover other countries or even continents to generate more generalized conclusions. Taking into account the above limitations, the author undertook further research on the innovation of Slovak logistics service providers (3PL, 4PL) as part of a project title *Innovativeness of logistics service providers in the logistics service of modern supply chain,* financed by the Visegrad Fellowship Program.

Funding: This research received no external funding.

References

- 1. Baxter, P., & Jack, S. (2008). Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers. The Qualitative Report, 13(4), 544-559. https://doi.org/10.46743/2160-3715/2008.1573.
- 2. Creswell J.W., (2007). Qualitative Inquiry and Research Design; Choosing Among Five Traditions, SAGE Publications, Inc., Thousand Oaks, London, New Delhi, 73.
- Czakon W. (2015). Basics of research methodology in management sciences, Wolters Kluwer Business, Warsaw.
- 4. Dondajewska A., (2016). Case study research in management sciences in terms of methodological rigor, *Scientific Journals of the Poznań University of Technology. Organization and management*, 70, 39-50. http://dx.doi.org/10.21008/j.0239-9415.2016.070.03.
- 5. Dul J., Hak T. (2008). Case Study Methodology in Business Research. Oxford: First edition Elsevier, 4.
- 6. Evangelista, P., Mogre, R., Perego, A., Raspagliesi, A., & Sweeney, E. (2012). A survey based analysis of IT adoption and 3PLs' performance. *Supply Chain Management*, 17, 172-186. https://doi.org/10.1108/13598541211212906.
- 7. Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *The Academy of Management Review*, 14(4), 532–550. https://doi.org/10.2307/258557.
- 8. Ellram L.M. (1996). The use of the case study method in logistics research, *Journal of Business Logistics*, 17 (2), 93-138.
- 9. Flint, D. J., Larsson, E., Gammelgaard, B., & Mentzer, J. T. (2005). Logistics innovation: A customer value-oriented social process. *Journal of Business Logistics*, 26(1), 113-147. https://doi.org/10.1002/j.2158-1592.2005.tb00196.x.
- 10. Grawe, S.J. (2009). Logistics innovation: a literature-based conceptual framework, *The International Journal of Logistics Management*, Vol. 20 No. 3, pp. 360-377. https://doi.org/10.1108/09574090911002823.
- 11. Jick T.D., (1979). Mixing Qualitative and Quantitative Methods: Triangulation in Action, *Administrative Science Quarterly*, Vol. 24, No. 4, Qualitative Methodology, 602-611. https://doi.org/10.2307/2392366.
- 12. OECD/Eurostat (2005). Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd Edition, The Measurement of Scientific and Technological Activities, OECD Publishing, Paris, https://doi.org/10.1787/9789264013100-en.
- 13. Tashakkori, A., & Creswell, J. W. (2007). Editorial: The New Era of Mixed Methods. *Journal of Mixed Methods Research*, 1(1), 3-7. https://doi.org/10.1177/2345678906293042.
- 14. Tranfield D., Denyer D., Smart P., (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review, *British Journal of Management*, 14(3), 207-222. https://doi.org/10.1111/1467-8551.00375
- 15. Wagner, S.M., Sutter, R. (2012). A qualitative investigation of innovation between third-party Logistics providers and customers. *International Journal of Production Economics*, 140(2), 94-98. https://doi.org/10.1016/j.ijpe.2012.07.018.
- 16. Wallenburg, C.M., Lukassen, P. (2011). Proactive improvement of logistics service providers as driver of customer loyalty. *European Journal of Marketing*, 45, 438-454. https://doi.org/10.1108/03090561111107267.
- 17. Wasielewska-Marszałkowska, I. (2023). Innovation process at logistics services providers: barriers and stimulation factors. *Scientific Papers of Silesian University of Technology Organization & Management*, 72, 635–657. https://doi.org/10.29119/1641-3466.2023.172.39
- 18. Wilson E.J., Vlosky R.P.,(1997). Partnering relationship activities: Building theory from case study research, *Journal of Business Research*, 39(1), 59-70, https://doi.org/10.1016/S0148-2963(96)00149-X.
- 19. Yin R.K. (2014). Case study research: Design and methods, Thousand Oaks-London-New Delhi, Sage Publications, 9-11.
- 20. Yin R.K. (2015). A case study in scientific research, Design and methods, Jagiellonian University, Cracow.

Digitalization in Education

Anikó Barcziová 1, Monika Bálintová 2 and Renáta Machová 3,*

- 1 PhD student (Faculty of Economics and Informatics, J. Selye University, Komárno, Slovakia); barcziova.aniko@student.ujs.sk
- ² PhD student (Faculty of Economics and Informatics, J. Selye University, Komárno, Slovakia); <u>balintova.monika@student.uis.sk</u>
- ³ Vice-Rector (Faculty of Economics and Informatics, J. Selye University, Komárno, Slovakia); machovar@ujs.sk
- * Correspondence: barcziova.aniko@student.ujs.sk

Abstract: In order to delve into the digitalization of teachers, a comprehensive evaluation was undertaken by the study. The research method utilized for this analysis was qualitative, in which two questionnaires were constructed. One was given while COVID-19 restrictions peaked in 2021, the other occurred two years later in 2023. Slovakia was the country where the teachers inquired were situated. In 2020, the School Education Gateway conducted a survey on online and distance learning in the EU. The data gathered was used as a basis for a similar survey mentioned earlier. Which was done in primary, high and university educational institutions. However, the purpose of the second one is to obtain the latest views and opinions of teachers on digitalization in education. Specifically, their satisfaction with e-learning techniques and whether they have continued using them after the pandemic. Additionally, through our study, we sought to uncover obstacles that educators faced in adapting to the hastened digitization and to gauge their appetite for assistance from third-party resources. The results of this inquiry provide invaluable perspectives into the changing terrain of digital technology in education and can apprise the construction of methods for boosting instructors' contentment and proficiency within the computerized educational sphere.

Keywords: education, digitalization, e-learning, primary education, high school education, university education

Introduction

For centuries, education has been an essential aspect of human existence, adapting to suit the changing needs of civilization. Nowadays, digital technology has become an increasingly noticeable element in the education system. In 2020, the COVID-19 outbreak compelled schools across Europe to shut down, resulting in a sudden need for remote learning within the households of students and teachers. This event served as a catalyst for the accelerated integration of technology into education. Regarding e-learning and digitalization, we aimed to examine the difficulties experienced by Slovakian educators in this study as a result of the rapid shift. Both students and educators were met with challenges during this swift transformation.

In our research we focus on implementation of digital education element within the education process in Slovakia from the perspective of teachers. We gathered data due to the help of a survey, which was sent out to teachers in 2021 after COVID-19 restrictions were implemented in the educational sector. Partial results of the mentioned survey were analysis and studied in research article Barcziová, Machová (2021) with title Methods of Education during the Pandemic in the Context of Demography. Additionally, an additional survey was done in 2023, four years after the pandemic outbreak. Our respondents in the first survey were asked about their experiences with e-learning and the rapid change. As for the second survey, we were questioning them, weather they were satisfied with digital methods during the actual time period, and if they are using them on daily base without the absence of the regulatory necessity of usage. The first questionnaire was created based on a questionnaire created by the EU. For the first survey we have received 204 answers and for the second one 64 from teachers located in Slovakia.

The first questionnaire was analyzed in article titled: Methods of Education during the Pandemic in the Context of Demography (Barcziová, Machová, 2021). We can consider this research as the continuation of the previously mentioned article. In the study titled: Digitalization in Education primary we would like to concentrate on the second questionnaire and analyze the actual situation in Slovakia from the aspect of usage of digital educational methods.

The implementation of digital educational methods is extremely crucial to the rapid evolution of technology. However, it can pose significant challenges for the teachers. They can have difficulties with learning new methods and programs, and utilizing them on a daily basis, which might take a lot of time from their usual preparation process. Because of the mentioned facts, it's crucial to create studies and researches in the topic, whether there is a desire from the educators' side or not. Furthermore, it's also important to ask them if they require help from third parties and define who these parties should be. Additionally, we've asked teachers whether or not they believe that the memorizing process of the students can be fastened and simplified through the use of digital methods in their teaching process.

1. Theoretical background

In the 21st century, e-learning has become significantly popular, and it's now common in the educational process. E-learning, as a form of instruction has both positive and negative aspects, similar to other educational methods. Currently, we participate on a daily basis in the mentioned educational mode in order to acquire new information, this has given us some experience, which we can assess the effectiveness, benefits, and disadvantages of. Mulabu (2023) in his research define e-learning as "eLearning is a combination of methods, structures and networked electronic tools orchestrated into systems that bring about, or are intended to bring about, learning." Moreover, in his study he wrote about modern technologies, which can be and also will be used in the educational process with time, as AR/VR (virtual reality) or AI (artificial intelligence). Also Mohammed, Rida and Chafiq (2021) tried to find a definition for the phrase of e-learning, in their article they wrote that "e-learning is a fast and efficient way of providing and sharing knowledge with learners in different parts of the world." With e-learning educational tool learning process can be available for anyone at any part of the world with internet connection. Based on Barcziová and Machová (2021) not only internet is needed, but in some cases the listeners and the educators need some special devices to make the process on the highest quality, for examples: computer, laptop or data projector. Osepashvili (2008) calls these digital tools as "mediators" among teachers and their students, which can increase the motivation. Jurik (2021) stated in his research that computer educating games can stimulate educational process in a positive way and can make it more entertaining. Also, he said that "according to Huba, Žáková and Bisták (2003), an average person remembers 10% of the information he or she reads (i.e., a text); 30% of the information he or she sees (i.e., a video and graphics) and 50% of the information he or she sees and hears (i.e., a video with an audio commentary). "

Advantages of E-learning

If we talk about the benefits what e-learning has brought for the population who wants to get new knowledge, as the first and the most important we need to mention the more effective time-management. With using e-learning students can save time, what we would be wasted for travelling to the school or waiting between the classes, they do not need to wake up 2-3 hours earlier before the beginning of the lesson. This extra saved time can be used more efficient, what can be better investment for the future of the students.

As second, we need to mention the place. E-learning gives students the opportunity to study from their comfort zone, from their homeplace. Studying or working at home can be more efficient since they save time what they would spend for travelling to school, sitting in the traffic jam. Moreover, at home the free time between classes can be used effectively, for relaxing, watching movies, doing house work or for preparation for the following lessons.

E-learning at home even gives our young generation opportunity to eat healthier meals daily. At home everyone can eat at least once cooked meal, what is good for the evolution of the young body. At school many families cannot afford to pay for cooked meal at the school canteen for their kids. The other example is when teenagers prefer fast food (pizza, kebab, sandwiches) instead of the cooked meal.

We need to mention that e-learning at home is even more comfortable. The Z and A generation is lazy and prefers to spend the day in comfortable clothes, sitting on their comfortable chairs and sofas, while they are listening their online classes.

E-learning, the classes online most of the time are recorded, what gives their listeners the opportunity to rewatch them. The uploaded records of the classes can be rewatched during a defined time-period, what gives the students the opportunity to listen again the topics what meant a problem for them to understand. At school this possibility does not exist, they need to concentrate when the teacher is explaining. Moreover, the students who are shier and more afraid to ask the teacher to repeat with this method they can easily listen it again.

As a result of e-learning method students are more relaxed for many reasons. Since they can sleep longer, they can even concentrate better on their online classes, and can join actively its procedure. Furthermore, e-learning brings benefits for those kids, who are stressing from oral exams, and even the introvert students can feel calm at home, without extra stress.

We cannot forget about the bullied kids neither, who suffer physically or mentally by their classmates, this period of e-learning gives them secure place, where they can feel themselves save.

Families in long-term have lower financial expenses, since they do not need to pay for books, extra activities for their kids.

Also, they learn individual work, what is a very important skill for the future, as professional, as private. They learn how to study individually from searching information by themselves.

Furthermore, thanks to the e-learning methods the new generation learns to use the internet for searching information, for studying and using different educational programs. These actions on the computer can be new for the students, but in the same time interesting.

New and creative learning method, what can motivate the Z and A generation more. Since the kids born in these eras were not grown up on reading books and playing board games, they are less attracted to learn from books. Their brain can work more effective with using online, digital tools and this can provide more effective and quality knowledge.

"Some fields of study can do very well with online education (maybe even better than traditional education) if the teachers involved in them accept as a premise the fact that they have to offer knowledge (facts, know-hows, techniques, methods of doing this or that). For example, many of today's computer specialists take pride in being autodidacts and in rejecting traditional forms of schooling. When, for whatever reason, one of them would feel the need to have a diploma certifying his/her skills, it is obvious that an online form of higher education would be a wise choice, since most of the knowledge needed can be easily transmitted online, while the physical presence of a teacher would be rather unnecessary. On the other hand, for fields such as visual arts, music, theater or dancing (to give just the extreme examples) it is impossible to envision an exclusive online experience, no matter how good the materials provided would be." (Patroc D, 2018)

Disadvantages of E-learning

The educational method of e-learning has many negative sides, too. E-learning is a new method what needs a lot of time to be prepared and organized for the quality application in the practice. The both sides, the information sender (teacher), as well the information receiver (student) has to be patient and invest a lot of time to its application.

We need to emphasize the time-investment of the teachers, who need to create a new study plan shaped on digital educational methods using the computer. This process can take longer time, while the teachers plan the lessons for all the classes for all the years from every subject.

Moreover, application of e-learning requires creativity from the educator who decided to use digital educational methods. The teachers should be provided presentation, workshops and different access to receiving new knowledge, ideas of digital e-learning method, about its use. This preparation should be done on high level, well it influences the quality of the education on this channel.

Other problem of e-learning can be that some of the teachers has no access to e-learning tools and the Internet. Teachers without these devices cannot share information, knowledge and educational material with the students. As a result of what the whole educational process would be stopped. Teachers do not only need access to the mentioned equipment, they even need to attend courses where they can learn about these digital tool, different educational programs and about the process of using them.

Naturally, we cannot forget about the students, an important percentage of the student do not have access to the Internet or to e-learning tools (computer, tablet, mobile phone, etc.). Those kids who have

no access to the Internet are in a big problem and have disadvantage compared to the other students. The schools or the state should provide financial support for families, with what they could assure the tools for the method to work. The students from the families without access to the internet and to digital devices lose their opportunity to study, even if they are smart or they would like to.

In short time, e-learning awaits from the students and the teachers to buy devices for its effective work. This creates extra costs for the families and educators in short time period.

Also, we need to mention that as a result of this educational method the disparity between the levels of living standards of the students can be emphasized more, what can influence highly their upcoming educational process. The students with no access to the Internet of digital tools will get worse marks, than the students who can join the class actively. Moreover, in the class some of the kids can be harmfully affected by others, what can have negative mental consequence on them.

Furthermore, with application of e-learning the physical contact between the pupils in minimalized. They forget about human connection and about its importance. These kids in these years go through important evolution, these years influence highly their future personality and life. If someone does not learn how to act and behave with people, in different situation as a young human being, in the later ages will have some problems. To learn to behave, act and react in real situation in person with people is an important part of our professional and personal life. We are human being, who from their nature is searching for human connection, without building connection networks around us we feel lonely, depressed.

Students, who spend their days sitting in front of the computer in their houses without activity become lazier. This new life style has a bad influence on their well-being, since the daily movement made by them is reduced, what can cause health problems, as obesity, and internal issues as well-high blood pressure, heart problems, immunity becomes weak, diabetes, depression and psychical problems.

We cannot forget about technical issues, what are created by technical breakdowns, as no Internet connection because of big storms, problem with the computer, etc. These are issues what's prediction is very difficult, can happen any time, moreover, the time spent on their repairing is questionable, depends on the type of the problem.

Problem with the quality and the process of the evaluation of tests is a newly created problem, as a result of application of e-learning method. This problem can highly influence the quality of the education in the institution or the country. Via digital education the level of cheating between students cannot be controlled efficiently. Students have to be asked more often orally, where the teacher can ask questions, where he can control its reality and if the student really understands the topic. At written exams students cannot be controlled in hundred percentage, the activation of the cameras, microphones or sharing the screen can reduce the possibility of immoral activities, with the goal of receiving better marks. Also, the teachers can prepare a collection of various questions, so the system can generate to every student different one, so the collaboration of the students become useless. But this preparation requires longer preparation of the teacher.

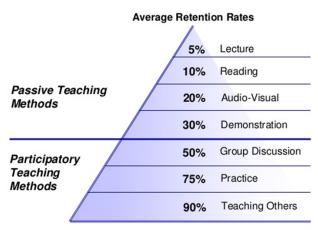
With using digital educational method, the feedback from both of the sides is problematic. As we mentioned before, the teachers have problem with giving real feedback to their students, while the interaction online is not that effective as in person in the schools. On the other side, even the students give feedback to their teachers more struggled. The teachers do not see the reaction of their students made by natural body language, they cannot analyze it and they cannot estimate well if the kids need that the topic was repeated or no. This disadvantage can have negative effects and can cause difficulties in the future on the newly received knowledge of the pupils.

"Moreover, remote teaching for children frequently requires parents' presence, which may make it impossible for them to balance their work activities with supporting their children during their online learning experience. Furthermore, some parents do not have adequate literacy to support learning at home: Small children need their parents' support, so what about the parent who is not able to work because they must play the teacher's role? How do parents work if they also need to look after their children at home? Studying (and playing)? This might end up disrupting the global economic model in the long run: work productivity will go down." (Ferri, Grifoni, Gizzo, 2020)

Educating via E-learning Methods

During the lesson the teacher uses and mix different educational methods with the goal to share to knowledge to his audience in the best quality. Other goal of the classes is that the students could remember the shared information in the longest time period counted from the day, when the knowledge was shared.

The Learning Pyramid*



*Adapted from National Training Laboratories. Bethel, Maine

Figure 1.: The Learning Pyramid

Source: National Training Laboratories, Bethel, Maine

On figure number one we can the pyramid of learning. On the top of the pyramid, we can see those educational methods, activities which are not the most effective in remembering, and making the topic long lasting, those with what the subject needs more time to remember, memorize the information. The percentual rate in particular categories of the pyramid is just approximation, more important is to follow the order of the categories in the pyramid. As well, the educational methods on the top of the pyramid are called "Passive Teaching Methods". These activities are passive, since the subject, the student does not participate actively in its acquiring, the educator makes the main interaction. Here we can mention educational methods, as lecture (where the teacher is explaining the topic to his students, and the students are listening), reading (more active method, that the lecture, while the students are also active, with reading and writing the memorization is more efficient for many people), audio-visual (we are applicating both our eyes and ears, both our senses are working for creating our memories about the new information) and demonstration (demonstration is very similar to audio-visualization but at this method we can see, listen, and even touch the item, what makes to work even three senses, so our brain can collect new memories from more sources). About all these mentioned educational methods we can declare that the student, pupils are now participating actively, they are just part of the education passively, they are listening, watching and touching, and memorizing these newly received experiences.

In the learning pyramid from the middle part to down we can see the activities of the "Participatory Teaching Methods", the name of these educational methods refers to the activity of the students, to their participation in the educational process. The percentage next to the educational activity shows us its average retention rate, the possibility to the successful memory creation of the student with the chosen method. So, for examples, in the case of group discussion according to this pyramid the memorizing possibility in average is 50%. In group discussion all the students are involved to join the learning process actively, the teacher can follow the participation and their techniques of partaking, moreover it helps to the teacher in understanding the students and their personalities (introvert- extrovert, leader- follower). Furthermore, with active work, discussion on a problematic the students can learn the subject easier, without any extra effort. On the pyramid we can see practice and teaching others between

the Participatory Teaching Methods. These methods require activity from the students, with practice they can work alone on the theme, or problem (for examples. accounting). This experience can motivate them for further activity, since they are working with real problems, not only the theory, the pupils can learn and memorize on practical issues easier, than from the theories.

If we had to decide if the educational method of e-learning is "passive teaching method" or "participatory teaching method", and where would it be situated on the pyramid, we would say it is located somewhere in the middle, it depends on the teacher and his educational style, and of the subject and the theme. Some topics or subjects are more theoretical for examples Theory of Economics, here e-learning would be the part of the passive teaching methods. On the other hand, in the case of subjects where students can try and use accounting programs on the computer e-learning would lie on the button of the Learning pyramid, what means, it would be participatory teaching method, students would work during the class actively on their computer in their homes.

With e-learning some methods, as group discussion works a little bit more complicated, since there is no personal contact between the students, they need to contact each other via computer in some application or website, where they can communicate. After doing these extra steps the communication and the group discussion can continue. As we see from this example, e-learning do not exclude other educational methods from the use, only the teacher has to be patient and creative to find solution for the situation.

Moreover, e-learning educational method creates extra opportunities for the teachers, gives the possibility to use new platforms online, which can make the lesson more exciting and entertaining for the students.

2. Methods and methodology

The aim of the research article titled: Digitalization in Education is to explore the practical application of digital e-learning tools in the educational process. We have used qualitative methods, specifically, we have investigated the literate in the area of research. Additionally, we've created two questionnaires. The first questionnaire was distributed to respondents in 2021, one year after the COVID-19 crisis in Slovakia began. During this time, educational institutions were closed down due to state regulations, and the teaching process was conducted online from the homes of both parties, teachers and students. This questionnaire was derived from a study conducted by the School Education Gateway of the European Union. Our objective with the first questionnaire was to contrast the results in Slovakia with the EU's analysis. In addition, we decided to conduct another study and survey in Slovakia in 2023 asking teachers whether they are satisfied with the digitalization of e-learning. However, we need to mention that in the current study primary we concentrate on the second survey and the current situation in Slovakia. The results from the first survey and its comparison with EU average can we read in article Methods of Education during the Pandemic in the Context of Demography (Barcziová, Machová, 2021). We also want to know if they are using digital tools in their daily educational processes without complying with regulations. The first questionnaire was created on the Survio platform and the second on Google Forms. However, both were analyzed and examined using the Microsoft Excel program. In the first survey we received 204 responses, in the second survey we received 64 responses from teachers actively working in various parts of Slovakia in 2023. The final investigation is ongoing and we are working to collect as much data as possible to enable the timeliest analysis possible. We used descriptive statistics for analysis. Both surveys were conducted in Slovak and Hungarian languages. In the first survey, 90% of respondents were female and 10% male, while in the second survey, only 78.1% were female and 21,9% male. In terms of age structure, most of the respondents in the first survey were between 46 and 55 years old (37%), and the analysis of the second survey also showed the same result (31.25%). In addition, based on the answers to the two questionnaires, we can determine that our interviewed teachers mainly carry out educational activities among high school and grammar school students, that is, students between the ages of 15 and 19.

3. Results

E-learning and digitization are necessary conditions that must be implemented in the education process of the 21st century. However, implementation and time frames may various by institution. Blezu and Popa (2008) stated that "the term "E-learning" is now used in the framework to capture the general intent to support a broad range of electronic media (Internet, intranets, extranets, satellite broadcast, audio/video tape, interactive TV and CD-ROM) to make vocational learning more flexible for clients." In our study, we focus on digitalization processes in emergency and non-emergency periods from the perspective of EU country, specifically Slovakia. The questionnaire was prepared and sent to various actively working teachers in two periods, 2021 and 2023. On the following pages, we compare the results of the mentioned two questionnaires from the aspect of time. However, in some cases, when we concentrate on the current situation, for examples on actual usage of digital education methods or on importance of digitalization from actual aspect, only the latest data will be studied.

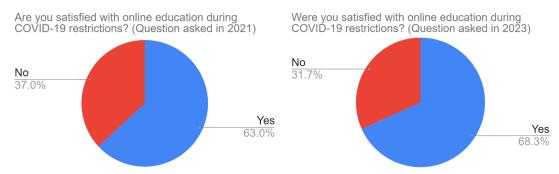


Figure 2. Satisfaction of teachers in 2023 with e-learning during COVID-19 period **Source:** Questionnaire, own elaboration

Our respondents were asked about their satisfaction in both surveys. The collected results were similar. While in the first survey right after the implementation of COVID-19 regulations in 2021, the percentual satisfaction of teachers was slightly lower (63%). In contract with that, in 2023 68,3% of our respondents thought that was satisfied with e-learning during the mentioned period from 2 years retroperspective. Due to the mentioned aspect the memories might be nicer than living the actual changes in the moment.

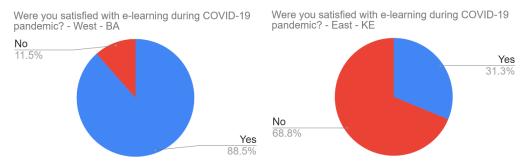


Figure 3. Satisfaction of teachers in 2023 with e-learning during COVID-19 period – regional differences **Source:** Questionnaire, own elaboration

If we compare the responses from regional aspects, significantly different results are shown. In Bratislava region, on the western part of the country, teachers felt satisfied with e-learning educational methods in 88,5%. While in the eastern region of Slovakia, in Košice only 31,3% of the respondents felt satisfied with the actual situation, which is significantly below the country average, where 63,3% of the respondents said yes. Thanks to this comparison, we can perfectly see the regional differences within Slovakia.

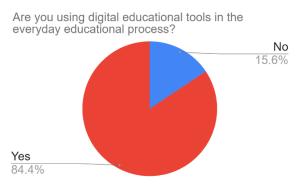


Figure 4. Usage of digital educational tools **Source:** Questionnaire, own elaboration

In Figure 4 we can see that we asked respondents whether they use digital educational tools in their daily education process. Our first questionnaire asked the same question, whether you plan to use it. In the first survey, we found that 71.43% of respondents planned to use it and 28.56% did not. However, current results show a positive impact by 2023, with more people using digital education methods every day than expected two years ago. The rapid implementation and massive use of e-learning tools in 2021 has accelerated the digitization of education. Additionally, teachers are provided with additional knowledge and experience that can be used perfectly in the future. In 2023, 84.4% of respondents said they used digital education methods, while only 15.6% did not. Also, we have asked them what concrete tools have been used during their lectures. Our respondent teachers said that digital devices, as laptop, computer, data projector, mobile phone, but also interactive educational games, websites, platforms and videos. Furthermore, we must mention that in order to obtain more specific and punctual results, we need to continue our research process and update our database and create new analyzes after a period of time.

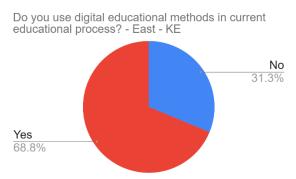


Figure 5. Usage of digital educational tools, Košice region **Source:** Questionnaire, own elaboration

Also, we analysis the same question from regional aspect. In Košice region, eastern part of Slovakia 68,8% of the questioned teachers is using digital educational tools in the everyday educational process. This is below the country average, which was 84,4%. However, on the western part of the country, in Bratislava region 100% of the teachers are using digital tools. The regional differences also can be observed here.

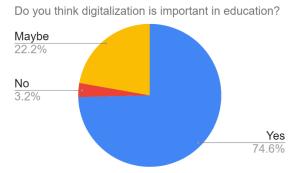


Figure 6. Importance of digitalization **Source:** Questionnaire, own elaboration

Figure no. 6 we wanted to know whether based on educators in Slovakia digitalization is important in daily educational process or not. The mentioned question was asked in 2023. The results were surprising since based on only 74,6% of our respondents' digitalization in education is important. On the other hand, on figure no. 3 we could perfectly observe that 84,4% of them is using it, even if they might think it is not significantly important. 22,2% of the questioned teachers cannot say whether its important or not, the "maybe" option was chosen by them.

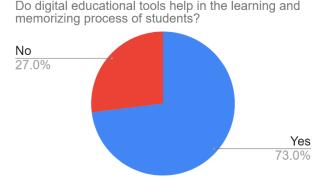


Figure 7. Memorizing process with digitalization **Source:** Questionnaire, own elaboration

Finally, we wanted to know, what do educators think, whether digitalization helps the learning and memorizing process of students or not. The results were not very positive, since 27% of the questioned teachers thinks that the usage of digital tools during the educational process does not help the memorizing process from the side of the students.

4. Discussion

Educational methods have been changing from decades to decades, which is not different in the 21st century neither. According to Zizikova, Nikolaev and Levchenko (2023) "in the modern world, content refers to the support of personaldevelopment, the transfer of positive social values and attitudes towards growing up. Anyimprovements in the infrastructure, improvement of the material and technical base will notgive proper results if you constantly pay attention to the outdated content of education, whilenot improving it. It is required to consider not only educational and methodological materials, but also to pay due attention to the methods, technologies, and educational practices that arecurrently the most relevant." In our work we were concentration on digitalization in education in Slovakia. Moreover, our research has been held in two time periods, in 2021 right after COVID-19 pandemic restrictions were implemented in the educational sector and in 2023. In 2023, we were curious whether, teachers are using and want to use digital educational methods without the compulsory regulation from the side of the state. It is very difficult to judge whether e-learning makes education process more effective or the opposite. As we saw it in our research the responses and the opinion might be different based on the person responding for the question. Also, they more experience, which also gives them

confidence with the usage of digital methods. Also, we cannot forget that even the level and the field of the education is important to be considered as a factor. For examples, for elementary schools is advised to have classes in present, since according to us those young kids in the age 5-15 need physical help from the teacher to achieve the highest knowledge possible. On the other hand, for older pupils (high school, especially at the universities) can be very positive to study at home, since they know how to learn and study by themselves without the presence of the teacher, and they can plan their time for the study session. Furthermore, the efficiency of e-learning educational method depends on the study field. Programs which are more practical (sport schools, chemistry, medicine, nurse schools etc.) the personal contact and the individual absence at the building of the school is more important than for fields as (economics, informatics, grammar school, etc.). In the second group the educational topics are more theoretical, which can be easily done at home with the help of a computer.

It is extremely important to mention, that paper titled: Digitalization in Education can be considered as the continuation of the article titled: Methods of Education during the Pandemic in the Context of Demography (Barcziová, Machová, 2021). The mentioned study concentrated on the first survey which was created and analyzed in 2021 after the implementation of COVID-19 pandemic regulations in Slovakia. The questionnaire was created based on a survey created by the EU and the collected data were compared with it. In our current paper, primary we want to concentrate on the current situation with the usage of digital educational methods in Slovakia.

In our research we saw very controversial and interesting results. 84,4% of our respondent teachers claim that is using digital educational tools on everyday base during the educational process. However, only 73% and 74% of them even thinks that it is important in the educational process and helps the memorizing process of their students. Nevertheless, based on Chitra & Raj (2018) digitalization in education has various benefits for students, as access to update content, quick delivery or reduces costs.

Furthermore, we need to mention the stated regional difference between the regions situated on the western and the eastern part of the country, concretely regions Bratislava and Košice. The observed results were significantly different. Teachers, located in Bratislava region use digital educational methods in bigger percentual ratio and were more satisfied than those located in region Košice. Šepeľáková and Ferencová (2022) in their study stated whether students and also teachers located in eastern regions are in disadvantageous situation compared to the ones situated in the western regions of the country. They concretely defined in their study that "The share of pupils uninvolved in distance education also differed by region, with the highest share of uninvolved pupils being in Košice (12.7%), Prešov (11.8%) and Banská Bystrica regions (9.2%)."

We need to emphasize that our survey is still in progress, we are working on collecting more data to make our research more punctual and increase its quality. Due to lower number of responses, concretely 64 on the second survey, we cannot make punctual general statements, we need to collect more data. Also, we would like to compare the analyzed results with other countries of the EU. Also, it would be extremely interesting to make a survey, in which the other side, the students would be examined and ask them about their opinion of digitalization in the educational process.

Funding: This research was supported by Collegium Talentum.

References

- Barcziová, A., & Machová, R. (2021). Methods of Education during the Pandemic in the Context of Demography. Relik Conference Proceedings 2021. https://www.researchgate.net/publication/357187567_METH-ODS_OF_EDUCATION_DURING_THE_PANDEMIC_IN_THE_CONTEXT_OF_DEMOGRAPHY
- 2. Blezu, C., Popa, & E., M. (2008). E-learning and its prospects in education. *Proceedings of the 12th WSEAS international conference on Computers*. https://www.researchgate.net/publication/262408133 E-learning and its prospects in education
- 3. Chitra, A., P., & Raj, M., A., (2018). E-learning. *Journal of Applied and Advanced Research, Published by Phoenix Research Publishers, Online ISSN:* 2519-9412. DOI: 10.21839/jaar.2018.v3iS1.158
- 4. Ferri, F., Grifoni, P., & Guzzo, T. (2020). Online Learning and Emergency Remote Teaching: Opportunities and Challenges in Emergency Situations, *Institute for Research on Population and Social Policies, National Research Council*, doi:10.3390/soc10040086

- 5. Huba, M., Žáková, K., & Bisták, P. (2003). WWW a vzdelávanie. Bratislava: *Vydavateľstvo STU, 2003. ISBN 80-227-1999-4*.
- 6. Jurik, P. (2021). Current Trends in E-learning. *Elektronnaja Kazaň* 2018: (*informacionnyje technologii v sovremennom mire*). *Meždunarodnaja naučno-praktičeskaja konferencija.At: Kazaň, Rossija*. https://www.researchgate.net/publication/348393318_CURRENT_TRENDS_IN_E-LEARNING
- 7. Mohammed, Q., Rida, N., & Chafiq, T. (2021). Overview of E-Learning Platforms for Teaching and Learning. International Journal of Recent Contributions from Engineering Science & IT (iJES). Published by International Association of Online Engineering. Online ISSN: 2197-8581. DOI: 10.3991/ijes.v9i1.21111
- 8. Mulabu, M., M. (2023). The Future of E-learning Systems. *Turku University of Applied Sciences Information and Communications Technology*. https://www.theseus.fi/bitstream/handle/10024/800655/Mulabu Moys.pdf?sequence=2
- 9. Osepashvili, D. (2008). The Role of E-Learning in Modern Media Education. *Javakhishvili Tbilisi State University* (*Georgia*). https://www.researchgate.net/profile/Dali-Osepashvili/publication/265163617 The Role of E-Learning in Modern Media Education/links/540192d80cf23d9765a49f4c/The-Role-of-E-Learning-in-Modern-Media-Education.pdf
- 10. Patroc, D. (2021). Arguments against e-learning, University of Oradea, Romania
- 11. Šepeľáková, L, & Ferencová, J, (2022). Desk research report in the project "Preventing post-COVID Social Exclusion Together" Partial report on education systems during the COVID-19 pandemic in Slovakia. https://www.researchgate.net/publication/360701776 Desk research report in the project Preventing post-COVID Social Exclusion Together Partial report on education systems during the COVID-19 pandemic in Slovakia
- 12. Survey on online and distance learning Results, School Education Gateway. (2020), https://www.schooleducationgateway.eu/en/pub/viewpoints/surveys/survey-on-online-teaching.htm
- 13. Zizikova, S., Nikolaev, P., & Levchencho, A., (2023). Digital transformation in education. E3S Web of Conferences 381(7). DOI: 10.1051/e3sconf/202338102036

Trends and tendencies in labor market in V4 countries in light of an empirical research

József Poór ¹, Zsuzsanna Szeiner ², Zdeněk Caha ³, Marzena Stor ⁴, Łukasz Haromszeki ⁵, Tímea Juhász ⁷

- 1 (Faculty of Economics and Informatics, J. Selye University, Komárno, Slovakia); poorj@ujs.sk
- $^2 \quad \text{(Faculty of Economics and Informatics, J. Selye University, Kom\'{a}rno, Slovakia); szeinerzsu@gmail.com}$
- 3 (Institute of Technology and Business in České Budějovice, Czehia); caha@mail.vstecb.cz
- ⁴ (Wroclaw University of Economics, Wroclaw, Poland); <u>marzena.stor@wp.pl</u>
- ⁵ (Wroclaw University of Economics, Wroclaw, Poland); <u>lukasz.haromszeki@ue.wroc.pl</u>
- 6 (Faculty of Foreign Trade, Budapest Economic University, Budapest, Hungary); juhasz.timea@uni-bge.hu
- * Correspondence: poorj@ujs.sk

Abstract: The background of our study is that the labor market of Central European countries has changed significantly since the regime change. Export-driven economic development based on cheap labor is over. We have been dealing with the HRM activities of domestic and foreign organizations for nearly three decades and analyzing labor market processes for a decade. Nowadays, the acquisition and retention of a talented good workforce has become a prominent issue. In research covering the organizations and employees of the V4 countries. Our research goal is to determine to what extent the employment and human resource management trends in the V4 countries that have developed over the past three years have persisted or what new trends have appeared in this area? In this article, we only provide an insight into some of the characteristics of the indicated research.

Keywords: labor market; employment; socio-economic environment; V4 countries

Introduction

Labor markets in the countries of the former Eastern Bloc, including the V4 countries (Czech Republic, Hungary, Poland, and Slovakia) have changed significantly over the past few decades, along with workers' attitudes toward employers. Two or three decades ago, life-long employment at companies or organizations was typical. The negative socio-economic phenomena of the 1990s also play a role in the current labor market situation. Already after 1989, high unemployment forced skilled and talented employees to migrate to Western Europe for work. Negative demographic phenomena, migration and wage disparities have caused a drastic rate of labor shortages, which has already threatened production in key sectors of the economy. The question was raised whether companies should get out of this situation by means of "wage races" or by increasing efficiency (Industry 4.0, robotics). What will happen to the economy after COVID-19? How do states, companies and workers react? In particular, our scientific goal is to help answer these questions.

One of the key issues of HRM in these countries today is the dramatic increase in labor shortages, which has been influenced by a variety of factors, namely outbound labor migration after the regime change, unfavorable demographic factors, the economic downturn, as well as wage differences within the EU (Morley et al., 2020). The labor markets of Eastern-European countries are going to face a number of challenges. The demand for skilled labor is growing rapidly. Excess labor supply has largely become a thing of the past, and it is unusual for job seekers to struggle to find a job. Rather, employers need to

make increased efforts to find the right candidates. Consequently, it is not the improvement of selection processes that causes problems for businesses but the problem of not having enough candidates (a recruitment "pool" shortage).

Before the Covid-19 pandemic that broke out at the end of 2019, the global, regional and V4 economic situation was good. Growth data and prospects were encouraging. Unemployment in the indicated year 2019 also showed a very positive picture. As a result of Covid-19, a significant economic downturn was observed in the whole world in 2020 - with the exception of a few countries (e.g. China, Ireland, etc.), but this was significantly corrected in 2021 due to the reopening of the economy, which continued in 2022. This year's outlook shows many uncertainties. Due to the impact of Covid 19, unemployment jumped, but it was much lower than most experts had expected.

Table 1. Population, GDP, unemployment rates in the V4 countries (%) in 2009-2022

No.	Indicators	Year	Czechia	Hungary	Poland	Slovakia
	indicators	Tear	(CZ)	(HU)	(PL)	(SK)
1	Donalstian (mil Donan)	2009	10,5	10,03	38,1	5,4
1	Population (mil. Person)	2020	10,7	9,8	37,95	5,45
		2009	-4,7	-6,6	2,8	-5,5
		2019	3	4,9	4,5	2,5
2	GDP	2020	-5,5	-4,5	-2	-3,3
		2021	3,6	7,2	6,8	4,9
		2022	2,5	4,6	4,9	1,7
		2009	6,66	10,03	8,17	12,02
		2019	2,02	3,42	3,28	5,76
3	Unemployment	2020	2,55	4,25	3,16	6,72
		2021	2,8	4,05	3,36	6,89
		2022	2,22	3,61	2,89	6,14

Sources: Eurostat – population, World bank – GDP, unemployment

The most important effects of the three waves of the Covid-19 pandemic related to the labor market can be summarized as follows (Dajnoki et al., 2022):

- The coronavirus epidemic has devalued and made many jobs dangerous due to overload (e.g. healthcare).
- Employers had to retain their employees with much more complex and innovative solutions than before (e.g. well work and wellbeing).
- The pandemic resulted in the appearance of new HR functions: the pandemic plan (workplace hygiene, health protection, isolation) was transformed into an area of strategic importance, organizations must prepare for the "operational" operation of flexible work organization solutions in the long term.

After a year and a half of the Russian-Ukrainian war, it can be concluded that the majority of organizations are currently pursuing a cautious business strategy and have not yet decided to take drastic change management steps. In addition, they are looking for opportunities to exploit the market changes brought about by the war (Tooze, 2022). For more than a year and a half, the war in Europe had

a significant impact on the world economy, which culminated in rapidly rising inflation, raw material shortages, and growing uncertainty in Europe and in the countries examined.

New technologies trigger a need for new ways of communicating in recruitment. In addition, to-day's generation has different expectations at the workplace. Previous research suggests that 47% of jobs in the US are at risk from robotization (Hess & Ludwig, 2017). The development of new technology will transform nearly three-quarters of physical jobs by 2030. However, we also need to take into account that the impact of new digital technologies will mean that not only physical jobs but also intellectual jobs will increasingly require less of the expert work that doctors, lawyers, and various experts. According to World Robotics (IFR, 2023) statistics, 3,5 million operational stocks of industrial robots are in factories worldwide in 2022.

1. Theoretical background

According to Barnow et al. (1998), we can talk about a shortage of professionals when the labor market balance is upset because the number of workers in demand exceeds the supply of those who are willing and able to work at given wages under given working conditions, in a given place and at a given time, with appropriate experience and education. In the V4 countries, both quantitative and qualitative labor shortages are present. Quantitative labor shortage indicates a shortage of labor that can be expressed in absolute numbers, and qualitative shortage results from a mismatch between the demand and supply side of labor.

In the field of human resources management, turnover refers to the migration of the workforce, employees changing jobs, leaving the workplace. Fluctuation shows the number of terminated employment relationships at the company within a given period, as well as the percentage of this phenomenon. Fluctuation is one of the most important performance indicators within human resources management. Within an organization, if this indicator begins to increase, it immediately draws the attention of managers to individual problems and errors. These problems can hinder the successful and effective operation of the organization in the long term. Being aware of this, serious attention must be paid to fluctuation within the organization and, where appropriate, this phenomenon must be influenced (Staw, 1980).

Determining the optimal level of the turnover rate is not a simple process, since we would think that very low turnover is best for an organization. However, this is not entirely true, as too low turnover implies that there is no movement, development and displacement within the organization, since everything is constant and the whole organization can fade into this permanence. High turnover definitely draws attention to processes that the company must make efforts to eliminate, and measures must be taken to reduce them (Huselid, 1995).

A thorough study of the topic naturally includes a systematic examination of the causes and, more broadly, of the factors influencing it. According to Ho (2016), the shortage of professionals is influenced by many factors, such as:

- poor demographic indicators,
- the demand of Western European investments for cheap labor,
- the durability of the demand for live work, the slow processes of automation and robotization,
- the salary level,
- educational and training deficiencies and lagging behind.

The labor market is constantly and rapidly changing, we live in a world where there is huge competition in every market: for customers on the goods and services market, for investors on the capital market, and for the best labor force on the labor market. The image of work and the ideal employer is also changing rapidly, the rise of globalization, innovation, and automation is radically changing both the demand and supply sides of the labor market. The example of the USA, which highlights the transformation that occurred between 1800 and 2015, serves to illustrate the enormous changes in the labor market of the industrialized world. Currently (US, 2023), the proportion of people employed in agriculture is 1.3%, in industry 12.8% and in services 80%. The labor market statistical data of the European Union show similar trends: agriculture (3.8%), industry (16%) and services (80.2%) (Statista, 2023).

We should not forget that our knowledge today depends on the knowledge of the past. Diamond (1999) believes that we can successfully prepare for the challenges of the future if we intelligently understand everything that is possible from the past. Many historians have pointed out that plague epidemics in the Middle Ages had a significant social impact: as a result of the large number of deaths, the value of labor increased, and serfs and peasants were able to make agreements with their landlords under much more favorable conditions than before. Other social scientists believe that we have no idea what the labor market will look like in 2050. It is generally agreed that machine learning and robotics will change almost every field of activity - from making yogurt to teaching yoga (Harari, 2019; Morgan, 2022). However, it must also be seen that new technologies are already eliminating many traditional jobs from the work process.

The impact of most technologies on jobs is expected to be net positive over the next five years. The jobs that are decreasing the fastest are office or secretarial roles, Bank tellers and related clerks, postal service clerks, cashiers and ticket operators, and data entry clerks (WEF, 2023). According to some opinions, today's labor shortage areas will soon disappear as a result of the new type of robotization (Ford, 2016). Based on the latest research, 47% of jobs in the USA are "at risk" due to robotization (Hess & Ludwig, 2017). If we look to the longer term, then the former may also occur in expert and knowledge intensive areas. indicated situation (Susskind & Susskind, 2015).

Goodhart and Pradhan (2020) believe that over the next three or four decades, many countries (e.g. Japan, China, North Asia, Europe, etc.) will see a significant decrease in the number of workers. However, the number of pensioners over 65 will increase rapidly due to the rise in life expectancy. But enabling older people to stay active for longer and engage in voluntary, caring and artistic activities can have both social and economic benefits and alleviate some of the fiscal burdens associated with aging societies (Brooking, 2016, IMF, 2020).

In the world's total labor market- and also in the labor market of the V4 countries - significant changes have taken place as a result of socio-economic changes. One of the consequences of these changes, according to surveys, is that the acquisition and retention of talent and a skilled workforce has become critical for employers. The problem is also relevant of Slovak companies (Štefánik, 2018). An important new factor in the Slovak labor market was until the outbreak of the crisis caused by the COVID-19 pandemic, that the unemployment rate fell to the level of the EU-28 average, which was already below the average unemployment rate before the outbreak of the economic crisis in 2008-2009. Of course, behind the favorable numbers were hidden regional differences (e.g. in Eastern and Central Europe and in Slovakia the unemployment rate is higher and around the capital negligible), generational (e.g. the unemployment rate in 2019 was among young people 16%) and other factors (e.g. sectoral differences) (Stachova et al., 2020).

Demographic processes - age composition (aging population, migration - have intensified in recent years. We cannot forget that educational structures (vocational education, adult education, higher education) cannot keep up with the real requirements of companies, we are thinking here of the "skill gap "(missing basic competencies), or" skill mismatch "(when the structure of human resources is not in line with the requirements of the economy.)

The outflow of skilled labor, brain drain abroad significantly reduce the competitiveness of the economy. With the accession of countries with a political system change, migration between member countries took on a new impetus and the impact of this generated processes different from before. The primary purpose of this new type of migration is employment.

Industry 4.0 and robotics, which are already present in our economy, can provide answers to some of the problems, but recent research suggests that robotics will also cause new problems - up to 34% of jobs "at risk".

It should be borne in mind that new digital technologies make it possible to change the workforce not only in areas where physical strength is required, but also in areas where expertise is required, i.e. in mental activities e.g. doctors, lawyers, other professionals. It is not a matter of whether robotization is required or not; rather, the question is when, where, how quickly, and how far it will spread in Slovakia and other countries. The current situation, labor shortages in certain sectors and the COVID-19 pandemic can speed up this process. This direction can have an impact on both education and state programs. These above-mentioned labor market anomalies have already arisen and are still being developed in various parts of the world, in the V4 countries. Without claiming completeness, the following may be mentioned:

- improving the demographic situation, increasing the activity rate of the population (e.g. raising the retirement age),
- educational reforms dual education (e.g. Germany), lifelong learning, e-learning methods in education (e.g. USA), retraining programs,
- hard and soft responses of companies (Backes-Tour, 2010)
- labor exchange, Industry 4.0 and robotization, labor import
- from countries with similar maturity, and from countries with low maturity, organizational climate, leadership style, development of employment relations, introduction new incentive systems (e.g. cafeteria), atypical employment.

We must not forget that wage competitions have also recently started in the V4 countries. Governments, businesses, business enterprises and individuals face several challenges. Where are Slovak companies, government programs and individuals heading / where should they go on the basis of comparison with international experience? Which goals should be prioritized in national economies? How can different generations of the population maintain their jobs and competitiveness in the labor market? In particular, we are currently seeking answers to these questions.

The problem of the lack of skilled labor increasingly affects the enterprises of the V4 countries, so they are forced to change their strategies related to human resource management and to introduce measures that can help them fill their vacant positions and retain their current good employees (Bakker et al 2004; Kozák, 2019) The general characteristics of the labor market of the four examined V4 countries can be described as follows:

- Population increases in Czechia and Slovakia and decrease in Hungary and in Poland.
- GDP in Poland has had four periods of growth and one period of decline under Covid. Czech Republic, Hungary and Slovakia have only three periods of growth and two periods of decline
- *Unemployment* in Slovakia has always been highest here. Czechia's unemployment level has always been the lowest. Hungary has always exceeded Poland's unemployment rate.

- Hourly labor cost in 2022 follow the next range in these countries: Czechia (15,5 €), Slovakia (14,2 €), Poland (11,5 €) and Hungary (10,4 €)
- *Minimum wages* in 2022 amount in V4 countries: Czechia (651 €), Slovakia (646 €), Poland (641€) and Hungary (547 €)
- On field of home-office, there is significant gap with the EU average. Share of home-office workers increased during the Covid and decline again since the end of the epidemic.
- *Number of foreign workers* is a follow: in Czechia (0,8 million people), in Poland (1,9 million people), in Hungary (0,2 million people) and in Slovakia ((0,2 million people).

2. Methods and methodology

Our empirical research basically ex-post (Usunier at al., 2017), i.e. relying on the actual data of the observation period, we examined the practices related to labor shortages and labor retention, as well as robotization, both regionally and in relation to the four countries examined. We conducted two surveys at the same time. Organizations in a one-respondent manner, the opinion of a respondent from an organization (company and institution, n=878) who was usually a top manager or HR manager. At the same time as the organizational survey, we collected the opinions of the employees of various organizations, during which we were able to collect valid answers from more than 2,000 individual respondents. In our current paper we summarize some of the first test results of the organizational research.

In order to facilitate statistical analyses, our organizational questionnaire uses closed questions in most cases. We asked the respondents to indicate the most typical of the pre-formulated answers that largely cover the examined topics. The organizational questionnaire used in the V4 countries consists of the following 4 main parts:

- The first part examines the data and main characteristics of the organization (companies, institutions) participating in the survey.
- The second part of the questionnaire asks about characteristics related to turnover and labor shortages.
- The third part deals with questions related to organizational (corporate and institutional) and government measures and programs related to labor retention.
- The fourth part examines opinions and experiences related to robotization.

Most of the answers were obtained through an online web survey using the so-called snowball method. The previously indicated questionnaire was already used during research carried out in two previous empirical studies with a similar purpose (in 2014 and 2020) and was further developed based on the experiences there. As we wrote earlier, various forms of labor shortages have become common in our region. Such a complex issue can be examined from many different angles. As a result, we can highlight a number of limiting factors.

The available time and financial framework made it possible to examine mainly aspects of the farming and management side within the framework of the current research.

- Data collection covering the V4 countries is a very complex task.
- With the help of our research partners and our data gathering experience, we were able to collect a diverse number of responses.
 - Since our research was basically benchmarking (Evans, 1977), the answers collected per country are not representative.

3. Results

In the following, we summarize some of the most important results of our organizational research.

3.1. Responding organization

It has been a one-respondent survey (one organization-company, institution and one respondent) This survey was carried out as a non-representative survey in 2023.

Table 2. Number of responding organizations (n=878)

Countries	No. of respondents	Frequency
Czech Republic	233	26,5
Poland	120	13,7
Hungary	397	45,2
Slovakia	128	14,6
Total	878	100,0

Source: Authors' own research

Almost two thirds of responding organizations are with fewer than 250 employees. The majority of Slovak respondents is small organization. In Czech and Polish samples there has been a higher proportion of large organizations.

Table 3. Size of responding organizations (by headcount) (%)

Countries	1-250	251-500	more than 500	Total
Countries	person	person	person	TOtal
Czech Republic	59,20%	12,40%	28,40%	100,00%
Poland	52,10%	10,40%	37,50%	100,00%
Hungary	62,70%	12,70%	24,60%	100,00%
Slovakia	71,80%	5,90%	22,30%	100,00%
Total	60,50%	18,40%	21,10%	100,00%

Source: Authors' own research

The majority of respondents, 71.5% by turnover, is belonging to the category of small organizations.

Table 4. Size of responding organizations (by revenue) (%)

Countries	under	3.000.000-	more than	Total
	3.000.000 EUR	30.000000	30.000.000	
		EUR	EUR	
Czech Republic	51,80%	36,50%	11,70%	100,00%
Poland	35,90%	46,20%	17,90%	100,00%
Hungary	55,30%	28,90%	15,80%	100,00%
Slovakia	72,00%	20,50%	8,40%	100,90%
Total	52,30%	19,20%	28,50%	100,00%

Source: Authors' own research

3.2. Impact of crisis on the labour force

For Polish and Czech organizations, there was an almost 50/50 split between yes and no responses. The Hungarian and Slovak samples had a very high proportion of uncertain (don't know) respondents. The effects on

individual workplaces largely depended on the extent to which the work required personal presence. There were sectors that were forced outright into shutdown or recession, mainly those economic activities and sectors that required personal presence for production and service, or those that relied heavily on inputs from global supply chains (Francis, 2020). In addition, there were sectors where traditional work was replaced by remote work, and thus they were able to maintain continuous operations thanks to digitalization, thus reducing the risk of unemployment.

Table 5. Impact of coronavirus crisis (%)

	Has the cor company/co			
Countries	n/a	Yes	No	Total
Czehia	3,0%	43,3%	53,6%	100,0%
Poland	1,7%	50,0%	48,3%	100,0%
	64,7%	16,9%	18,4%	100,0%
Hungary				
Slovakia	46,1%	15,6%	38,3%	100,0%
Total	37,0%	28,2%	34,7%	100,0%

Source: Authors' own research

In general, it can be said that the proportion of "yes" answers is lower than that of no answers for all the countries examined. So far, we have experienced global economic effects, which currently culminate in declining GDP growth in Europe and the world, rapidly increasing inflation, as well as a lack of raw materials and increased uncertainty. According to experts, the influx of refugees can play a role in rebalancing the labor market with a shortage of supply.

Table 6. Impact of war crisis (%)

	Did the war cris			
Countries	n/a	Yes	No	Total
Czechia	3,0%	43,3%	53,6%	100,0%
Poland	1,7%	50,0%	48,3%	100,0%
Hungary	64,7%	16,9%	18,4%	100,0%
Slovakia	46,1%	15,6%	38,3%	100,0%
Total	37,0%	28,2%	34,7%	100,0%

Source: Authors' own research

3.3. Tools of workforce retention

In the course of our research, we also examined what labor retention tools the respondents used during the coronavirus pandemic and the war that began in February 2022.

Thus, it was concluded that, regardless of the form of ownership, most organizations - where the nature of the work processes made it possible - switched to remote work. Among the retention strategies, the use of flexible working hours and the use of government measures played a significant role. The use of government measures also played an important role in retaining the workforce.

Ranking Methods

Working time reduction

1. Home office
2. With the help of government measures
3. We deduct all other salary-related benefits
4. We reduced their salaries
5. We sent them on unpaid leave
6.

Table 7. Methods of coronavirus crisis (%)

Source: Authors' own research

Based on what has been said and described, we believe that from the perspective of workforce retention, it can be extremely important to prioritize the pursuit of employee well-being and to create a positive workplace environment where employees have the chance to work in an experiential manner, where they feel valued and receive appropriate treatment, and where their work is continuously evaluated. There are possibilities for teamwork, professional development, and progress, they get feedback, and they are happy with the work environment.

Table 8. Methods of war time (%)

Ranking	Methods
1.	Working atmosphere
2.	Stability
3.	Personality of the leader
4.	Flexibility
5.	Opportunity for development
6.	Feedback
7.	Predictable career path
8.	Job interview as first impression
9.	Other

Source: Authors' own research

4. Limits and future thoughts

Among the limitations of the research, we mentioned the low sample size and the selection method in our paper. We believe that our experience and conclusions in this study will contribute to a deeper understanding of the evolution of employment activities regarding different organizations and employees as well (Wengraf, 2001; Mason, 2002). In the coming weeks, the organizational and employee V4 project reports and our article containing two multivariate in-depth statistical analyzes will be ready.

Funding: This research was funded by VEGA 1/0688/21 project support.

References

- Backes-Gellner, U., & Tuor, S. N. (2010). Avoiding Labor Shortages by Employer Signaling: On the Importance of Good Work Climate and Labor Relations. ILR Review, 63(2), 271– 286. https://doi.org/10.1177/001979391006300205
- 2. Barnow, B. S., Trutko, J. & Lerman, R. (1998). *Skill Mismatches and Worker Shortages: The Problem and Appropriate Responses*. Washington: Urban Institute.
- 3. Bakker, A. B., Demerouth, E. & Verbeka, W., (2004). Using the job demands-resources model to predict burnout and performance. *Human Resource Management*, 43(1), 83–104. https://doi.org/10.1002/hrm.20004

- 4. Dajnoki K. et al. (2023). Impact of the three waves of COVID-19 pandemic on the HR practices of Hungarian organizations–Experience from an empirical study. *PLoS ONE* 18(6), 1-22.: e0283644. https://doi.org/10.1371/journal.pone.0283644
- 5. Diamond, (2019). Upheaval: Turning Points for Nations in Crisis. New York: Kindle.
- 6. Evans, I. S. (1977). The Selection of Class Intervals. Contemporary Cartography, 2(1), 98-124.
- 7. Ford, M. (2016). Age of robots. (In Hungarian) Budapest: HVG book.
- 9. Goodhart, Ch. & Pradhan, T. (2020). *The Great Demographic Reversal: Ageing Societies, Waning Inequality, and an Inflation Revival.* London: Palgrave Macmillan.
- 10. Ho, P. H. K. (2016). Labour and skill shortages in Hong Kong's construction industry. *Engineering, Construction and Architectural Management*, 23(4), 533–550. https://doi.org/10.1108/ECAM-12-2014-0165
- 11. Harari, Y. 2019. 21 Lessons for the 21st Century. London: England: Vintage.
- 12. Hess, D.E. & Ludwig, K. (2017). Humility Is the New Smart Rethinking Human Excellence in the Smart machine Age. Oakland: Berrett-Koehler Publishers Inc.
- 13. Ho, P. H. K. (2016). Labour and skill shortages in Hong Kong's construction industry. *Engineering, Construction and Architectural Management*, 23(4), 533–550. https://doi.org/10.1108/ECAM-12-2014-0165.
- 14. Huselid, M. A. (1995). The impact of human resource management practices on turnover, productivity, and corporate financial performance. *Academy of Management Journal*. 38 (3), 635-672.
- 15. IFR (2022). World Robotics Report. IFR= International Federation of Robotics.
- 16. ILO (2018). World Employment and Social Outlook: Trends 2018 International Labour Office (ILO). Geneva: ILO.
- 17. Kennedy, J.F. (1959). Remarks of Senator John F. Kennedy, convocation of the United Negro College fund Indianapolis, Indiana, USA, April 12, 1959. https://www.jfklibrary.org/archives/other-resources/john-f-kennedy-speeches/indianapolis-in-19590412.
- 18. Kozák, A. (2019.) Organizational reactions and employee behavior in the labor shortage environment: summary thoughts in the light of the results of an empirical research, (In Hungarian) *Hungarian Science (Magyar Tudomány)*, 180(9), 1376–1385. https://doi.org/10.1556/2065.180.2019.9.12.
- 19. Mason, J. (2002), Qualitative researching. Thousand Oaks: Sage Publications.
- 20. Morgan, J. (2022). Yuval Harari On the Future of Jobs & Technology, Intelligence vs Consciousness, & Future Threats to Humanity. https://www.linkedin.com/pulse/yuval-harari-future-jobs-technology-intelligence-vs-threats-morgan
- 21. Morley, M.J., Poór, J., Kazlauskaitė, R., Kabalina, V. & Blštáková, J. (2020). Human Resource Management in the Post-Socialist Region of Central & Eastern Europe. In E.Parry, M. J. Morley & C. Brewster (eds.), *The Oxford Handbook of Contextual Approaches to Human Resource Management*. Oxford: Oxford University Press.
- 22. Stachova, K., Stacho Z., Raišienė, A.G. & Barokova, A. (2020). Human resource management trends in Slovakia. *Journal of International Studies*, 13(3), 320-331. doi:10.14254/2071-8330.2020/13-3/21.
- 23. Statista (2023). Number of employees in the European Union in quarter 1 of 2023, by sector. https://www.statista.com/statistics/1195197/employment-by-sector-in-europe/
- 24. Staw, B. M. (1980). The consequences of turnover. Journal of Occupational Behavior, 1. 253-273.
- 25. Štefánik, M. 2018, Labour market in Slovakia, 2019. Bratislava: Centre of Social and Psychological Sciences, Slovak Academy of Sciences (CSPS SAS), Institute of Economic Research, Slovak Academy of Sciences (IER SAS) and Faculty of Arts, Comenius University in Bratislava (FA CU).
- 26. Susskind, R. & Susskind, D. (2015). *The Future of the Professions: how technology will transform the work of human experts*. Oxford: Oxford University Press.
- 27. **Tooze,** A. (2022). Ukraine's War Has Already Changed the World's Economy. https://foreignpolicy.com/2022/04/05/ukraine-russia-war-world-economy/ (Accessed: April 17, 2022.)
- 28. Torrington, D., Hall, L., Taylor, S. & Atkinson, C. (2014). Human Resource Management. Harlow: Pearson.
- 29. Usunier, J. C., Van Herk, H. & Lee, J. A. (2017). *International and Cross-Cultural Business Research*. Los Angeles: Sage.
- 30. WEF (2023). Future of Jobs Report 2023. Cologne/Geneva: World Economic Forum.
- 31. Wengraf, T. (2001), *Qualitative Research Interviewing: Biographic Narratives and Semistructured Methods.* London: Sage.

Financial Health of Construction Companies in the Czech Republic Assessed using Bankruptcy Models

Simona Činčalová 1, Jaroslav Jánský 2* and Roman Fiala 3

- Department of Economic Studies, College of Polytechnics Jihlava, Jihlava, Czech Republic; simona.cincalova@vspj.cz
- ² Department of Economic Studies , College of Polytechnics Jihlava, Jihlava, Czech Republic; jaroslav.jansky@vspj.cz
- 3 Department of Economic Studies, College of Polytechnics Jihlava, Jihlava, Czech Republic; roman.fiala@vspj.cz
- * Correspondence: jaroslav.jansky@vspj.cz

Abstract: The aim of the paper is to evaluate companies in this sector in the crisis years of 2010 and 2014, as well as in the standard year of 2017, based on the Altman Z"score bankruptcy model. Based on the calculations, the research question about the dependence of the size of the accounting units and their financial health is answered. The size of the company affects the financial stability of the company from the point of view of the bankruptcy model.

Keywords: Altman's Z-score; bankruptcy models; construction industry; Czech economy

Introduction

Construction is one of the main national economic sectors of the economy and has a significant multiplier effect on a whole range of other sectors. It is thus considered one of the important indicators of economic development. Business failure in the construction industry is a significant research factor for predicting the financial situation. The construction industry in each country has specific characteristics that sharply distinguish it from other sectors of the economy. These characteristics in many ways contribute to the industry's high failure rate.

In 2008, the European economy was marked by the growing global financial and economic crisis, which entered a critical phase in September. This crisis is rooted in the major subprime mortgage crisis and subsequent sharp economic slowdown in the United States, as well as high oil and commodity prices. Construction is an atypical sector in which the crisis will not manifest itself immediately, but only over the course of several years.

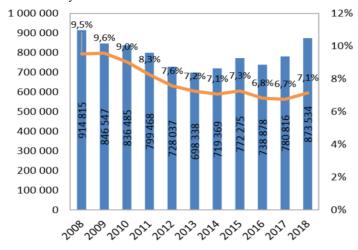


Figure 1. Construction production and share of the whole economy.

Source: MIT (2020)

The goal of the contribution is to evaluate companies in this sector according to different size entities, i.e. according to the size of the accounting unit in the crisis years of 2010 and 2014 and also in 2107 using the Altman Z"score bankruptcy model. Based on the calculations, the research question posed by

the authors is answered, whether there is a relationship between the size of accounting units and their financial health.

The construction industry is a key customer for some industrial sectors, but at the same time a field that has an influence on the appearance of landscapes, villages and cities. In addition, the construction industry represents one of the important measures of the development of the economy

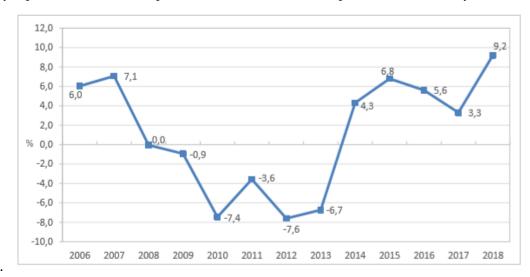


Figure 2. Development of the number of construction companies in 2008-2019.

Source: MIT (2020)

The number of enterprises in the construction industry began to increase after a sharp decline in 2013 and grew until 2018, but in 2019 they decreased (see Figure 1). Traditionally, small businesses have the largest presence in this industry, where self-employed people have a large share. In 2019, it was the category of the smallest enterprises with up to 9 employees that saw their number decrease only slightly and the slowest of all groups in 2019, and therefore slightly increased its share in the total number of enterprises to just under 98%. (CZSO, 2021)

1. Theoretical background

Knowing the financial situation and financial health of the company is very important for any financial management or decision making in the company. Any financial decision-making in the company must be supported by financial analysis, the results of which are based on the management of assets and financial management of the company, investment and price policy, inventory management, etc. Information based on financial analysis can serve many external and internal users. There are a number of financial models that diagnose and predict the financial health of a company, as well as a number of authors who deal with these models in their studies (Fiala et al., 2020; Semenets, 2019; Senteney et al., 2020; Schönfeld et al., 2018; Syamni et al., 2018; Kilowski et al., 2022).

In general, the models can be divided into two basic categories - creditworthiness and bankruptcy models. Kuběnka and Slavíček (2014) claim that their construction is usually similar and individual models differ mainly in their focus. Due to the goal, the post is focused only on bankruptcy models. Multivariate prediction of bankruptcy, which was determined using univariate analysis of bankruptcy predictors, was originally developed by Beaver (Karas and Reznakova, 2013), who found that a number of indicators can differentiate between matched samples of failed and non-bankrupt firms over a period of five years before failure. Altman (1968) defines five hypothesized factors and provides a foundation for other researchers to examine the validity of multivariate models. Following on from Beaver and Altman's research, Altman's models appear to be valid, but their predictive power is gradually diminishing (Charpentier, 2014). Begley et.al (1996) examines Altman's model and concludes that the model performs better in US data during the 1980s than during the period 1990-1995. Similar are the findings of Grice and Ingram (2001), who also find better performance for manufacturing companies.

In order to answer the research question regarding the dependence of the size of the accounting units and their financial health, the bankruptcy model Altman's Z" score will be used in the article. Z"score is one of the most famous bankruptcy prediction indices in the world (Qiu et al., 2020; Akbar et al., 2020). Altman (1968) developed this model for evaluating the quality of ratio analysis. The equation incorporates several financial variables and predicts bankruptcy using a multiple discriminant statistical method. The first Altman Z-score (Altman, 1968) contained five ratios. Subsequently, seven ratios were modified and examined (Altman et al., 1977). Furthermore (Altman, 1993) a Z' score was created for companies not traded on capital markets, again with five indicators, in 1995 (Altman, 2005) the so-called EM score was tested on selected Mexican companies. Another revision by Altman (2005) compiled a Z" score, which is applicable to non-American non-manufacturing enterprises, and for this reason an indicator (sales / total assets) not yet used.

There are foreign studies that have examined the relationship between the size of accounting units (AU) and their financial health. For example, Lensberg et al. (2006) developed a model that offers a comprehensive view of the interaction of bankruptcy-related factors, particularly the effect of company size. Also LoPucki et al. (2008) found a certain dependence between the variable size of enterprises and financial health. However, in the construction industry, these studies are lacking.

2. Methods and methodology

The contribution focuses on all enterprises in the construction industry in the Czech Republic in 2010, 2014 and 2017. However, enterprises for which the data were incomplete had to be excluded. The statistical data of these enterprises were analyzed for the mentioned years using the Albertina database, Statistica and Excel programs. In 2010, there were 9,584 construction companies operating in the industry, and in the crisis year of 2014, a decrease of 2,738 was recorded, i.e. by 28.6%, and on the contrary, in 2017, compared to 2010, the number of companies increased by 3,912, i.e. by 40.8% (see Table 1) .

Table 1. Structure of the construction industry by company size in selected years

AU/year	2010	2014	2017
Micro	6009	4742	10770
Small	3066	1805	2357
Medium	421	238	310
Large	64	50	59
Total	9560	6835	13496

Source: own processing according to the Albertina database (2021)

The authors asked themselves the following research question when processing the analysis of construction companies in the mentioned years: Do the Z" score results in the analyzed years 2010 and 2014 indicate that the larger the accounting unit, the stronger (or more stable) it is?

The analysis is based on previous studies by the authors (Jánský et al., 2019; Činčalová and Jánský, 2020; Jánský and Činčalová, 2021), in which they examine the crisis years 2010 and 2014. The crisis years are deliberately chosen with a delay, as the construction industry reacts only with distance to the Great Recession, compared to other industries.

The entire group of enterprises was divided according to the size of the accounting units (UU) based on the amendment to the Accounting Act for both monitored years, into so-called micro, small, medium and large enterprises. Companies can be classified into different categories according to their size. The most common is the number of employees, where small and medium-sized enterprises employ less than 250 people and large companies employ 250 or more people. Small and medium-sized enterprises are further divided into micro-enterprises (1-9 persons), small (10-49 persons) and medium-sized enterprises (50-249 persons).

```
The Z''score model has the following form (Altman, 2005): Z'' = 6.56x_1 + 3.26x_2 + 6.72x_3 + 1.05x_4,
```

where: $x_1 = \text{net working capital / total assets}$

(1)

 x_2 = retained earnings of previous years / total assets

 $x_3 = EBIT / total assets$

 x_4 = book value of equity / total debt

The evaluation calculates the Z" score in the relevant sector:

- Z > 2.60 sectors for financially healthy businesses,
- $1.10 \le Z \le 2.60$ zone of ignorance or the so-called grey zone,
- Z < 1.10 sector for companies in bankruptcy.

3. Results and Discussion

In consecutive crisis years 2010 and 2014, it was examined how many companies (see Table 2) are bankrupt according to Altman's Z" score, i.e. below the value of 1.1. From the original number of 9,560 construction companies in 2010, 3,549 are bankrupt according to the above methodical approach, i.e. 37.1%. In 2014, the total number of enterprises was 6,835, of which 2,409 enterprises were bankrupt, i.e. 34.0%. If we look at construction companies according to the size of the AU in both analyzed years, the situation of bankrupt companies is quite different. In 2010, according to the relative frequency of bankruptcy models, microenterprises represent the largest percentage, small and large enterprises occupy approximately the same frequency of bankrupt enterprises, and medium-sized enterprises are the least in the bankruptcy situation.

The situation is quite different in the analyzed year of 2014, when the largest frequency of bankrupt enterprises, according to the size of the AU, is represented by micro-enterprises, namely 38.5%, followed by small enterprises (24.9%). The relative frequency of medium-sized enterprises (16.8%) and large enterprises (10.0%) is only partially different in 2014.

Table 2. Number of bankrupt businesses

AU/year	20	10	20	014
	absolute	relative	absolute	relative
	frequency	frequency	frequency	frequency
Micro	2554	42,5 %	1827	38,5 %
Small	894	29,2 %	449	24,9 %
Medium	81	19,2 %	40	16,8 %
Large	20	31,3 %	5	10,0 %
Total	3549	37,1 %	2321	34,0 %

Source: own processing according to the Albertina database (2021)

It is clear from Table 2 that between 2010 and 2014, during this time of crisis, the financial situation of construction companies improved, i.e. in total and also according to the size of the AU. In 2014, the number of bankrupt construction companies decreased compared to 2010, even regardless of the overall decrease of companies by 28.6% between the two analyzed years. The lowest decrease in the relative frequency of bankrupt enterprises between 2014 and 2010 is for medium-sized AUs, namely 2.4%, followed by micro AUs by 4.0% and small AUs by 4.3%.

As stated by Kuběnka and Králová (2013), it appears that the construction industry was financially strong in 2009, in 2010 there was stagnation, or to a slight deterioration and in 2011, on the contrary, to a strong improvement. Based on the predominantly increasing trend of the Z' Score indicator, we can state that globally the situation in the construction industry is improving and the probability of financial distress is decreasing.

Similar conclusions emerge from the comparison of both researches, that after 2010 the situation in the field of financing is improving. However, in our research, we can specify that the probability of financial distress still exists for accounting units of micro-enterprises.

The Z" score model was used for the calculation according to the size of the AU of construction companies, while the first calculations are based on the averages of the indicators for individual AUs and the second calculations are based on the medians of the indicators. For comparison, the Z" score is

also calculated for the entire set of enterprises that do not consider classification on the AU (see Table 3).

Table 3. Z" score results

AU / Year	201	10	20	14
	average	median	average	median
Micro	1.19	1.23	1.18	1.48
Small	3.03	2.67	4.28	3.99
Medium	2.91	3.30	3.46	3.32
Large	2.64	2.53	3.00	2.87
Total	2.63	1.67	2.97	1.76

Source: own processing according to the Albertina database (2021)

Based on the calculated values, we can conclude (see Table 4) that the construction of the Z" score models is affected by whether we assess the selected indicators of the accounting units based on the average or the median. According to the above-mentioned characteristics of the average and the median, the median indicator can be considered a better indicator in this situation.

Table 4. Evaluation of Z" score

AU / Year	2010		2014	
	average	median	average	median
Micro	grey zone	grey zone	grey zone	grey zone
Small	healthy AU	healthy AU	healthy AU	healthy AU
Medium	healthy AU	healthy AU	healthy AU	healthy AU
Large	healthy AU	grey zone	healthy AU	healthy AU
Total	healthy AU	healthy AU	healthy AU	healthy AU

Source: own processing according to the Albertina database (2021)

The research question that was set "the results of the Z" score will be more favorable in the analyzed year 2014 for all construction companies according to the size of the accounting unit than in 2010" can be confirmed on the basis of the processed calculations. The results of large AUs and the median from the gray zone in 2010 reached the section of financially healthy enterprises in 2014. Other AUs, apart from micro-enterprises, were healthy in both monitored years.

As stated by Kuběnka and Králová (2013), the value of the Z" Score from 2009 (3.36) globally indicates that the construction industry is financially strong (Z">2.6 a financially strong company), in 2010 there was stagnation, or to a slight deterioration and in 2011, on the contrary, to a strong improvement of this indicator almost up to the value of 3.43. Based on the predominantly increasing trend of the Z" Score indicator, we can state that globally the situation in the construction industry is improving and the probability of financial distress is decreasing.

Similar conclusions emerge from the comparison of both researches, that after 2010 the situation in the field of financing is improving. However, in our research, we can specify that the probability of financial distress still exists for accounting units of micro-enterprises. From the analyzes carried out, it can be seen that the number of AUs decreased by a total of 29% in 2014 compared to 2010, and then micro AUs decreased by 21%, small by 41%, medium by 43% and large by 21%. Even this decrease proves the crisis situation that arose in the analyzed years in the construction industry.

The research further focused on the analysis of the calculated Z" Score values for bankrupt and non-bankrupt enterprises comprehensively for both monitored years 2010 and 2014 according to the size of the accounting unit. The Z" Score was calculated for both years 2010 and 2014 as an overall weighted average using the number of bankrupt and non-bankrupt enterprises and also as a median between the two years.

Table 5. Z" score results for bankrupt and non-bankrupt enterprises for both years 2010 and 2014

AU	Bankrupt enterprises		Non-bankrupt enterprises	
	weighted average	median	weighted average	median
Micro	-9.68	-0.97	5.54	2.72
Small	-0.44	-0.08	4.85	2.12
Medium	-0.26	0.09	6.06	4.62
Large	0.31	0.08	3.65	1.40

Source: own processing according to the Albertina database (2021)

From the results presented in Table 5, it is clear that bankrupt companies are in high financial distress. In particular, a disproportionately high financial distress is evident in micro-enterprises and small enterprises, both in the Z" Score values calculated as a weighted average and also as a median (index values are negative for both accounting units). A very bad financial situation is also found in bankrupt enterprises of medium and large accounting unit size, even if the Z' Score values here are slightly negative or slightly positive. However, as stated above, according to Altman's Z" Score, values below 1.1 represent bankrupt companies. Table 2 shows that in the observed years of 2010 and 2014, the number of bankrupt enterprises ranged from 34.0% to 37.1% of all construction enterprises. This means that more than a third of construction companies are in serious financial distress in the analyzed years. If we monitor the number of bankrupt companies according to the size of the accounting unit and also the value of the Z" Score, the results confirm a very unfavorable financial situation, especially for microenterprises. The situation is also complicated for small and partly also medium-sized enterprises.

The financial situation in the analyzed years 2010 and 2014 for non-bankrupt enterprises in the field of construction in the Czech Republic, as also shown in Table 5 with respect to the values of Z" Score, is completely opposite according to the size of the AU, and these enterprises reach values significantly above the value of 2.6. From this Z' Score, businesses are classified as financially sound.

In all analyzes carried out in the authors' previous studies (Jánský et al., 2019; Činčalová and Jánský, 2020; Jánský and Činčalová, 2021), micro-enterprises were problematic when assessing the financial situation. It can be stated that the most numerous form of enterprises, namely micro-enterprises, also from the point of view of financial distress, are in the same situation as in the previous contributions.

Overall, it can be stated that the development of the bankruptcy situation in the construction sector was best managed by the AU of large and medium-sized enterprises in the monitored years. Small businesses have a more complicated financial situation when evaluating bankruptcy models, and as mentioned above, the most complicated financial situation is for micro-enterprises. In the case of micro-enterprises, it should be noted that the beginning of the crisis hit them hardest, which is also understandable considering their economic situation (see Table 2).

Furthermore, it is also appropriate to assess the development of operating revenues of construction companies according to the AU in the individual analyzed years. In 2010, the total operating revenues of all analyzed construction companies listed in the Albertina database were CZK 518.8 billion, and in 2014 they decreased by 44.05% compared to 2010. The following Table 6 shows the share of individual construction companies according to the AU.

Table 6. Share of operating revenues by accounting units in %

AU / Year	2010	2014
	average	average
Micro	6,79	7,46
Small	28,44	24,41
Medium	26.67	23.33

Large	38,09	44,80
Total	100,00	100,00

Source: own processing according to the Albertina database (2021)

From Table 6, it is clear that large enterprises have the largest share of the operating revenues of the analyzed accounting units of construction enterprises, in both years 2010 and 2014. Next, small enterprises follow and, with a slight difference, medium-sized enterprises. In both years, micro-enterprises hover around the level of 7%. From the given table of the share of construction companies in operating income, small and medium-sized companies together have the greatest influence. Micro-enterprises are in a more difficult situation in crisis situations with regard to the results presented in Tables 2 and 5. Large construction enterprises manage crisis situations quite well without major complications, provided construction production grows.

4. Conclusions

The aim of the contribution was to analyze companies in the construction industry in 2010 and 2014 based on Altman's Z"Score. Based on the calculations, the research question about the dependence of the size of the accounting units and their financial health can be answered. The size of the company has an effect on the stability of the company from the point of view of the bankruptcy model, as evidenced by the results especially for large and medium-sized companies. In particular, large and medium-sized enterprises in the analyzed period coped better with the resulting financial situation assessed through bankruptcy models. It should be added, however, that the impact of the bankruptcy situation was relatively lower for medium-sized enterprises in both monitored years, and this also indicates their relatively higher financial stability. The financial situation of micro-enterprises evaluated using Altman's Z"Score is the most complex, and it is obvious that these enterprises are apparently unable to solve the situation.

In this direction, it is necessary to realize the relatively higher uncertainty of micro-enterprises in crisis years and to pay them much more attention in the measures that are taken in this context, even though they are probably more flexible during crisis changes.

The complex situation in the construction industry, i.e. also for construction companies according to the size of the UJ, is also evident this year, when construction production fell by 4.3% year-on-year, when building construction fell by 1.5% and engineering construction even by 14.4%. According to the CZSO economic survey, the biggest barriers to growth in the construction industry are the lack of employees and insufficient demand.

With regard to the current situation in the construction industry, it is important to further analyze the crisis financial situation according to individual size groups of construction companies, especially with the aim of mitigating the resulting crisis financial situation of construction companies as much as possible, i.e. the main premise of further research at our workplace.

Funding: The research was supported by the contribution of long term institutional support of research activities by the College of Polytechnics Jihlava.

References

- 1. Akbar, M., Akbar, A., Maresova, P., Yang, M., & Arshad, H. M. (2020). Unraveling the bankruptcy risk–return paradox across the corporate life cycle. Sustainability, 12(9), 3547. https://doi.org/10.3390/su12093547
- 2. Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bank-ruptcy. The Journal of Finance, 23(4), 589–609. https://doi.org/10.1111/j.1540-6261.1968.tb00843.x
- 3. Altman, E. I. (1993). Corporate Financial Distress and bankruptcy: A Complete Guide to predicting and avoiding distress and profiting from bankruptcy. Wiley.
- 4. Altman, E. I., Haldeman, R. G., & Narayanan, P. (1977). ZETATM analysis a new model to identify bankruptcy risk of corporations. Journal of Banking & English Finance, 1(1), 29–54. https://doi.org/10.1016/0378-4266(77)90017-6

- 5. Altman, E. I. (2005). An emerging market credit scoring system for corporate bonds. Emerging Markets Review, 6(4), 311–323. https://doi.org/10.1016/j.ememar.2005.09.007
- 6. Begley, J., Ming, J., & Watts, S. (1996). Bankruptcy classification errors in the 1980s: An empirical analysis of Altman's and Ohlson's models. Review of Accounting Studies, 1(4), 267–284. https://doi.org/10.1007/bf00570833
- 7. Činčalová, S., Jánský, J., & Palát, M. (2019). Assessment of the construction sector in the Czech Republic based on selected indicators of Corporate Social Responsibility. 6th SWS International Scientific Conference on Social Sciences ISCSS 2019. https://doi.org/10.5593/sws.iscss.2019.2/s05.048
- 8. Činčalová, S., & Jánský, J. (2020). Hodnocení finančního zdraví stavebních firem s využitím Altmanova Z''score. 12. ročník mezinárodní vědecké konference KONKURENCE 2020.
- 9. Činčalová, S., & Jánský, J. (2021). Hodnocení stavebních podniků v období krize českého stavebnictví. Logos Polytechnikos, 12 (3), 34-55.
- 10. Fiala, R., Hedija, V., Dvořák, J., & Jánský, J. (2020). Are profitable firms also financially healthy? Empirical evidence for pig-breeding sector. CUSTOS E AGRONEGOCIO ON LINE, 16(1), 173-201.
- 11. Grice, J. S., & Ingram, R. W. (2001). Tests of the generalizability of Altman's bankruptcy prediction model. Journal of Business Research, 54(1), 53–61. https://doi.org/10.1016/s0148-2963(00)00126-0
- Charpentier, J. A. V. (2014). Modelos de Beaver, Ohlson y Altman: ¿son realmente capaces de predecir La Bancarrota en el sector empresarial costarricense? (models of Beaver, Ohlson and Altman: Are really able to predict the bankruptcy in the Costa Rican Business Sector?). TEC Empresarial, 8(3), 29. https://doi.org/10.18845/te.v8i3.2078
- 13. Jánský, J., Činčalová, S., Dočekalová, M., & Palát, M. (2019). Ekonomicko-statistická analýza odvětví stavebnictví. 11. ročník mezinárodní vědecké konference KONKURENCE 2019.
- 14. Jánský, J., & Činčalová, S. (2021). Analýza stavebních podniků v krizových letech po roce 2008. In Sborník z konference Trendy v podnikání 2020 (1-8). Plzeň: Západočeská univerzita v Plzni.
- 15. Karas, M., & Reznakova, M. (2013). Identification of financial signs of bankruptcy: A case of industrial enterprises in the Czech Republic. 6th International Scientific Conference: Finance and the Performance of Firms in Science, Education, and Practise.
- 16. Kuběnka, M., & Slavíček, O. (2014). Detection of Cognation between Creditworthy Models and Bankruptcy Models. Managing and Modelling of Financial Risks,
- 17. Kuběnka, M., & Králová, V. (2013). Využití Z'' score při hodnocení finančního zdraví odvětví stavebnictví, E&M Economics and Management, 16(1), 101–112.
- 18. Lensberg, T., Eilifsen, A., & McKee, T. E. (2006). Bankruptcy theory development and classification via Genetic Programming. European Journal of Operational Research, 169(2), 677–697. https://doi.org/10.1016/j.ejor.2004.06.013
- 19. LoPucki, L. M., & Doherty, J. W. (2008). Professional overcharging in large bankruptcy reorganization cases. Journal of Empirical Legal Studies, 5(4), 983–1017. https://doi.org/10.1111/j.1740-1461.2008.00148.x
- 20. Semenets, A. O. (2019). Bankruptcy Probability Monitoring in the Trading Companies' Internal Audit System. Financial and credit activity: problems of theory and practice, 2(29), 305–314.
- 21. Senteney, M., Stowe, D. L., & Stowe, J. D. (2019). Financial statement change and equity risk. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3335910
- 22. Schönfeld, J., Kuděj, M., & Smrčka, L. (2018). Financial health of enterprises introducing safeguard procedure based on bankruptcy models. Journal of Business Economics and Management, 19(5), 692–705. https://doi.org/10.3846/jbem.2018.7063
- 23. Syamni, G., Majid, M. S., & Siregar, W. V. (2018). Bankruptcy prediction models and stock prices of the coal mining industry in Indonesia. ETIKONOMI, 17(1), 57–68. https://doi.org/10.15408/etk.v17i1.6559
- 24. Qiu, W., Rudkin, S., & Dłotko, P. (2020). Refining understanding of corporate failure through a topological data analysis mapping of Altman's Z-Score Model. Expert Systems with Applications, 156, 113475. https://doi.org/10.1016/j.eswa.2020.113475

Central Bank Digital Currency - Challenges and expectations from the perspective of central banks

Kitti Hajmási 1, Imrich Antalík 2 and Renáta Machová 3,*

- ¹ Faculty of Economics and Informatics, J. Selye University, Komárno, Slovakia; hajmasi.kitti@student.ujs.sk
- ² Faculty of Economics and Informatics, J. Selye University, Komárno, Slovakia; antaliki@ujs.sk
- Faculty of Economics and Informatics, J. Selye University, Komárno, Slovakia; machovar@ujs.sk
- * Correspondence: Renáta Machová; machovar@ujs.sk

Abstract: Nowadays, the digital revolution has become an integral part of everyday life, and technological innovations have not spared the financial and banking systems. Electronic payment methods have gained increasing popularity, and the COVID-19 pandemic significantly boosted the prevalence of contactless payments, gradually pushing cash into the background. The popularity of cryptocurrencies, stablecoins, and tech giants poses a substantial challenge to the existing monetary system. The emergence of financial innovations has brought about the digital transformation of money. The aim of our research is to summarize the challenges faced by central banks and the expectations regarding digital central bank currency, while also providing insights into the Hungarian and international context of its implementation. We placed special emphasis on uncovering the public policy, societal, and economic challenges confronting central banks. We analyzed the functional expectations, technological challenges, as well as banking and systemic risks associated with the introduction of digital central bank currency. Based on the results of our research, we have concluded that central banks in order to maintain their long-term financial stability have to find innovative solutions. One effective tool for achieving this goal could be the introduction of digital central bank currency.

Keywords: digital central bank money, central bank, cash, digital money, CBDC

Introduction

The rapidly changing societies and the increase of tech giants outside the banking sector, the emergence and popularity of various cryptocurrencies and stablecoins pose new challenges both to commercial and central banks. Electronic payment methods have become increasingly popular among the population, the use of cash has significantly decreased, while the contactless payment have become more popular as a result of COVID- 19 pandemic. The growing demand for financial innovations has led to digital transformation of money. Central banks have to respond to challenges threatening their monetary sovereignty, with one of the main tools being the introduction of digital central bank currency. The main objective of this research is to provide a comprehensive overview of the key challenges in the banking sector and digital transformation of the financial system, as well as the expectations regarding the digital central bank currency; briefly providing and overview about the Hungarian and international trends.

1. Theoretical background

1.1 The "evolution" of money

In economic terms, money serves as a medium of exchange generally accepted by consumers for the exchange of goods and services as well as for repayment of debts. Money is used to facilitate transactions in order to avoid the need for labour and capital resources that would be required if barter were the only form of exchange (Sakiz- Gencer, 2022). Some theories suggest that the origin of money is not rooted in barter, but rather in establishment of the first forms of states, empires and central authorities (Bánfi, 2015; Graeber, 2011).

The evolution and development of money has had a significant impact on the course of history. The initial form of money was the so called commodity money, followed by the introduction of the first

coins around 600 BCE (Balogh et al., 2002). Money has been a catalyst for economic and technological growth since the ancient times.

Money has developed three essential functions: it is used as a medium of exchange, which has an accepted value by its users; it is a unit of account; it can determine the price of the goods and services; money also has a value-preserving function (ECB, 2015).

Due to technological progress and the economic and geopolitical changes in the 17th century, money began to play an increasingly important role internationally. This resulted in monopolization of money issue and establishment of central banks. Central banks became " institutions responsible for issuing the financial tool facilitating the final settlement, while on the other hand, they typically have some public mandate". The primary responsibilities of central banks include ensuring financial stability, maintaining the stability of the currency exchange rates, use expansive and restrictive monetary instruments in order to adapt to the economic trend, as well as ensure monetary sovereignty in the two-tier banking system (Horváth-Horváth, 2021).

In the late 20th century, many countries experienced hyperinflation as a result of the economic instability (Vígh-Mikle, Zsámboki, 1999), a deposit-based (foreign currency-based savings) and carry-trade based (foreign currency used as a medium of exchange) dollarization took place (Geng, Scutaru és Wiegand, 2018). Dollarization weakened the monetary sovereignty of the affected nation states, diminished the authority of central banks, and increased the financial vulnerability (Mecagni et al., 2015).

Over the past 50 years, thanks to technological and digital development, the electronic money (emoney) was created by commercial banks. Additionally, with the rise of BigTech companies and the ongoing wave of innovation, the electronic payment methods and digital currencies, including the cryptocurrencies became widespread. It is increasing the possibility of digital dollarization and loss of the monetary sovereignty (Brunnermeier et al., 2019).

The rise of tech-driven currencies that bypass the banking system pose new challenges to central banks. The money issued by central banks has to be transformed in order to remain competitive and meet the demands of the modern era. One potential solution is the introduction of the digital central bank currency, which will be a significant milestone in the history of money, fundamentally changing the structure and use of the money (Alnasaa et al., 2022).

1.2 Digital central bank money

Digital central bank money (CBDC) is an electronic currency issued by the central bank "a digital form of central bank money that fundamentally differs from traditional central bank money held in nostro and reserve accounts; it qualifies as a digital payment instrument denominated in domestic currency, and represents a direct liability of the central bank" (Fáykiss – Szombati 2021:105).

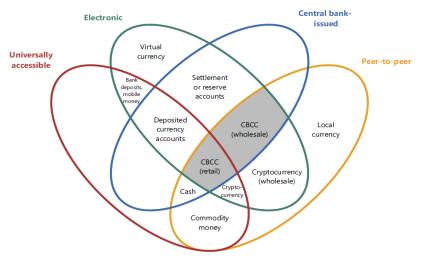


Figure 1. The money flower: a taxonomy of money

Source: Bech & Garratt (2017) Central bank cryptocurrencies (p60)

The main characteristics of the digital central bank money: since the money is issued by the central bank, it is risk-free and digital, which makes it easy and comfortable to use, widespread, can be used for peer-to-peer transactions similarly to cash.

2. Methods and methodology

In terms of research methodology, a multifaceted approach was employed to analyze the challenges confronted by central banks as they adapt to the digital revolution and evolving societal expectations. This approach encompassed the following key elements:

Data Collection:

Literature Review: Information was amassed through a comprehensive review of academic sources, encompassing scholarly articles, reports, and publications. This literature review focused on understanding the ramifications of the digital revolution on financial systems, the evolving role of central banks, and the emergence of digital currencies. The sources referenced in this analysis were publicly available, including government publications, documents from financial institutions, and reports from international organizations.

Data Analysis:

- Thematic Analysis: Thematic analysis was employed to elucidate recurring themes and challenges that were discernible within the extant literature. This approach was instrumental in unveiling common threads and shared complexities discussed in the reviewed literature.
- Case Study Analysis: A case study methodology was implemented, centering on the Digital Student Wallet program, which served as an illustrative pilot project for digital currency in Hungary.

This research undertaking provides a comprehensive picture of the multifaceted challenges facing central banks and the implications of digital central bank currencies. Based on a synthesis of existing academic literature and reports, it will provide a useful starting point for future qualitative research initiatives, such as expert interviews and focus group studies.

3. Results

3.1. Challenges of central banks (meeting social, economic and sustainability expectations)

The digital revolution had an impact on the financial and banking system, as well as the COVID-19 pandemic has accelerated these changes. The purchasing habits of consumer societies have changed, the use of cash has significantly decreased, the use of different forms of electronic payments (e-payments) increased. The banking sector has had to adapt to the changing trend. The disappearance of cash would increase the risk-free value maintenance function of the money (Felcser et al., 2021).

The financial innovations resulted in introduction of virtual money (cryptocurrencies, stablecoins). The tech giants as Facebook, Google or Amazon have built their own ecosystems by development of services provided to their users. These companies are on the verge of introducing their own virtual currencies, referred to as the "Amazonized" financial market (Müller-Kerényi, 2021). The announcement of Facebook's Libra project in 2019 intensified the research into the introduction of digital central bank currency (Auer et al., 2021). The greatest risk of privately issued digital money is that transaction can be conducted without traditional financial intermediaries. The "amazonized" financial market can continuously monitor the consumer habits and preferences, thus to improve the services provided. It can efficiently fulfil consumer needs by enhancing the consumer experience (Brunnermeier et al., 2019).

The rise of digital currencies circulating outside the banking system decreases the importance and functions of central banks. It can reduce or even eliminate the role of central bank in issuing money or influencing the development of exchange rates and interest rates. "The efficiency of transmission mechanism of monetary policy might decrease, since the economic actors will prefer the digital currency as a medium of exchange over the traditional legal tender" (Horváth, Horváth, 2021). There is an increased likelihood that individuals will keep their savings in digital assets and will decrease their bank deposits. As a result of this, the banks might increase the interest rates on loans due to their decreasing profit (Assanmacher, 2020). A complete transition to tech currencies would result in drastic devaluation of national currencies. The increasing inflation would threaten the price stability, and risk the monetary independence of central banks of nation states.

The above challenges exert urgent pressure on central banks. Szalai (2021) suggests the following three reactions for the situation described above:

- Introduction of regulations similar to traditional financial institutions also in the case of alternative virtual currencies, as well as enhancing the existing system to maintain the market share (valid until 2019).
- Introduction of digital central bank currency as an alternative to tech-driven currencies, thereby increasing the efficiency of the banking system. There are several institutional and technical solutions available for implementation.
- Introduction of central bank digital currency, while banning non-bank digital currencies, thus strengthening monetary sovereignty.

3.2. Various challenges of introducing digital central bank currency

3.2.1. Socio-political, social and economic challenges

Numerous international academic works are addressing the issue and the social, economic and political challenges related to the introduction of digital central bank currency. Péter Fáykiss and Anikó Szombati (2021) highlight the following areas for consideration:

- The financial culture and awareness in the society has to be developed; it is necessary to ensure wider access to financial services by development of cheap, uniform and user-friendly system (According to the World Bank survey conducted in 2020, 1/3 of the world's adult population has no access to the basic financial services).
- It is crucial to increase the use of innovative technologies in public administration (automation of processes, management of records and interconnection), which affects the innovation of financial sector as well. The development of new technologies and digital user platforms is important in terms of operational efficiency, as well as important their acceptance and availability in the society.
- Encourage the development of financial services: The development of financial services offered by banks has to be encouraged in order to reduce the current costs of electronic payments and transactions, and provide an immediate settlement on both sides of the transaction. The integration of low-cost and immediate payment system with government agencies would reduce the bureaucratic costs and time spent with administration (e.g. use of smart contracts in real estate transactions, automatic update in land registry entries after the purchase price is settled).

Mitigate crisis situations: Measures have to be taken in order to eliminate crisis situations that could arise due to various reasons (e.g. natural disasters, cyberattacks, operational disruptions, maintenance). It is essential to ensure that the payment system operates cost-effectively and without risk in order to guarantee customer safety.

-Enhance the effectiveness of monetary policy: The efficiency of monetary policy has to be increased, while reducing the prevalence of grey and black economy (illegal financial transactions) and support the economic growth. A considerable aspect is the level of verifiability (anonymity) of transactions made in digital central bank currency, as well as ensuring stability affecting the functionality of the monetary policy and creating an interest rate environment that does not jeopardize the functioning of commercial banks (changing deposits into CBDC, bank panic).

Reduce environmental impact: minimize the costs associated with the issuance and logistics of cash. The development and operation of new system is cost-sensitive. These have to be arranged respecting the principles of sustainability.

3.2.2. Functional expectations

In addition to providing basic monetary functions, the digital central bank currencies have to meet the market requirements, user needs and the central bank expectations (BoE, 2020), presented in the following figure:



Figure 2. Basic expectations regarding a CBDC system

Source: Bank of England (2020): Central bank digital currency opportunities, challenge and design (p22)

3.2.3. Functional requirements

The introduction of digital central bank currency has to meet several technical criteria as well (BIS, 2020):

- -Easy to use, convenient, user-friendly (one-step payment, operate in offline mode, user-friendly for elderly and disabled)
- -Resistant and safe (protection against attacks and phishing, provision of real-time registration system).
 - -Fast and scalable (avoid capacity limit by increasing the number of transactions)
 - -Ensure interoperability with the existing payment infrastructure
 - -Flexible and possible to develop

3.2.4. Bank and system-level risks

The introduction of digital central bank currency will have a significant impact on the operation of commercial banks. The emerging risks largely depend on the financial intermediary actions performed by the issuing central banks (cash replacement, deposit collecting, providing loans) and the level of demand generated by the issue of CBDC, influencing the balance of the bank system and profitability of the sector (Fülöp et al., 2021):

Cash-replacing digital central bank currency: displacing cash with digital central bank currency has a neutral impact on financial stability.

Deposit-collecting central bank: due to withdrawal of deposits from commercial banks, the profitability and liquidity of the banking sector is decreasing, resulting in expensive loans (increase of credit risk), which will result in decrease of investment and provision of loans, thus threatening the economic growth. The central bank has to find a solution that stimulates competition among the commercial banks, while supporting the viability and functioning of the banking system as well as ensuring stability (e.g. introduction of quantitative restrictions).

-Lending central bank: A lending central bank can pose financial stability risks similar to a deposit-collecting central bank, primarily through decreased profitability of commercial banks and increased lending risks. It has to be considered which segment the central bank makes the lending available for.

In order to manage operational and system level risks (new infrastructure, technology and institutions, cyberattacks, bank panic, etc.), the establishment of a new prudential framework and regulatory system, supported by legal regulations and supervisory monitoring becomes vital that might be a further challenge for central banks (Fülöp et al., 2021).

3.3. International practice

The financial innovation driven by modern digitalization, the emergence of various cryptocurrencies that strengthen the disintermediation and the growing power of tech-giants requires urgent steps made by central banks in order to preserve their monetary sovereignty. An efficient tool to address this challenge might be the introduction of the digital central bank currency backed by several international research, testing and pilot program presented in the figure below.

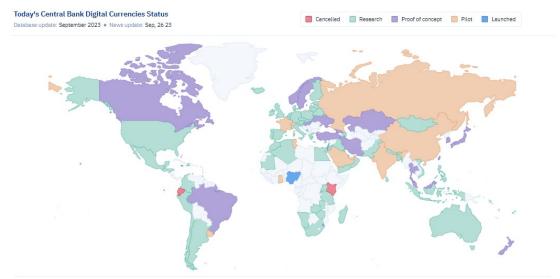


Figure 2. Today's Central Bank Digital Currencies Status **Source:** https://cbdctracker.org/ (Download: 2023.09.26)

The first officially introduced digital central bank currency (CBDC) was launched in the Bahamas under the name "Digital Sand Dollar" (Müller-Kerényi, 2022). The main goal of launching this digital currency was to decrease the difficulties arising from cash distribution between the islands and increase the financial involvement of the population (CBoB, 2019). According to portal cbdctracker.org, digital central bank currency has been officially introduced in Nigeria and Jamaica under the name Naira and JAM-DEX in 2022. In addition, various digital central bank currencies are being tested in China, France, Switzerland, Italy, India, Singapore, South Korea, Ghana, the United Arab Emirates, Saudi Arabia, Tunisia, Uruguay and the Eastern Caribbean Economic and Currency Union.

China deserves special attention among the international digital central bank currency projects. China started to develop the e-renminbi in 2014. They started to test the currency under the name e-CNY (digital yuan) in 2020 in 4 Chinese cities (Goreczky, 2020). The introduction and international popularity of the digital yuan can strengthen the world economic position of China, decreasing the global dominance of the USD.

3.4. Digital central bank currency in Hungary

The Hungarian National Bank (NHB), (the first green mandate central bank in Europe) is committed to sustainability and digital innovations. In addition to practical and theoretical questions, the comprehensive study collection of the Hungarian National Bank (2021), which gained significant attention in international scope, presents the challenges and summarizes the international experience with digital central bank currency.

While analyzing the digital central bank currency in Hungary, Kajdi and Varga (2021) came to conclusion that introduction of digital central bank currency is not urgent in terms of money circulation. Cash usage in Hungary has decreased (still dominant among the population), electronic payment transactions and development of financial services are in progress, the account access to elderly and socially disadvantaged has to be improved. Continuous monitoring is crucial, since certain events may justify the wide-spread introduction of the digital central bank currency. Therefore, the National Bank of Hungary examines the possibilities, conditions, risks and the expected impact of the introduction of the digital central bank currency (Ádor et al., 2021).

The first digital central bank currency pilot project in Hungary started in 2020. It was the Digitális Diákszéf (Digital Student Wallet), developed by the National Bank of Hungary in cooperation with the Pénziránytű Foundation. in 2020. The mobile application on financial education and involvement is primarily targeting the basic school students, allowing them to collect and exchange digital coins by answering quiz questions. The students can also set saving goals. They can redeem their coins for valuable items during the redemption periods. The Digital Student Wallet program is suitable for testing the digital central bank currency. The student tokens can be considered as a form of digital central bank currency, available in a limited and controlled manner (Csonka et al., 2021).

4. Discussion

The research identified a number of challenges that central banks face in the face of the digital revolution and societal change. The digital revolution and the COVID-19 epidemic have changed consumer payment habits, virtual currencies and tech giants have introduced their own digital currencies, creating new challenges. One of the biggest challenges for central banks is that the growing popularity of digital money outside the banking system could jeopardise their role in issuing money and setting monetary policy. Based on our research, we identified three possible responses by central banks: introducing regulations for alternative virtual currencies, introducing a digital central bank currency for a more efficient banking system, and introducing a central bank digital currency by banning non-bank digital currencies, thus strengthening monetary sovereignty. The introduction of a digital central bank currency also raises a number of social, economic and political challenges, such as improving financial culture, encouraging the use of innovative technologies, improving financial services, managing crisis situations, increasing the efficiency of monetary policy and minimising ecological impacts. The introduction will also have a significant impact on commercial banks and will entail various risks that need to be managed. Digital central bank currencies also need to meet a number of functional and technical requirements, including ease of use, resilience and security, speed, scalability, interoperability and upgradeability. The results of the research show that the introduction of a CBDC is a complex process involving many aspects and requiring carefully considered actions by central banks.

Central banks have reached a crossroads as they have to face significant challenges due to technological development and changes of consumer preferences. The introduction of CBDC provides an opportunity for central banks to adapt to these changes while reinforcing their monetary sovereignty and financial stability. However, effectively addressing the challenges listed above is crucial to ensure the successful integration of CBDCs into the global monetary system and utilization of their entire societal and economic potential. Central banks play a key role in shaping the future of money, and CBDCs can be an efficient tool in this regard.

Overall, our research contributes to the existing CBDC research by providing a comprehensive and detailed examination of the challenges and opportunities related to the introduction of digital central bank currencies, taking into account the international and Hungarian context, and also it will provide a useful starting point for future research. In terms of future research directions, it may be worthwhile to conduct further in-depth research in various aspects of introducing digital central bank currencies. It would be interesting to address how does it affect financial inclusion, what impact CBDCs have on liquidity of the financial markets, as well as conduct comparative analysis on implementation and experience with introduction of digital central bank currencies in different countries.

Based on the results and conclusions of this research, the introduction of digital central bank currency can be a strategic step in ensuring the sustainability of the central banks and financial systems, while meeting the societal and economic demands of the digital age.

Funding: Please add: "This research received no external funding" or "This research was funded by NAME OF FUNDER, grant number XXX" and "The APC was funded by XXX". Check carefully that the details given are accurate and use the standard spelling of funding agency names at https://search.crossref.org/funding. Any errors may affect your future funding.

References

- Ádor István Eigen Péter Huszár Zoltán Láda-Hartyáni Zsolt Szécsiné Kardos Szilvia Taczmann Róbert (2021) A digitális jegybankpénz főbb megvalósítási kérdései a működés és infrastruktúra tükrében. Magyar Nemzeti Bank. In: Egy új kor hajnalán Pénz a XXI. században, MNB, 2021. ISBN 978-615-5318-44-3
- Alnasaa, M., Gueorguiev, N., Honda J., Imamoglu, E., Mauro, P., Primus, K., Rozhkov, D., (2022): "Crypto, Corruption, and Capital Controls: Cross-Country Correlations", IMF Working Paper, 2022 ISBN/ISSN:9798400204005/1018-5941, https://www.imf.org/en/Publications/WP/Issues/2022/03/25/Crypto-Corruption-and-Capital-Controls-Cross-Country-Correlations-515676 (Download: 2023.09.02)
- 3. Assenmacher K. (2020): Monetary policy implications of digital currencies. SUERF Policy Note Issue No 165, May 2020 https://www.suerf.org/docx/f_ec9b954aefd15bc4fffe9 2f5683d1dd2_13537_suerf.pdf (Download: 2023.02.02)
- 4. Auer, R. Frost, J. Gambacorta, L. Monnet C. Rice T. Shin, H.S. (2021): Central bank digital currencies: motives, economic implications and the research frontier. BIS Working Papers No 976. https://www.bis.org/publ/work976.pdf (Download: 2023.09.02)
- 5. Balogh András, Hamvai Réka Margit, Horváth Gábor, Nyikes Ádám, Török Gergő (2022): A digitális jegybankpénz átírja a pénzhez való hozzáférést. in.: Új fenntartható közgazdaságtan-Globális vitairat. Szerkesztette: Baksay Gergely, Matolcsy György, Virág Barnabás. Magyar Nemzeti Bank, ISBN 978-615-5318-51-1
- 6. Bánfi Tamás (2015): Pénzügypolitika és pénzelmélet, Cenzus, Budapest, 2015 ISBN 978-963-12-3584-5
- 7. Bank of England (2020): Central bank digital currency opportunities, challenge and design (https://www.bankofengland.co.uk/-/media/boe/files/paper/2020/central-bank-digital-currency-opportunities-challenges-and-design.pdf (Download: 2023.09.02)
- 8. Bech & Garratt (2017): Central bank cryptocurrencies. BIS Quarterly Review, September 2017 https://www.bis.org/publ/qtrpdf/r_qt1709f.pdf) (Download: 2023.09.02)
- 9. BIS (2020): Central bank digital currencies: foundational principles and core features, Report No. 1, October. https://www.bis.org/publ/othp33.pdf (Download: 2023.09.02)
- 10. Brunnermeier M., K. James- H. Landau J. P. (2019): The Digitilazion of Money. NBERWorking Paper No. 26300, National Bureau of Economics Research
- 11. CBDC-Tracker (2023): Today's Central Bank Digital Currencies Status https://cbdctracker.org/ (Download: 2023.09.26)
- 12. CBoB (2019): Central Bank of The Bahamas Annual Report & Statement of Accounts For the Year Ended December 31, 2019 https://www.centralbankbahamas.com/viewPDF/documents/2020-07-09-02-33-21-Annual-Report--Statement-of-Accounts-2019.pdf (Download: 2023.08.02)
- 13. Csonka András Szabolcs, Danóczy Bálint, Sajtos Péter (2021): A lakosság pénzügyi bevonódásának erősítése a digitális jegybankpénz alkalmazásával Lakossági számlavezetés és az ezen túli lehetőségek. Magyar Nemzeti Bank. In: Egy új kor hajnalán Pénz a XXI. században, MNB, 2021. ISBN 978-615-5318-44-3
- 14. European Central Bank (2015): What is money?, https://www.ecb.europa.eu/ecb/educational/explainers/tell-me-more/html/what_is_money.hu.html (Download: 2023.09.02)
- Fáykiss Péter Szombati Anikó (2021): A digitális jegybankpénz koncepcionális keretei. Magyar Nemzeti Bank. In: Egy új kor hajnalán Pénz a XXI. században, MNB, 2021. ISBN 978-615-5318-44-3
- 16. Felcser Dániel Kuti Zsolt Török Gergő (2021): Digitális fordulat a monetáris politikában? A digitális jegybankpénz monetáris politikai vetületei. Magyar Nemzeti Bank. In: Egy új kor hajnalán Pénz a XXI. században, MNB, 2021. ISBN 978-615-5318-44-3

- 17. Fülöp Zénó Szakács János Szomorjai Péter Varga Balázs Zsigó Márton (2021): A digitális jegybankpénz bevezetésének pénzügyi stabilitási szempontjai. Magyar Nemzeti Bank. In: Egy új kor hajnalán Pénz a XXI. században MNB, 2021. ISBN 978-615-5318-44-3
- 18. Geng N. Scutaru T. Wiegand J. (2018): Carry vs. Deposit-Driven Eurozation. IMF Working Paper No. 18/58, International Monetary Fund ISBN/ISSN:9781484345269/1018-5941, https://www.imf.org/en/Publications/WP/Issues/2018/03/15/Carry-Trade-vs-45686 (Download: 2023.09.02)
- 19. Goreczky Péter (2020): Digitális jegybankpénz Kínában a régóta várt áttörés? KKI- elemzések. Külügyi és Külgazdasági Intézet, 2020. ISSN 2416-0148 https://doi.org/10.47683/KKIElemzesek.E-2020.85 (Download: 2023.09.02)
- 20. Graeber, David (2011): Debt: the first 5000 years, Melville House Publishing, 2011, ISBN: 978-1-933633-86-2, https://warwick.ac.uk/fac/arts/english/currentstudents/undergraduate/modules/fulllist/special/statesofdamage/syllabus201516/graeber-debt_the_first_5000_years.pdf (Download: 2023.09.02)
- 21. Horváth Balázs István és Horváth Gábor (2021): Globális készpénz alternatívák és hatásuk a monetáris implementációra in: Egy új kor hajnalán- Pénz a XXI. században, MNB, 2021 https://pubdocs.worldbank.org/en/230281588169110691/Digital-Financial-Services.pdf (Download: 2023.09.02)
- 22. Kajdi László- Varga Lóránt (2021): A digitális jegybankpénz pénzforgalmi hatásai. Magyar Nemzeti Bank. In: Egy új kor hajnalán Pénz a XXI. században, MNB, 2021. ISBN 978-615-5318-44-3
- 23. Mecagni M.- Corrales J. Dridi J. Garcia-Verdu R. Imam P. Matz J. Macario C. Maino R. Mu Y. Moheeput A. Narita F. Pani M. Torres M. R. Weber S. Yehoue E. (2015): Effective De-Dollarization Strategies. In: Dollarization in Sub-Saharan Africa Experience and Lessons, International Monetary Fund, 2015, ISBN: 9781498368476, https://www.elibrary.imf.org/view/journals/087/2015/005/article-A001-en.xml (Download: 2023.09.02)
- 24. MNB (2020): Elérhető az MNB új innovatív kezdeményezése, a Digitális Diákszéf mobilapplikáció in.: https://www.mnb.hu/sajtoszoba/sajtokozlemenyek/2020-evi-sajtokozlemenyek/elerheto-az-mnb-uj-innovativ-kezdemenyezese-a-digitalis-diakszef-mobilapplikacio (Download: 2023.09.02)
- 25. MNB (2021): Egy új kor hajnalán Pénz a XXI. században, Magyar Nemzeti Bank, ISBN 978-615-5318-44-3
- 26. Müller, János és Kerényi, Ádám (2021) Kiútkeresés a digitális pénzügyi innovációk labirintusában A digitális pénzügyi rendszer szabályozási kihívásainak csapdája. Hitelintézeti Szemle / Financial And Economic Review, 20 (1). pp. 103-126
- 27. Sakiz, Burcu Gencer, Ayşen Hiç(2022): "Digital Currencies, Cryptocurrencies and Central Bank Digital Currencies" https://www.avekon.org/papers/2621.pdf_(Download: 2023.09.02)
- 28. Szalai Zoltán (2021): A digitális pénzek pénzelméleti és nemzetközi spillover aspektusai. Magyar Nemzeti Bank. In: Egy új kor hajnalán Pénz a XXI. században, MNB, 2021. ISBN 978-615-5318-44-3
- 29. Vígh-Mikle Sz. Zsámboki B. (1999): A bankrendszer mérlegének denominációs összetétele 1991-1998 között, MNB Füzetek, 1999/9, Magyar Nemzeti Bank
- 30. World Bank (2020): Digital financial services April 2020 Ceyla Pazarbasioglu, Alfonso Garcia Mora, Mahesh Uttamchandani, Harish Natarajan, Erik Feyen, and Mathew Saal

Challenges of the corporate sector in times of turbulent changes - focus on customers

Enikő Korcsmáros 1,*, Renáta Machová 2 and Bence Csinger 3

- ¹ Faculty of Economics and Informatics, J. Selye University, Komárno, Slovakia; <u>korcsmarose@ujs.sk</u>
- ² Faculty of Economics and Informatics, J. Selye University, Komárno, Slovakia; <u>machovar@ujs.sk</u>
- 3 Faculty of Economics and Informatics, J. Selye University, Komárno, Slovakia; csinger.bence@gmail.com
- * Correspondence: korcsmarose@ujs.sk; (Enikő Korcsmáros)

Abstract: (1) Background: Thanks to the effects of the COVID-19 epidemic, the role of customer focus has undoubtedly strengthened both among companies and customers. From the point of view of the companies, it is extremely important to analyze the expectations and satisfaction of the customers in more depth in order to be able to properly correct them and possibly improve their customer focus (2) Methods: We assessed the extent to which the coronavirus epidemic affected the by examining Slovakian and Hungarian companies from different aspects. The formulated hypothesis: By using segmentation ads on Facebook, companies can more easily address potential customers. The survey period lasted from September 2021 to December 2022. During the period a total of 545 fillings were collected. In the case of testing the hypothesis, we used the Somers delta test. (3) Results: In the case of both countries, it can be said that the more attention companies pay to reliability, the easier it is to convince customers to buy the service and/or product. (4) Conclusions: Our results show that companies who believe that it is much more difficult to convince customers after the COVID-19 epidemic want to introduce new marketing tools in the hope that they can encourage them to buy. Changes in individual purchasing habits only make it more difficult for companies to address customers.

Keywords: SME, competitiveness, customer focus

Introduction

The social challenges of the last period, the epidemic, and then the disastrous ones, and at the same time the economy, had a significant impact on the entrepreneurial niche. Due to their adaptation and compliance with consumer needs, the SME sector is heavily involved in this issue. The fact that satisfied, loyal customers can be retained and made to buy again is much easier and more economical than new customers. Thanks to the effects of the COVID-19 epidemic, the role of customer focus has undoubtedly strengthened both among companies and customers. In our opinion, customer focus is key for the company to maximize customer satisfaction. From the point of view of companies, it is extremely important to analyze the expectations and satisfaction of customers more deeply in order to be able to correct them properly and possibly improve their customer focus. To achieve this, customer satisfaction must be continuously monitored, as these analyzes provide valuable information for companies.

1. Theoretical background

According to Belandria (2022, online), the oversupply has pushed the customer into a certain protagonist position, where all the efforts of the companies are already focused on the customer. Companies that actually use customer-oriented operations place the customers' values at the center of the goals to be achieved at all times. Based on this, they try to operate individual departments within the company based on this philosophy.

According to Hemel and Radmakers (2016, online), companies that prioritize becoming customercentric and make every effort to make it happen can reap significant benefits. In their opinion, companies should primarily motivate their employees and give them guidance in order for customers to grow with positive experiences and develop a suitable image of the company and its customer-oriented methods.

For companies following a customer-centric approach, it is crucial to make sure that they can create the best value for customers under the circumstances. Based on Hughes et al., (2014, online), it is worth focusing on those simple, yet bold approaches that tangibly reinforce the key messages formulated by the company and intended to be advertised, which contribute to customer focus. Based on the results of the authors, it is primarily important to map the current level of the company's customer focus, thanks to which they can get a more comprehensive picture of what tools are used to contribute to the achievement of customer focus. In addition, it can be rewarding to document and carefully follow the customer life cycle from beginning to end, as this provides companies with key information regarding the customer experience. In connection with this, performing the so-called deep research analysis can have a positive effect, since the company can draw conclusions from the data derived from them, which can result in appropriate decisions. Finally, both short-term and long-term developments must be taken into account, so that companies can concentrate on achieving customer focus. According to Ulwick (2015, online), becoming a customer-centric company is not easy, but it is not impossible either. The main goal is not for every employee to be a customer-centric expert, but rather for them to understand and draw appropriate conclusions from the right customer data. To achieve this, companies need to start customer-focused research processes that enable the collection of unique information about their customers, which they can use for future value creation.

Before describing sales promotion tools, we thought it important to define the concept itself. Kotler (1988) defined sales promotion as increasing the intention to buy by influencing consumer behavior quickly and primarily in the short term. Given their short-term impact, they can lead to a significant drop in revenue, as customers will not be interested in purchasing after the promotional period. It is also an important fact that sales promotion can be effective mainly in association with advertising or personal selling, since in order for people to buy, it is first necessary to introduce them to the company and the possibilities (Lőrincz et. al., 2017; Sánta – Baša – Wágner, 2022, online). Sales promotion activities have become an essential part of modern marketing practice. One of the main reasons for this is the rapidly developing industries and the huge international market competition. As a result, companies use more and more sales promotion activities, with which they not only encourage customers, but also compete with other companies. In the absence of quality, no product can remain on the market for a long time, but without promotional activities, no matter how high-quality the goods are, they cannot effectively arouse the interest of consumers. It is important to note that sales incentives not only recruit new customers, but also help existing customers become loyal and encourage repeat purchases. Entrepreneurs' belief that their firm will survive in the medium term has a significant impact on the area of business ethics (Belas – Rahman, 2023)

The motivational factors for sales can be classified into two groups based on the advantage they serve. Among the utilitarian advantages is the low price, but consumer motivations are extremely different, which is why it is important to mention other influencing factors as well. One of the most popular aspects is savings, so, for example, the consumer can buy more goods for the same amount within the framework of a promotion than without. For many customers, the main expectation is to find the most suitable product or service easily and in a time-saving manner. The other three incentives form the group of hedonic benefits. These include the consumer's insight, the satisfaction and joy of discovery, and the experience of entertainment. These can be triggered by buying an expensive product on sale, getting to know a new product that was previously unknown to the customer after purchase, and the pleasure of participating in sweepstakes (Chandon–Wansink–Laurent, 2000, online).

Based on their type, we now know a lot of promotions. The most well-known of them are the following: discount, coupon, refund, gift, product sample, lottery prize campaign, competition (Gyulavári–Agárdi, 2013). Examining the incentive effect of promotions, the researchers realized that their effect can be different in different cultural environments. Based on demographic characteristics and consumer habits, people react differently to individual promotions. Research shows that consumers often have a more positive attitude toward sales incentives that include monetary incentives, such as coupons, discounts, or rebates. Despite the fact that both offline and online tools can be effective, they do not provide a long-term sustainable competitive advantage, and they can only increase the performance of brands and companies in the short term. Based on these, companies should definitely conduct research on which technique can best influence the market and generate sales in the country and environment where they conduct their business (Fam et. al., 2019, online). Thanks to the rapid development

of digitalization and online commerce, there are many opportunities for companies to use new tools. Live chat and chatbots used on websites can provide quick help to potential customers, thereby reducing website abandonment (Mclean–Osei-Frimpong, 2017, online). By using the chat interface, the customer can feel important and valuable, thereby encouraging them to buy. Also, customers often want to belong to a community of people with similar interests. Based on this, the customer can be offered club membership, the advantage of which is that members are constantly informed about new products and services and receive discounts, which can increase their brand loyalty (Kusumawati–Kumadji–Azizah, 2016, online). Upsell is also one of the most well-known techniques. It is characterized by the fact that during the sales activity, the seller offers the customer a higher value product or service instead of the previously selected product or service. The essence of the technique is that the seller lists advantages that make the customer think it is worth it and is willing to pay the higher amount (Lőrincz et. al., 2017).

It is an interesting option to subscribe to a regularly purchased product with a specific company, as the company notifies the customer at predetermined intervals, so it is easier to avoid running out of the product before purchasing it again. The extra service makes you feel special while you are committed to the company. It can generally be said that before someone decides to make a purchase that is more expensive than their financial background, they like to make sure that the company they are buying from is reliable and that the product or service is of high quality, or at least the price-value ratio is adequate. To this end, it is worth giving customers the opportunity to express their opinions on various platforms, which can even be constructive. Sending a thank-you e-mail, in which you can ask for an evaluation of the purchase, is an effective tool after the purchase. Thanks to the feedback, the company can pay attention to possible shortcomings in the future and raise the customer experience to a higher quality.

Promotions can generally be said that the more interesting they are, the more customers they can convince to buy. That is why sales promotion is closely related to impulse buying. The impulse behavior of individuals is influenced by the possibility and desire to satisfy needs. A sudden, unplanned purchase is much more likely to happen if the customer can buy the desired product or service with some kind of promotional tool. Promotions give them motivation that triggers immediate action, in this case a purchase. Individuals are motivated to buy things that appeal to them, and as a result, it is often difficult to resist the urge to buy goods, so potential negative consequences are often ignored (Kempa-Vebrian-Bendjeroua, 2019, online). Sales promotion is also important from the consumer's point of view, as it can enable consumers to strengthen their personal values, as they often manage to buy the product or service they previously desired with the help of promotional tools. The effectiveness of sales promotion techniques can be influenced by the customers' rationality, consideration of the price-value ratio, the perception of the advantages and disadvantages of the purchase, as well as the perception of the product, i.e. the packaging, the appearance, but also many other factors. A rational consumer is more likely to compare the quality and price of products before purchase, and therefore, with appropriate promotion, is more likely to be willing to pay a higher amount for better quality (Antunes-Martinez-Martinez, 2022, online). Although this type of technique proves to be effective in the short term, by increasing the frequency of their use, the conscious consumer remembers the company and the brand and will visit them on their own in the future. (Kopcsay, 2013).

2. Methods and methodology

The survey period lasted from September 2021 to December 2022. During the collection of responses, a total of 545 responses were collected, the distribution of which between the two countries was as follows: The proportion of Hungarian companies was 45.5% (248 responses), and that of Slovakian companies was 54.50% (297 responses).

In order to be able to strengthen the obtained results, we performed a representativeness calculation. In view of the sample size, it is important to note that our research cannot be said to be representative. During the calculation, we used the following formula:

$$n = \frac{N*Z^2*p*(1-p)}{(N-1)*e^2+Z^2*p*(1-p)}$$

Where N= the total population, which according to the data of the Slovak Statistical Office and the Central Statistical Office is 1,335,102 companies, at a 95% confidence interval the critical value of Z is 1.96, P= expected frequency participation is 40%, and the limit d= 5%. After the calculation, we can find out that a total of 385 respondents are needed to be able to strengthen our results. After the survey period, 545 responses were collected, which confirms the results.

In the course of our research, we used questionnaires to assess the extent to which the coronavirus epidemic affected Slovakian and Hungarian companies from different aspects. During our practical part, we presented the sample using various descriptive statistical tools, and then applied statistical tests to examine the hypotheses we formulated.

The examination of the hypotheses we set up was carried out broken down into separate countries. The formulated hypothesis: By taking advantage of segmentation ads on Facebook, companies can more easily address potential customers.

H0: There is no significant relationship between Facebook segmentation ads and potential customers.

H1: A significant relationship can be demonstrated between Facebook segmentation ads and potential customers.

Our study can be classified as a descriptive research strategy, during which we used the single-cross-sectional research method, because we took a single sample from the basic population, and then collected information from it. It is also necessary to take into account the disadvantage of the research method, that cause-and-effect relationships cannot be revealed during the analyses. Within the quantitative research method, we use the questionnaire research option, which we sent in the form of e-mail to the companies included in the database we collected, and we also made our questionnaires available in various online groups. The survey period lasted from September 2021 to December 2022. During the collection of responses, a total of 545 responses were collected, the distribution of which between the two countries was as follows: The proportion of Hungarian companies was 45.5% (248 responses), and that of Slovakian companies was 54.50% (297 responses).

In the case of testing the hypothesis, we used the Somers delta test, which requires one condition to be fulfilled for its correct use. It is necessary to have an ordinal dependent and independent variable, which is fulfilled in our case.

3. Results

In the following figure, we looked at whether companies with a website pay an external individual for its maintenance, which we broke down according to company size and countries.

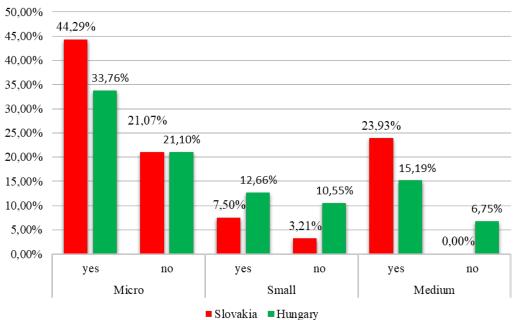


Figure 1. External application for website maintenance broken down by company size and country

Source: own editing based on primary data collection by Marča and Korcsmáros

Based on the 1. Figure, we can say that 44.29% of micro-enterprises operating in Slovakia participating in the survey pay an external party for website maintenance, while 33.76% of those operating in Hungary do the same. In contrast, Slovakian medium-sized companies pay a 23.93% share of external employees, while Hungarian companies do the same in 15.19%. In contrast, 21.07% of Slovakian microenterprises do not pay external employees, while 21.10% of Hungarian ones do. Creating a website can be expensive in many cases, and the subsequent maintenance can also be burdensome for companies operating with smaller budgets, so it may be worth considering the use of free interfaces, thanks to which these costs can be significantly reduced or even completely zeroed out. Free or low-cost content management systems include Wix, Weebly, and WordPress. Using these systems, the user can create a website and update the content continuously for free or for a very small fee, which usually means 5-8 euros per month.

To examine the hypothesis of our research, we performed a Somers'd test, the results of which are presented in the next section. During the investigation, we performed the asymmetric version of the Somers'd test. Table 1 shows the test results.

Table 1. Somers'd test

			Value	Sig	Value	Sig
			SK	SK.	HU	HU.
Variables	Somers' d	Symmetric value	0.399	0.000	0.417	0.000
		Segmentation ads	0.370	0.000	0.402	0.000
		Acquisition of po-	0.405	0.000	0.434	0.000
		tential customers				

Source: primary data collection based on Marča - Korcsmáros, own editing in SPSS software

In the case of Slovakia, it can be said that a Somers'd test was performed to examine whether there is a relationship between the use of segmentation ads and the acquisition of potential customers. Based on the results, it can be said that there is a moderately strong, positive correlation between the investigated variables, which was also statistically significant (d= 0.405, p < 0.001). On the other hand, in the case of Hungary, it can also be said that a moderately strong, positive correlation can be shown between the examined variables, which was also statistically significant (d= 0.434, p < 0.001).

Referring to the results of the hypothesis test, it can be said in the case of both countries that the more attention companies pay to reliability, the easier it is to convince customers to buy the service and/or product. We compared our research results with the results of other international studies in order to get a more comprehensive picture of the individual results. Based on the quantitative approach study by Ngaliman - Giofani - Suharto (2019, online), in which a questionnaire survey was also used, we can learn that reliability has a direct impact on customer satisfaction. The research focused mostly on service-providing companies, which also shows that if the companies are able to provide a little more than the promised service, then the chance that customers will evaluate the service used more positively will be much higher. Thinking about this further, referring to the empirical results of Seres Huszárik and Józsa (2017, online), it can be stated that the provision of higher quality service makes customers much happier and more satisfied. In our opinion, if the given customer base is more satisfied; it is much easier for the given company to persuade existing customers who are already satisfied to buy again. Referring to the thought process of Tóth, Józsa, Seres Huszárik and Kim-Shyan (2022, online), companies usually focus on newly acquired customers, but it would be necessary to pay the same amount of attention to retained customers as well. To achieve this, it is clearly necessary to use the tools and opportunities provided by modern technology. This clearly includes approaches such as "Machine Learning" and "Big Data Analysis". We believe that data is clearly an integral part of our everyday life, with the analysis and research of which we can get a deeper and more accurate insight into our possible business questions, and the operation of the given company can be steered much more towards datadriven decision-making. Of course, it is important to keep in mind that micro and small businesses do not necessarily have a budget that would allow the employment of a data analyst. However, in those cases where it is possible, it would definitely be necessary to use it, because thanks to it the plans can be improved and the set goals can be achieved more efficiently.

4. Discussion

Our statistical analyzes revealed that Slovakian companies that experienced a critical situation during the COVID-19 period will pay more attention to remobilizing existing customers. In our opinion, one of the most cost-effective ways to generate income is clearly to retain existing customers and reactivate them. Thanks to customer retention, we can increase the number of repeat sales as well as the income levels. According to Tóbiás Kosár, Gódány and Szabó (2015, online), companies need to use different indicators and measurement tools in order to get a more comprehensive picture of customer retention. This includes the retention rate, based on which a 5% customer retention rate can result in a profit increase of up to 95%. Small-scale businesses can achieve a more cost-effective customer retention rate with opportunities such as community building, according to which many companies can become a pillar of the given neighborhood and become an integral part of the community, which will result in a fruitful relationship as a result. Another important factor that small companies can use to their advantage in customer retention is fast response time. If a disappointed customer receives a quick solution or an answer to the given problem, there is also a chance to increase satisfaction.

5. Conclusions

Our results also reveal that companies that believe that it will be much more difficult to convince customers after the COVID-19 epidemic want to introduce new marketing tools in the hope that they can encourage them to buy. COVID-19 has clearly changed both shopping habits and demand. In these times, online shopping, impulse waiting, hoarding, panic buying, compulsive buying, patriotism, and environmental protection factors came to the fore. Changes in individual purchasing habits only make it more difficult for companies to reach customers. In such cases, it may be worthwhile to introduce new tools to achieve this. Based on the study by Kovács, Poór, Šeben and Szretykó (2021, online), the COVID-19 period offered both marketers and marketing researchers the opportunity to study both the temporary and lasting effects of the epidemic on consumer behavior. By studying this, it is easier to decide on the future marketing strategy as well as the newly introduced tools. In the post-pandemic period, emphasizing the company's values is more important than ever before. In the event that the company's values are largely in line with the customers' values, it is definitely worth conveying it clearly and comprehensibly. The author's opinion can also be reflected in community building, because according to him, its existence will also play a key role in reaching and retaining customers in the future.

In any case, it may be worth paying a lot of attention to the analysis of the feedback and its evaluation. In our opinion, companies with a customer-centric approach may consider using the following tools:

- 1. Customer expression score, the English equivalent of which is the Customer Effort Score, or CES. This metric gives us information about how much effort the customer has to make to complete a given transaction. This tool is usually used in post-purchase questionnaire surveys, during which the company asks customers to evaluate the difficulty of the purchase using a Likert scale. After data collection, the value is obtained by dividing the number of positive responses by the total number of responses and then multiplying this by 100.
- 2. Customer satisfaction score, the English equivalent of which is the Customer Satisfaction Score. By using this indicator, we can easily find out how satisfied the customers are. The relevant data can also be measured with a Likert-scale solution, and thanks to data-driven decision-making based on the data derived from it, companies can even reduce the attrition rate and increase the positive shopping experience. The simplest calculation of the indicator takes place by calculating the number of customers, who are satisfied with the company, then dividing this by the total number of customers and multiplying this by 100. The value that is considered good varies from area to area, so it may be worth keeping the current benchmarks in mind.

Funding: This research was funded by the grand VEGA 1/0070/23 - Examining the effects of the uncertain economic environment of small and medium-sized enterprises on new work organization processes

References

- Antunes, I., Martinez, L. M. & Martinez, L. F. (2022) The effectiveness of sales promotion techniques on the millennial consumers' buying behavior. *Revista Brasileira de Marketing*. vol, 21. no, 3. https://doi.org/10.5585/re-mark.v21i3.19997
- 2. Belandria, J. (2022) What is customer orientation and why is it important for your company? *TechBlog*. [online] https://www.gb-advisors.com/what-is-customer-orientation-and-why-is-it-important-for-your-company/.
- 3. Belas, J. & Rahman, A. (2023) Financial management of the company. Are there differences of opinion between owners and managers in the SME segment? *Journal of Business Sector*. Vol.1. No. 1 https://www.ecesr.eu/files/ugd/a7cf91 bcd75a71d2cb4142ad8d3c085be11254.pdf
- 4. Chandon, P., Wansink, B. & Laurent, G. (2019) A Benefit Congruency Framework of Sales Promotion Effectiveness. *Journal of Marketing*. vol, 64. No, 4. https://doi.org/10.1509/jmkg.64.4.65.18071
- 5. Fam, K. et al. (2019) Consumer attitude towards sales promotion techniques: a multi-country study. Asia *Pacific Journal of Marketing and Logistics*. Vol 31, No 2. https://doi.org/10.1108/APJML-01-2018-0005
- 6. Gyulavári, T. & Agárdi, I. (2013) Értékesítésösztönzés. In Horváth Dóra–Bauer András (szerk.) *Marketingkom-munikáció*. Akadémiai Kiadó, 231–242.
- 7. Hemel, C. V. D. & Rademakers, M. (2016) Building Customer-centric Organizations: Shaping Factors and Barriers. *Journal of Creating Value.*, vol. 2, no. 2 https://doi.org/10.1177/2394964316647822
- 8. Hughes, C. et al. Customercentricity Embedding it into your organisation's DNA. *Deloitte Leading Business Advisers*. https://www2.deloitte.com/content/dam/Deloitte/ie/Documents/Strategy/2014 customer centricity deloitte ireland.pdf
- 9. Kovács, Á., Poór, J., Šeben, Z. & Szretykó, Gy. (2021) A koronavírus-válság hatása a munkaerőpiacra és a humán erőforrásokra In: Makkos, A. & Kecskés, P. (ed.) Kizökkent világ szokatlan és különleges élethelyzetek: a nemkonvenciális, nem "normális", nem kiszámítható jelenségek korszaka, ISBN 978-615-5837-91-3, pp. 134-144
- Kempa, S., Verbian, K. & Bendjeroua, H. (2020) Sales Promotion, Hedonic Shopping Value, and Impulse Buying on Online Consumer Websites. SHS Web Conferences. vol, 76. https://doi.org/10.1051/shsconf/20207601052
- 11. Kopcsay, L. (2013) A marketingcsatorna menedzselése. Akadémiai Kiadó. 264 p. ISBN 978 963 05 9763 0
- 12. Kotler, P. Marketing management analysis, planning, implementation, and control 6th ed. Englewood Cliffs, NJ. 1988. 777 p. ISBN 0135561507
- 13. Kusumawati, A., Kumadji, S. & Azizah, D. F. (2022) Community Based Marketing and Customer Live Time Value: An Analysis on Their Potential for Improving the Economy of East Java Province. *International Journal of Social and Local Economic Governance*. vol, 2. no, 1. https://doi.org/10.21776/ub.ijleg.2016.002.01.10
- 14. Lőrincz, K. et al. (2017) Turizmusmarketing. Akadémiai Kiadó, Budapest, 360 p. ISBN 978 963 454 060 1
- 15. Mclean, G. & Frimpong, K. O. (2017) Examining satisfaction with the experience during a live chat service encounter- implications for website providers. *Computers in Human Behavior*. vol., 76. https://doi.org/10.1016/j.chb.2017.08.005
- 16. Ngoma, M. & Ntale, P. D. (2019) Word of mouth communication: A mediator of relationship marketing and customer loyalty. *Cogent Business & Management*. vol, 6. no, 1. https://doi.org/10.1080/23311975.2019.1580123
- 17. Sánta, K., Baša, P. & Wágner, E. (2022) A Lewin-féle vezetési stílusok és a munkavállalói elégedettség kapcsolatának elemzése. 13th International Conference of J. Selye University, https://doi.org/10.36007/4119.2022.53
- 18. Seres Huszárik, E. & Józsa, L. (2017) Ügyfélcsoportok az életgörbe együttműködési fázisában, Bukor, J. (ed.) Zborník medzinárodnej vedeckej konferencie Univerzity J. Selyeho 2017: "Hodnota, kvalita a konkurencieschopnosť výzvy 21. storočia" Sekcia ekonomických vied, ISBN 978-80-8122-225-2, pp. 433-441
- 19. Tóbiás Kosár, S., Gódány, Zs. & Szabó, T. (2015) Culture and Knowledge Management in Organizations in Slovakia Nijkamp, P. (ed.) 5th Central European Conference in Regional Science. Conference proceedings. ISBN 978-80-553-2015-1, pp. 1063-1073
- 20. Tóth, Zs., Józsa, L., Seres Huszárik, E. & Fam, K. S. (2022) Business culture and behavioral characteristics. *Acta Polytechnica Hungarica* Vol. 19, No. 7, pp. 69-86 https://doi.org/10.12700/APH.19.7.2022.7.4
- 21. Ulwick, A. W. (2015) Blueprint for Building a Customer-Centric Culture of Innovation. <u>Strategyn. https://strategyn.com/wp-content/uploads/2019/10/Blueprint-for-Building-a-Customer-Centric-Culture-of-Innovation-Strategyn.pdf</u>

Intellectual Property Rights in the Knowledge Economy: Critical Issues and Potential Solutions

Helena Majduchová 1,* and Daniela Rybárová 2

- ¹ University of Economics in Bratislava, Faculty of Business Management, Slovakia; helena.majduchova@euba.sk
- University of Economics in Bratislava, Faculty of Business Management, Slovakia; daniela.rybaroval@euba.sk
- * Correspondence: helena.majduchova@euba.sk

Abstract: This article aims to provide a comprehensive analysis of the robustness and utilization of intellectual property rights (IPR) in various countries, with a particular focus on Central and Eastern Europe. Utilizing a multimethodological approach, the study employs quantitative analysis through the Intellectual Property Rights Index (IPRI), comparative methods across countries, and descriptive and interpretative analyses. The article also synthesizes data from multiple sources, including reports, indices, and academic studies. The findings indicate that while the robustness of IPR is increasing in the analyzed countries, its utilization in the entrepreneurial sphere lags behind. The article reveals a positive relationship between the management of IPR and the increasing quality of human capital on one hand, and the performance of entrepreneurial entities on the other. However, the overall IPRI score has been declining for five consecutive years, indicating a decrease in the availability and utility of IPR for businesses. The article identifies several challenges, such as the weak research activities in the private sector, insufficient financial support for science and research, and a lack of effective legal systems for IPR enforcement. It also highlights the need for a balanced approach between strong IPR protection and public awareness of innovations. The article concludes with an academic discussion, integrating the findings into broader theoretical and practical contexts. It calls for more effective legal systems and public-private partnerships to enhance the utility of IPR, thereby contributing to economic development and innovation.

Keywords: intellectual property rights; IPR protection; performance of entrepreneurial entities

Introduction

In the era of the knowledge economy, the importance of intellectual property rights is continually increasing. While the registration of these rights is undoubtedly crucial, their utilization is even more significant in terms of their impact on economic performance. The use of intellectual property rights positively influences economic growth and creates economic incentives for research and innovation (O'Mahony & Vecchi, 2009; Marrocu et al., 2011). Intellectual Property (IP), as an intangible asset of a business, shares many similarities with tangible assets. It is the result of investment activities, offers economic benefits, is identifiable, transferable, and its value can be determined. According to the World Intellectual Property Organization (WIPO), intellectual property encompasses creations of the human mind—inventions, patented products, literary works, and other artistic works, as well as symbols, names, images, and designs intended for commercial purposes. Intellectual property is divided into two main areas. One is industrial property, which includes inventions, new products with or without patents, trademarks, and industrial designs or models. On the other hand, copyrights cover literary and artistic works, including novels, poems, plays, films, musical compositions, artistic artifacts, paintings, photographs, sculptures, and architectural designs.

1. Theoretical background

As we have already mentioned, mere ideas and thoughts are insufficient; they need to be given a business dimension. The set of activities aimed at implementing innovations can be defined as innovative entrepreneurship. A significant tool for its realization is technology transfer. This is a complex process involving the transfer of scientific knowledge, inventions, discoveries, and expertise generated

through research and development activities into practical economic applications. Knowledge should also be openly available (Bonnet & Teuteberg, 2023); therefore, intellectual property law is fundamentally about finding the right balance between the interests of authors (protection, enforcement, monetization) and the interests of users (usage, access). The main phase of this process is the protection of intellectual property, followed by its commercialization (Grimaldi, Cricelli, & Rogo, 2018; Rivette & Kline, 2000; Ziegler et al, 2013).

It is not the size of the portfolio or the number of intellectual property rights in a given enterprise that matters, but rather its ability to manage and administer them effectively (Somaya, 2016). The management of intellectual property rights, particularly patents, is positively and significantly related to multiple dimensions of firm performance (Somaya, 2012). However, awareness of patent management within firms is still rare, leading to ineffective management of these assets (Soranzo, Nosella, & Filippini, 2017). Even when some form of intellectual property management exists within firms, it seldom has a strategic dimension (Fisher & Oberholzer-Gee, 2013). This may be due to the fact that research institutions, which generate a certain type of intellectual property, focus primarily on its creation and protection rather than its management (Fishman, 2010). Issues related to intellectual property within firms are too often left to the legal department, which has different tasks and expertise than managers (Fisher & Oberholzer-Gee, 2013). From this, it can be concluded that in sectors rich in intellectual property, both legal and managerial expertise are crucial (Grzegorczyk, 2020).

A report by the European Union Intellectual Property Office (EUIPO, 2021), published in 2021, confirmed a positive relationship between owning various types of intellectual property rights and a company's economic performance. Specifically, the report stated, 'In the case of SMEs, the revenue per employee of IPR owners is 68% higher than that of non-owners.' The published analysis was based on data from more than 127,000 enterprises across all European Union member states. The study emphasized that mere ownership of intellectual property rights does not directly influence a company's economic performance. Instead, it may signal a greater ability to succeed in the innovation process and, consequently, in competitive markets. Another report (EUIPO, 2022) corroborated that 'IPR-intensive industries are more productive than industries not using IPR intensively.' In other words, simply registering intellectual property rights is not sufficient to trigger a company's economic growth. What is crucial is how the company can utilize these rights, integrate them into its production process, and effectively capitalize on them. Only then can a company expect a return on investment in its intangible assets and, based on quality, registered intellectual property rights, formulate its innovative strategy. In the case of SMEs, open innovation is particularly important, i.e., sharing external knowledge in collaboration with other companies, research and technology centers, and universities.

The aim of our contribution is to characterize and evaluate the level of utilization of intellectual property rights in selected Central European countries, based on an internal analysis of data from the International Property Rights (IPR). We consider this factor to be a fundamental prerequisite for the effective utilization of intellectual property rights and their positive impact on a country's economic performance. We focused on the V4 countries (Czech Republic, Hungary, Poland, and Slovakia). In addition to these countries, we also included Slovenia, a country that, like the V4 nations, has undergone a transformational process. We also included Austria, which is geographically and size-wise comparable to the selected countries.

The International Property Rights Index (IPRI) provides a comprehensive view of the state of property rights in individual countries around the world. It operates on the premise that property rights are the foundation for a free society that shapes its own civil and social life. The index consists of three components (de Solo Fellow, 2022):

- Legal and Political Environment (LP)
- Physical Property Rights (PPR)
- Intellectual Property Rights (IPR)

To fulfill the objective of our contribution, we focused specifically on the last component, namely Intellectual Property Rights (IPR). This is a component that has a significant impact on the socio-economic development of a country and reflects the level of its innovative potential.

Intellectual Property Rights assess the protection of this type of property through the following sub-components (Table 1):

IPR sub-components	Data source
Protection of Intellec-	Global Competitiveness Report
tual Property Rights	https://www.weforum.org/reports/ global-competitiveness-report-2019
Patent Protection	Patent Index
	https:// www.propertyrightsalliance.org/wp-content/uploads/Trademarks-and-Patent-Index.pdf
Trademark Protection	Trademark index
	https:// www.propertyrightsalliance.org/wp-content/uploads/Trademarks-and-Patent-Index.pdf
Copyright Protection	BSA Global Software Survey; The Compliance
	https://www.bsa.org/~/media/Files/Stud-iesDown-load/2018_BSA_GSS_Report_en.pdf

Table 1. Four Intellectual Property Rights components and data courses included in the analysis

Source: Own processing according to (de Solo Fellow, 2022)

An internal analysis of the individual components of the International Property Rights Index (IPRI) allows for the evaluation not only of the state of intellectual property rights in a selected set of countries but also of the strength of these rights in each country's national legislation, highlighting critical areas in their utilization. In the following section of our contribution, we analyze the individual components of IPRI.

IPRI monitors 129 countries, representing 93.91% of the global population and 98.12% of global GDP, with an average score of 5.19 (max. 8.17; min. 1.77). This score has been deteriorating for the fifth consecutive year. When adjusted for population size, the IPRI score drops to 5.12, indicating difficulties for the vast majority of people in accessing property rights protection and their utilization (de Solo Fellow, 2022).

As the IPRI's final report states: 'The results consistently suggest that countries with high IPRI scores and its components also have high income and high levels of development, pointing to a positive relationship between a robust system of property rights and the quality of people's lives.' The findings underscore the significance of the property rights system and its association with the best performances and processes of individual societies.

2. Methods and methodology

This study aims to provide a comprehensive analysis of the robustness and utilization of intellectual property rights (IPR) in various countries, with a particular focus on Central and Eastern Europe. In the context of the stated objective, the study presented in the article is based on quantitative analysis (Miyashita et al, 2020; Nurani et al, 2021), which involves the collection and interpretation of numerical data. This approach is evident from the use of indicators and scores, such as the IPR (Intellectual Property Rights). A comparative method was used to compare selected countries (Virchenko et al, 2021) based on specific metrics and indicators. This approach is useful for identifying patterns or trends that would not be apparent when examining individual countries in isolation. The article used descriptive elements that characterize the state of affairs in different countries. This approach is fundamental for understanding the context and conditions in which the analyzed countries operate. To interpret the gathered data and explain its significance, the authors used interpretive analysis. The article also contains normative elements where the authors evaluate the situation and suggest what should be considered as "better" or "worse" in the context of intellectual property and innovation.

The article is based on a broad range of sources, including studies, reports, and indices (Svishchova, 2022). This approach allows for a more comprehensive understanding of the issue at hand. In the concluding section, the article transitions into academic discourse, aiming to integrate the findings into a broader theoretical and practical context.

These methods and approaches collectively contribute to the scientific rigor of the article and enable a comprehensive understanding of intellectual property issues in various countries.

3. Results

In this section of our contribution, we will focus on the internal analysis of the individual components of the International Property Rights (IPR) as one of the components of IPRI.

3.1. Global Competitiveness Index 4.0. (GCI)

The Global Competitiveness Index (GCI) evaluates countries based on their competitiveness, drawing its parameters from both official statistics (e.g., Eurostat, international organizations, academic institutions, and non-governmental organizations) and surveys of opinions from leading executives of the World Economic Forum. GCI examines 103 indicators, which are divided into 13 pillars. Approximately 30% of the indicators are derived from surveys of around 15,000 business leaders and 150 partner institutions. The GCI identifies and evaluates factors that are crucial for economic growth and the improvement of the quality of human life. It operates on the premise that all economies are interconnected and mutually influential, indicating the necessity to promote systemic thinking and approaches. Only in this way can global challenges be addressed with an emphasis on the creation and implementation of holistic solutions and strategies. GCI also does not shy away from visionary topics, based on the assumption that only a combination of economic growth, equality, and sustainability can be successful in addressing the socio-economic policies of all countries worldwide. Currently, GCI data is available for the year 2019.

Out of the 12 pillars that GCI monitors, for the purposes of our article, we have selected an indicator from Pillar 1 focused on the protection of intellectual property and Pillar 12, which monitors innovation capability (Table 2).

The intellectual property protection indicator from Pillar 1 is aimed at tracking the extent of protection for intellectual property rights, including financial assets, on a scale from 1 (not at all) to 7 (to a great extent).

Pillar 12 focuses on examining a country's innovation capability and tracks the following themes:

- Indicator 12.01: Workforce Diversity, considering factors such as ethnicity, religion, sexual orientation, and gender.
- Indicator 12.02: Cluster Development, examining the geographical concentration of firms, suppliers, substitute products, and specialized institutions in a given area.
- Indicator 12.03: International Joint Inventions, measured by the number of joint patent applications
 per million inhabitants. These must be filed by at least one co-inventor based abroad and submitted
 to one of the five major intellectual property offices in the world (European Patent Office, Japanese
 Patent Office, Korean Patent Office, Chinese Patent Office, and the United States Patent and Trademark Office).
- Indicator 12.04: Multi-Stakeholder Collaboration, which explores cooperation among employees in sharing ideas and inventions, as well as collaboration between businesses and universities in research.
- Indicator 12.05: Scientific Publications, examining the number of publications and citations in published works. Only articles, reviews, and conference papers primarily indexed in Scopus are counted.
- Indicator 12.06: Patent Applications, measured as the sum of patent applications filed in at least two of the five major intellectual property offices in the world, per million inhabitants.
- Indicator 12.07: Research and Development Expenditure, at both operational and capital levels, regardless of the type of ownership (public or private). Research includes both basic and applied research, as well as experimental development.
- Indicator 12.08: Importance of Research Institutions. The score is calculated as the sum of the inverse values of all research institutions in the country that are included in the Scimago Institutions Rankings (SIR). This encompasses a broad spectrum of research institutions, from universities to government agencies, business entities, and laboratories.
- Indicator 12.09: Buyer Sophistication, which tracks the decisive motivation for consumer purchases (1= lowest price; 7= sophisticated performance of decisive attributes).
- Indicator 12.10: Trademark Registration Applications, tracking the number of international trademark applications per million inhabitants

Table 2. The Global Competitiveness Index (GCI) for 1st pillar (sub-components 1.14 and 1.15) and 12th pillar in selected countries for 2019

		Austria	tria	Czech R	Czech Republic	Hun	Hungary	Pol	Poland	Slovak	Slovak republic	Slovenia	enia
		value	Score	value	Score	value	Score	value	Score	value	Score	value	Score
poradie	poradie Index Component												
1st pilla	1st pillar: Institutions (0-100)												
	Property rights (0-100)	x	81,5	x	70,3	x	62,5	x	9'55	х	8'29	x	2'99
1.14	property rights 1-7 (best)	6,2	86,2	4,7	62,3	4	49,5	4,1	51,4	4,4	26,9	4,6	2'09
1.15	1.15 Intellectual property protection 1-7 (best)	2,9	81,6	4,9	65,2	4,1	51,5	4,1	52	4,3	55,5	4,8	62,6
12th pill	12th pillar: Innovation capability (0-100)	х	74,5	x	26,9	x	47,4	x	46,7	x	46,3	x	58,2
	Interaction and diversity	x	71,6	x	53,7	x	40,8	1	39,4	x	45,7	x	54
12.1	diversity of workforce 1-7 (best)	4,5	57,9	4,4	56,6	2,6	25,8	3,6	43,8	3,9	48,2	4,5	58,8
12.2	state of cluster development 1-7 (best)	4,9	65,7	3,8	46,8	8'8	47,2	3,8	46,8	3,8	46,6	3,8	45,9
12.3	12.3 international co-inventions per million pap.	36,15	100	6,23	60,7	4,51	52,4	1,69	30,4	3,31	44,8	6,49	61,8
12.4	multi-stakeholder collaboration 1-7 (best)	4,8	62,9	4	50,5	3,3	37,9	3,2	36,8	3,6	43,4	4	49,4
	Research and development (0-100)	×	77,6	x	57,6	x	48,6	x	52,2	x	39,6	×	56,8
12.5	scientific publications score	579	94,2	396,7	88,6	390,7	88,4	481	91,5	242	81,4	254,7	82,1
12.6	patent applications per million pop.	234,27	100	29,58	62,8	20,24	56,1	12,68	48,1	9,82	43,8	51,7	72,8
12.7	R&D expenditures %GDP	3,1	100	1,7	55,9	1,2	40,2	1	32,2	0,8	26,3	2	66,7
	Research institutions prominence 0-100												
12.8	(best)	90′0	16,1	0,08	22,8	0,04	9,8	0,14	36,9	0,02	6'9	0,02	5,6
	Commercialization (0-100)	×	73,9	×	62,1	×	58	x	65,1	x	60,7	×	9'69
12.9	12.9 buyer sophistication 1-7 (best)	3,9	47,9	3,1	35,4	2,9	32,3	3,6	43,3	3,2	36,1	3,6	42,9
12.10	12.10 trademark applications per million <u>pop.</u>	11700,63	100	3879,61	88,9	2410,49	83,8	3190,73	86,8	2788,85	85,3	n/a	96,4

 $^*/$ Scores are on a 0-100 scale, where 100 represents the optimal situation or "frontier".

Source: Own processing according to Global Competitiveness Report: https://www.weforum.org/reports/global-competitiveness-report-2019. Note: In the Score column, green indicates an increase and red indicates a decrease in the year-on-year comparison. Black means unchanged.

The Intellectual Property Rights Protection indicator (Table 2) showed an increase in all analyzed countries compared to the previous period, with the exception of Slovakia. Austria achieved the highest score on a scale of 0-100, registering 81.5, followed by the Czech Republic with a score of 70.3. The other V4 countries scored within the range of 55-66. Despite Slovakia's year-over-year decline in the perception of intellectual property rights protection, it cannot be said that the protection of intellectual property rights is perceived by respondents as lower than in the analyzed countries. For instance, Slovakia scores higher than countries like Poland or Hungary and is very close to the perception of respondents in Slovenia.

The results achieved in the Innovation Capability pillar (Table 2) of the country are significantly more differentiated.

Hungary, the Czech Republic, and Slovakia have recorded a year-over-year deterioration in this indicator. A significant contributing factor to this decline is the diminishing collaboration among stakeholders in innovation. While the COVID-19 pandemic may have played a role in this decline, the disbanding of research teams is not a positive signal for the dissemination and development of innovations. Alarmingly, we note that the Research and Development sector in all countries, except Austria, has experienced a decline. This is most prominently reflected in the indicators for expenditure on science and research and the importance of research institutions.

Conversely, the number of filed patents has increased in the majority of the analyzed countries, as has the number of publications recorded in citation indexes. This indicator has risen in all the countries under study. In our view, this is unequivocally the result of mounting pressure on academia for its staff to publish in reputable scientific journals. However, in Slovakia and Slovenia, this indicator reaches a level of just over 80 points, in contrast to Austria and Poland, which score more than 90 points.

3.2. International Trademark Index (ITI) and International Patent Index (IPI)

The methodology for these indices was developed by Prof. Walter G. Park in collaboration with the Property Rights Alliance. These indices are predicated on the assumption that intellectual property rights, including trademarks and patents, foster creative intellectual activity for the benefit of a free society. Through intellectual property rights, innovations gain protection, and their creators have the opportunity to benefit from them. Intellectual property rights not only ensure protection for creators but also serve as motivators for further efforts in generating new innovations. Trademarks are effective tools for communicating with customers and allow businesses to differentiate themselves from competitors. They protect the labeling of a company's products and also serve as a tool for consumer protection against the purchase of substandard products. Patents provide legal protection for inventions, granting the patent holder exclusive rights for the industrial application of the invention. By disclosing their invention in a patent application, the patent owner provides valuable technical information to the public. This disclosure creates one of the largest and most current sources of technical information available worldwide. We consider patents to be fundamental stimuli for innovation support. Effective patent protection stimulates research and is a key condition for overall economic growth.

The ITI and IPI indices are designed to capture the strength of national regulations in the field of intellectual property rights. They are not oriented towards the quality or effectiveness of protection. Another feature is that they are designed to capture the greatest variability among individual countries. The analyzed set consisted of 122 countries worldwide.

The International Trademark Index consists of four groups: (1) Coverage (the scope of trademarks that can be protected and registered), (2) Treaty Membership, (3) Procedures (which aggregate duration, enforcement, and limitations of rights, licensing conditions, and their usage), and (4) Trademark Applications (indicating the intensity of intellectual property system utilization, reflecting demand).

The overall ITI rating scale is [0 - 1], where 1 is the highest and 0 is the lowest value. In the country rankings, the USA achieved the highest overall score of 0.8794 as an average of the values obtained.

	,	The Internation	al Trademark	Index (202	1)	
					Procedure (re-	trademark ap-
	Ranking	point total	treaties	coverage	strictions)	plications
Austria	3	0,7594	1	1	1	0,0378
Czech Republic	36	0,6176	0,67	1	0,78	0,0207
Hungary	6	0,7265	1	1	0,89	0
Poland	15	0,6879	0,83	1	0,89	0,0317
Slovakia	45	0,6023	0,83	1	0,56	0,0193
Slovenia	44	0,6100	0,83	0,83	0,78	0

Table 3. The International Trademark Index (ITI) in selected countries for 2021

Source: Own processing according to Patent Index: https://www.propertyrightsalliance.org/wp-content/up-loads/Trademarks-and-Patent-Index.pdf

The most successful country in our analyzed set is Austria, which achieves the highest score of 1.0 in three out of the four evaluated indicators. Hungary follows as the second most successful country with an overall score of 0.7265. Interestingly, this country does not report the value for the last criterion concerning the number of trademark applications, similar to Slovenia. In the 'Procedure' criterion, Slovakia is the least successful country. This indicator demonstrates the strength of intellectual property rights protection concerning trademarks, i.e., the conditions, limitations, or restrictions that either weaken or strengthen the level of protection. Rights are stronger if such limitations are not imposed (or weaker if they are). Compared to other countries, Slovakia has weak protection of these rights. Slovakia also scores low on the last indicator, which demonstrates the utilization of trademarks. These facts suggest that Slovakia has a relatively broad portfolio of registered trademarks that are, however, underutilized.

The International Patent Index consists of six groups: (1) Coverage (the scope of patents that can be protected and registered), (2) Membership in international treaties, (3) Duration of protection (0 to 20 years), (4) Mechanisms for limitation and enforcement, (5) Loss of rights, and (6) Patent applications. The overall ITI rating scale is [0 - 1], where 1 is the highest and 0 is the lowest value. In the country rankings, the USA achieved the highest overall score of 5.88 as the sum of the values obtained,

		The	Internation	onal Patent I	ndex (2021)	ı		
	Rank-		dura-	enforce-	loss of			patent ap-
	ing	point total	tion	ment	rights	treaties	coverage	plications
Austria	6	4,3306	1	1	0,33	1	1	0,00061
Czech Repub-	11							
lic	11	4,3301	1	1	0,33	1	1	0,00014
Hungary	24	4,0006	1	1	0	1	1	0,00006
Poland	36	3,7503	1	0,67	0,33	1	0,75	0,00033
Slovakia	45	3 5504	1	0.67	0	1	0.88	0.00008

Table 4. The International Patent Index (IPI) in selected countries for 2021

Slovenia

Source: Own processing according to Patent Index: https://www.propertyrightsalliance.org/wp-content/up-loads/Trademarks-and-Patent-Index.pdf

Once again, the most successful country in our analyzed dataset is Austria, which achieves the highest score of 1.0 in four out of the six evaluated indicators. The Czech Republic follows as the second most successful country with an overall score of 4.3301. Slovenia did not report any values in this index. Slovakia maintained the same position in the ranking as it did in the trademark protection index,

securing the 45th place. All the analyzed countries scored a level of 1.0 in the 'Duration' and 'Treaties' indicators, demonstrating that these countries adhere to the standard duration of patent protection according to TRIPS, which is 20 years. The 'Enforcement' indicator for Poland and Slovakia points to the weak strength of court orders in cases of patent rights infringement by third parties, indicating weak protection for the patent holder against infringement. The 'Loss of Rights' indicator achieved low values, suggesting that in some countries, the rights to patent protection can only be exercised if the patent is actually being utilized; otherwise, the patent holder is obliged to offer its rights to another party for a reasonable licensing fee. The last indicator, the number of patent applications, also achieved very low values. In contrast, this indicator reached a value of 1.0 in the USA.

3.3. Copyright Protection (Use of Unlicensed Software)

An important indicator of the effectiveness of intellectual property rights enforcement is the level of piracy in a given country. According to a report by BSA/The Software Alliance (BSA, 2018), despite a decline in the use of unlicensed software in countries, it is still widely used on a global scale, with approximately 37% of unlicensed software installed on personal computers. Countries in Central and Eastern Europe utilize unlicensed software at a rate approaching nearly 60%, bringing this region closer to Asian countries in terms of software piracy. The installation of unlicensed software is prevalent in both large enterprises and small-to-medium-sized businesses. Within the Central and Eastern Europe region, individual countries have achieved extremely varied values. The Czech Republic has the best values in this region, with a rate of 32%. Austria, in the context of this report, was categorized under Western Europe. Conversely, the worst values in the Central and Eastern Europe region were achieved by Armenia, with a rate of 85%. The countries we analyzed are operating at lower levels, and we can conclude that the proportion of unlicensed software is declining. The commercial value of unlicensed software is highest in Poland. However, its value is far from approaching that of Russia, which reaches this value at the level of 1.291 billion dollars.

	rates	of unlice		ware	commer	cial value of		l software
	2017	2016	tion (%) 2015	2014	2017	2016	1. \$) 2015	2014
Austria	19	21	22	23	121,00	131,00	173,00	226,00
Czech Republic	32	33	34	35	149,00	150,00	182,00	214,00
Hungary	36	38	39	41	104,00	107,00	127,00	143,00
Poland	46	48	51	53	415,00	447,00	563,00	618,00
Slovakia	35	36	37	40	51,00	55,00	67,00	68,00
Slovenia	41	43	45	46	28,00	30,00	41,00	51,00

Table 5. The Copyright Protection in selected countries for

Source: Own processing according to BSA Global Software Survey; The Compliance: https://www.bsa.org/~/media/Files/Stud-iesDownload/2018_BSA_GSS_Report_en.pdf

In this context, it is essential to note that the installation of unlicensed software significantly elevates the risk of incurring costs for the removal of so-called 'malware,' i.e., malicious software that can lead to data loss, database corruption, negatively impact a company's image, and even halt its operations. The BSA report (BSA, 2018) estimates that the costs of mitigating the effects of malware for a single company can amount to as much as \$10,000 annually, with the impact potentially lasting up to 50 days.

From an internal analysis of the International Intellectual Property (IPP) for the Slovak Republic, the following conclusions emerge:

• Despite the proclaimed efforts of every government in Slovakia, research activities in the business sector remain underdeveloped. This is closely related to insufficient financial support for science and research. R&D conducted in the private sector has been consistently below the EU and OECD averages. Poor research outcomes can also be attributed to administrative fragmentation and a lack of coordination in the thematic focus of research conducted in Slovak enterprises and institutions. There is a lack of public infrastructure to support innovations, specifically in SMEs.

- High costs of innovation creation are not adequately offset by sufficient incentives in the area of reducing companies' tax bases by recognizing these expenditures as tax-deductible expenses.
- Slovak manufacturers have a weak influence on the international distribution of scientific knowledge, and the Slovak economy attempts to compete more with cheap labor than with advanced technologies.
- A significant drawback is the weak collaboration between universities and businesses, the low
 quality of R&D institutions, insufficient capacity for innovation, and the availability of scientists
 and researchers.
- The enforceability of law in Slovakia is generally very protracted and ineffective, which also applies to the infringement of intellectual property rights.

4. Conclusions

The internal analysis of the Intellectual Property Rights (IPR) as a components IPRI has revealed that while the robustness of intellectual property rights is increasing in the countries analyzed, their utilization in the business environment continues to lag. It is important to note that this is not just an issue confined to the countries we have analyzed; the overall IPRI score has been declining for the fifth consecutive year. This indicates a decreasing availability and utility of intellectual property rights in the business sector. We consider this fact to be crucial, as the IPRI results have shown that there is a positive relationship between the system and management of intellectual property rights and the increasing quality of human capital on one hand, and the growing performance of business entities on the other. As studies cited in our contribution have shown, finding a balance between strong protection of intellectual property rights and public awareness of innovations and creative approaches is highly challenging. Within the professional community, there is consensus among stakeholders in the field of intellectual property that an effective legal system is vital in the paradigm of a knowledge-based economy. However, there are differences in the perception of factors that need to be considered in seeking an economic balance between strong intellectual property rights, economic development, and innovations.

We regard this contribution as an academic discussion on this topic, and through our analyses, we aim to highlight certain laws that exist between innovations and the tools of intellectual property rights utilized in countries within the European space.

Funding: This research was funded by VEGA, grant number 1/0462/23, entitled "Circular economy in the context of social requirements and market constraints", grant share: 50% and grant number 1/0582/22 "Dimensions of cross-sectoral entrepreneurship of cultural and creative industry entities in the context of sustainable development", grant share: 50%

References

- 1. Bonnet, S. & Teuteberg, F. (2023). Impact of blockchain and distributed ledger technology for the management, protection, enforcement and monetization of intellectual property: a systematic literature review. *Information Systems and e-Business Management*, 21, 229–275. https://doi.org/10.1007/s10257-022-00579-y
- 2. BSA. Global software survey. (2018). Software Management: Security Imperative, Business Opportunity. Available at: https://www.bsa.org/files/2019-02/2018_BSA_GSS_Report_en_.pdf
- 3. De Solo Fellow, H. (2022). International Property Rights Index 2022. Full Report. May, 2022. Dr. Sary Levy-Carciente. Available at: https://atr-ipri22.s3.amazonaws.com/IPRI_FullReport2022_v2.pdf
- EUIPO. (2021). Intellectual property rights and firm performance in the European Union. Firm-level analysis
 report, February 2021. Available at: (uipo.europa.eu/tunnel-web/secure/webdav/guest/document_library/observatory/documents/reports/IPContributionStudy/IPR_firm_performance_in_EU/2021_IP_Rights_and_firm_performance_in_the_EU_en.pdf2021)
- EUIPO. (2022). IPR intensity and industrial dynamics. August 2022. DOI 10.2814/99855 TB-07-22-601-EN-N
 Available at: https://euipo.europa.eu/tunnel-web/secure/webdav/guest/document_library/observatory/documents/reports/2022_IPR_intensity_and_dynamics_report/2022_IPR_intensity_and_dynamics_FullR_en.pdf
- 6. Fisher, W. W., & Oberholzer-Gee, F. (2013). Strategic Management of Intellectual Property: An Integrated Approach. *California Management Review*, 55(4), 157-183. https://doi.org/10.1525/cmr.2013.55.4.157
- 7. Fishman, E.A. (2010). The role of intellectual property management education in a technology management curriculum. *The Journal of Technology Transfer*, 35, 432–444. https://doi.org/10.1007/s10961-009-9145-z

- 8. Grimaldi, M., Cricelli, L., & Rogo, F. (2018). Auditing patent portfolio for strategic exploitation: A decision support framework for intellectual property managers. *Journal of Intellectual Capital*, 19, 272-293. https://api.semanticscholar.org/CorpusID:158456925
- 9. Grzegorczyk, T. (2020). Managing intellectual property: Strategies for patent holders. *The Journal of High Technology Management Research*, 31(1), 100374. https://doi.org/10.1016/j.hitech.2020.100374
- 10. Marrocu, E., Paci, R. & Pontis, M. (2011). Intangible capital and firms' productivity. *Industrial and Corporate Change*, 21(2), 377-402. https://doi.org/10.1093/icc/dtr042
- 11. Nurani, N., AkbarBernovaldy Zul Fahmi, M. & AziizBernaldy Zul Fauzi, M. (2021) Micro Medium and Small Enterprise Human Resources' Creativity in West Java Through Intellectual Property Rights (IPR) License in the Pandemic Covid-19 Situation. *Turkish Journal of Computer and Mathematics Education*. 12(4), 684-694. https://doi.org/10.17762/turcomat.v12i4.553
- 12. O'Mahony, M. &Vecchi, M. (2009). R&D, knowledge spillovers and company productivity performance. *Research Policy*, 38(1), 35-44. https://ideas.repec.org/a/eee/respol/v38y2009i1p35-44.html
- 13. Property Rights Alliance. (2021) International Trademark and Patent Index 2021. Available at: https://www.propertyrightsalliance.org/wp-content/uploads/Trademarks-and-Patent-Index.pdf
- Rivette, KG. & Kline, D. (2000). Discovering New Value in Intellectual Property. Harvard Business Review. 55(1), 45-50. https://www.researchgate.net/publication/245941864_Discovering_New_Value_in_Intellectual_Property
- 15. Somaya, D. (2012). Patent Strategy and Management: An Integrative Review and Research Agenda. *Journal of Management*, 38(4), 1084-1114. https://doi.org/10.1177/0149206312444447.
- 16. Somaya, D. (2016). How patent strategy affects the timing and method of patent litigation resolution. *Advances in Strategic Management*, 34, 471-504. https://doi.org/10.1108/S0742-332220160000034014
- 17. Soranzo, B., Nosella, A. & Filippini, R. (2017). Redesigning patent management process: an Action Research study. *Management Decision*. 55(6), 1100-1121. https://doi.org/10.1108/MD-04-2016-0226
- 18. Miyashita, S., Katoh, S., Anzai, T. & Sengoku, S. (2020). Intellectual Property Management in Publicly Funded R&D Program and Projects: Optimizing Principal–Agent Relationship through Transdisciplinary Approach. *Sustainability*, 12(23), 9923. https://doi.org/10.3390/su12239923
- 19. Svishchova, N. (2022). Development of the Combined Approach to the Valuation of Intellectual Property Objects. *Technology Audit and Production Reserves*, 1(4(63), 16–23. https://doi.org/10.15587/2706-5448.2022.253472
- Virchenko, V., Petrunia, Yu., Osetskyi, V., Makarenko, M., & Sheludko, V. (2021). Commercialization of Intellectual Property: Innovative Impact on Global Competitiveness of National Economies. *Marketing and Management of Innovations*, 2, 25-39. http://doi.org/10.21272/mmi.2021.2-02
- 21. World Economic Forum (2019). Global Competitiveness Report. Available at: https://www.weforum.org/reports/global-competitiveness-report-2019
- Ziegler, N., Ruether, F., Bader, M. & Gassmann, O. (2013). Creating value through external intellectual property commercialization: a desorptive capacity view. The Journal of Technology Transfer, 38(6), 930-949. https://ideas.repec.org/a/kap/jtecht/v38y2013i6p930-949.html

Current steps in strengthening scientific integrity and ethics in Slovakia

Sylvia Bukovová 1, Katarína Grančičová 2, *

- ¹ Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia; sylvia.bukovova@euba.sk
- ² Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia; katarina.grancicova@euba.sk
- Correspondence: katarina.grancicova@euba.sk

Abstract: An important factor in the development of science and the consolidation of its place in society is increasing the quality and credibility of scientific research. Therefore, in this context, this article points to the growing importance of the issue of ensuring compliance with the rules of ethics and scientific integrity in research work. From the point of view of the structure, it first briefly presents the starting points in the field of creation and implementation of regulations in the researched area at the EU level, then analyzes the current state and contemplated changes in the rules of compliance with the principles of ethics and scientific integrity in Slovakia. In the conclusion, it identifies and states that the basic trend in the creation and implementation of the rules of ethics and scientific integrity in Slovakia is a significant strengthening of them.

Key words: Research integrity and ethics, Principles of research integrity, Code of ethics

Introduction

Scientific research, as one of the basic sources of material and spiritual wealth of society, with the aim of achieving an adequate quality of life for all citizens, is currently an integral part of all elements of society. The basic value of scientific research is freedom and independence connected with the awareness of the responsibility of science and the scientist towards the whole society. This responsibility must be applied as a basic principle for the performance of scientific work. The application of this principle is primarily the task of every scientist, but also of scientific institutions, which through organizational and procedural law and the resulting regulations ensure the performance of correct scientific practice. In the individual sections, this article one by one addresses: starting points in the field of ensuring the principles of ethics and scientific integrity within scientific practice – it presents a brief overview of the preparation and implementation of regulations at the EU level; it analyzes the current situation in the researched area in Slovakia and subsequently identifies trends in the strengthening of the principles of ethics and scientific integrity in Slovakia.

1. Theoretical background

In 1997, the European Commission (EC) created the first European Group on Ethics and New Technologies, whose task is to provide independent advice on the ethical aspects of science and new technologies in connection with the preparation and implementation of Community legislation and policies.

Already in 2001, the EC adopted the Action Plan for Science and Society. In the chapter on the ethical dimension of science and new technologies, it emphasizes gaining and maintaining public trust by making available information on ethical issues in science and supporting dialogue with the non-governmental sphere, companies, and religious and cultural communities.

In connection with the strengthening of the culture of scientific integrity, the Horizon Europe (HE) program focuses primarily on preventive activities – the creation of materials and modules aimed at the education and "training" of researchers in the field of ethics and research integrity for universities, research institutions, as well as for relevant national and institutional ethics commissions. The EC should also focus its attention on the evaluation and assessment of the ethical dimensions of the proposed research, which are an integral part of the evaluation of project proposals in order to support excellent research, which must necessarily be ethical. The ethical evaluation process aims to increase the quality of suggested research project proposals.

The EC recommends that all researchers carrying out research supported by the HE program should adopt the principles of the European Code of Conduct for Research Integrity. The code is a joint output of two organizations – ALLEA (The European Federation of Academies of Sciences and Humanities) and ESF (European Science Foundation). The creation of the code followed the Memorandum on Research Integrity issued by ALLEA in 2003, and the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers adopted by the EC in 2005.

The European Code (the Code) serves as a framework for self-regulation in all scientific and professional disciplines and in all types of research. It is a living document, revised as necessary every three to five years to take into account new issues and challenges, and can continue to serve the academic community as a framework for good research practice. It thus responds to new challenges resulting from technological development, open science, citizen science, and the growing influence of social media. (ALLEA, 2017).

The EC regards the Code as a reference document in the field of research integrity for all projects supported by funds and as a model for institutions and researchers in Europe. The Code was published in English on March 24, 2017, and has been translated into all official languages of the European Union.

The Code sets out the principles of research integrity, criteria of good research practice and describes how to prevent violations of research integrity. The Code is applicable to the publication and use of digital repositories, and takes into account new ways of communicating scientific results and engaging in research. The aim of the Code is to establish an understanding of research and how it should be conducted that will be shared by researchers, diverse research institutions, research-supporting agencies, and publishers. (SAS, 2021).

The aforementioned rules were also transferred to the 7th framework program, which allocated part of the funds to research the connections between ethics and science and to support an informed debate on these issues. (MESRS SR, 2021)

2. Methods and methodology

The aim of this article is, based on the study of available, primarily domestic sources, in the framework of the creation and implementation of the rules of compliance with ethics and scientific integrity and with the use of general scientific methods – research, analysis, synthesis, induction, deduction, comparison – to identify and characterize the basic documents governing the activity of scientific research workers in research institutions in Slovakia, to analyze their content with regard to the implementation of the principles of research ethics and scientific integrity in the scientific research work of these institutions and to identify new trends in the strengthening of these principles in Slovakia.

3. Results and Discussion

This chapter presents the current situation in the field of rules governing ethics and scientific integrity in Slovakia. In the first part, valid basic documents are identified and analyzed – regulations and rules that currently regulate the implementation of the principles of ethics and integrity in scientific research practice in Slovakia, and then the intention of the changes is presented – the proposed new code and its comparison with the valid rules. In conclusion, it is stated that the new proposal primarily develops and refines the existing rules, in an effort to ensure the performance of correct scientific practice in Slovakia.

3.1. Declaration on the strengthening of the culture of scientific integrity in Slovakia

The Slovak Center of Scientific and Technical Information (SCSTI), which is the national information center for science, technology, innovation, and education as well as the scientific library of the Slovak Republic, issued a Declaration on the Strengthening of the Culture of Scientific Integrity in Slovakia in 2021 (the Declaration). The SCSTI, as a directly managed organization of the Ministry of Education, Science, Research and Sport of the Slovak Republic, coordinates scientific and research activities in Slovakia and ensures the operation of interdisciplinary research and development centers and national infrastructures for research, development, innovation, and education.

With this Declaration, the SCSTI formulates the basic principles of scientific research activity and calls on all organizations carrying out and financing research and education in Slovakia to pledge to comply with the highest ethical standards in the field of scientific integrity with the intention of

strengthening the ethical aspect of scientific activity and increasing the trust of the public and the international research community to Slovak research workplaces. The Declaration refers to the entire system of institutions organizing research activities, which by the very nature of their activities have an obligation to observe and support the principles of scientific integrity.

The Declaration is based on European standards, especially the European Code of Conduct for Research Integrity, which is also a binding document for researchers involved in EU Framework Programs.

In the Declaration, attention is paid to the definition of recommended rules and principles that must be applied and unconditionally observed in scientific research practice.

Correct scientific research practice is primarily based on the following principles:

- reliability in ensuring the quality of research, which is reflected in the design of its concept, methodology, analysis, and in the use of resources;
- honesty in developing, conducting, assessing, reporting, and presenting research and its results in a transparent, honest, complete and impartial manner;
- respect for colleagues, research participants, society, ecosystems, cultural heritage and the environment;
- responsibility for research from the initial idea to its publication, for its management and organization, professional training, supervision and professional leadership, education of a new generation of researchers, as well as for the wider consequences of research.

For the purposes of the Declaration, a set of terms is defined, the definitions of which are given in this document (SAAHE, 2020):

- Scientific integrity is the primary condition for quality scientific work, which is based on consistent
 adherence to the highest professional and moral standards, transparency, conducting research critically and without prejudice, and the absolute integrity of the practice, teaching, and administration of science. Its opposite is scientific dishonesty and deceitfulness. Thus, by the term scientific
 integrity, the authors understand both research integrity and academic integrity.
- Scientific fraud is a dishonest and deceitful act that is the opposite of research integrity and contradicts moral standards. This mainly concerns plagiarism, cheating during exams, fabrication of research results, recording of fictitious data, omission of inappropriate facts and data, falsification of research, dishonest practices in publishing results, failure to declare a conflict of interests, misuse of information obtained during assessment, fictitious authorship, superficial and low-quality assessment, systematic and conscious publication in magazines and publishing houses in which there are signs of unfair practices (so-called predatory). By the term scientific fraud, the authors understand both research fraud and academic fraud.
- Fabrication is creating fictitious results and recording them as if they were real.
- Falsification is the manipulation of research material, equipment, or processes, or the unjustified alteration, omission, or deletion of data or results.
- Plagiarism is the use of other people's work and ideas without proper reference or unjustified change, omission, or removal of data or results on the original source, which violates the rights of the original author or authors on the results of their creative intellectual activity. (Allea, 2017)

The Annex to the Declaration is the "National Code of Conduct for Scientific Integrity" (NCC), which follows the current legislation and emphasizes the values of responsibility, honesty, truthfulness, humanity, and sustainability.

In Article I, the NCC specifies the scope and activities to which it applies – which is research carried out in institutions (including private ones) that have adopted the NCC. It includes research funded by public as well as private funds, whether it is basic, applied, or practice-oriented research. According to the NCC:

- All scientific research activities of institutions bound by this code respect and apply the valid legislation of the Slovak Republic.
- These norms are understood as minimum standards and, of course, can be supplemented and expanded for each discipline, field, industry, or institution.

• In practice, the already existing codes of conduct (including the rules of procedure/statute of the ethics commission) of the signatory institutions will remain.

In Article II "The Rules of Research Activity and Education", the NCC presents basic principles and ethical rules that must be observed in the following areas of activity of scientific research institutions:

- Right research practice,
- Research environment,
- Education, supervision, and professional guidance,
- Research procedures,
- Ethical measures ensuring protection and safety,
- Data processing and management,
- Cooperation and coordination,
- Publication and dissemination of information,
- Assessment, evaluation, and editorial activity.

All principles are based on the assumption that the fundamental value of science is the freedom of scientific research and its independence from political, religious, and ideological beliefs. Limiting the freedom of research from the position of any authority is unacceptable.

Article III "Violations of Scientific Integrity" provides recommendations for solutions to violations and accusations of violations of the ethical rules of research and education. The NCC defines the categories of violations of the ethical rules of research and other unacceptable practices, cases of serious violations of scientific integrity, and dubious scientific practices and offers ways to resolve violations and accusations of violations of the rules of scientific integrity.

In the conclusion, the NCC presents recommendations regarding the solutions to violations and accusations of violations of the rules of scientific integrity and recommendations on the composition and competencies of ethics commissions. Their goal is to help in the creation of institutional ethics commissions, as well as in solving cases of violations of the principles of scientific integrity. (SCSTI, 2021)

Researchers, university teachers, and other employees are guided by generally valid ethical principles in the performance of their work, and in their relations with other employees, they maintain human dignity, consideration, respect, courtesy, and honesty in accordance with the principles stated in the NCC.

3.2. The "New" Code of Conduct for Scientific Integrity in Slovakia

Currently, a new non-legislative draft by the Ministry of Education, Science, Research and Sport of the Slovak Republic is being prepared for the adoption of a new Code of Scientific Integrity and Ethics in Slovakia, which significantly complements and specifies the existing Code. Its commenting procedure ends on October 5, 2023. The new code will be "a joint expression of voluntarily accepted ethical obligations and requirements of scientific integrity, which are binding for all professional scientific and academic workers in the field of science and research, as well as for all state or private organizations and institutions that plan, evaluate, carry out, publish or finance basic or applied scientific research and development on the territory of the Slovak Republic, including their participation in international scientific or technological cooperation." (MESRS SR, 2023).

The Code applies and develops generally accepted ethical values, principles, and norms of a democratic society in the field of science, research, development, and academic activity. Its mission is to contribute to the observance of demanding ethical requirements, as well as to the prevention of unethical and dishonest actions and behavior, primarily in the field of science, research, and development, but also in the education and training of scientific research workers, thus working to increase their quality and credibility both domestically and internationally. The Code follows up on the relevant legislation of the Slovak Republic, legally binding acts of the European Union, and international treaties and agreements. (MESRS SR, 2023).

Article 1 of the Code provides definitions of the basic terms associated with the given issue:

1. **Scientific integrity** is a basic condition for quality scientific work – it represents strict adherence to the highest professional and moral standards. The term scientific integrity means:

- Research integrity a set of principles and ethical values, deontological obligations, and professional standards that form the basis of responsible and correct action and behavior of all entities that carry out, support, finance or evaluate scientific research. Research integrity is the primary condition for quality research work, consisting of strict adherence to the highest professional, moral, and ethical principles, standards, and transparency, conducting research critically, without prejudice, and in absolute integrity with practice. The main principles of research integrity are responsibility, honesty, respect, and reliability.
- Academic integrity a set of values and rules related to study and education, which ensure that study and education are based on the principles of responsibility and honesty. It is related to the morals and deontology of the student, teacher, and educational institution, based on right study and educational practice.
- 2. **Right scientific and research practice** represents the international ethical and scientific standard for the implementation of all stages of scientific research activity, the evaluation and publication of its results, as well as the ethical and scientific standard of action and behavior of all entities operating in these areas.
- 3. **Ethical principles and standards** are generally accepted starting points, rules, and requirements of moral action and behavior of natural persons and legal entities.
- 4. **Violation of the provisions of the Code** is the action or behavior of natural persons or legal entities contrary to the provisions of the Code.

Article 2 regulates the scope of activity of the participating entities, while it applies to:

1. professional activities and processes:

- in the field of science, research, development, and academic work, carried out during the entire life cycle of scientific research and development, from their planning and creation to their evaluation, approval, implementation, publication of results, as well as their application in practice,
- regarding study, education, formation of professional, scientific, research, and development workers, as well as the actions and behavior of all natural persons or legal entities operating in these areas.
- associated with the receiving and awarding of scientific or academic qualifications and ranks.
- **2. Institutions and organizations (legal entities)** all institutions and organizations operating in the field of science, research, development, study, education, and training of professional, scientific, research, and development workers financed from public funds, as well as public institutions and private institutions (including those not financed from public funds) in case they carry out research in the form of cooperation.
- **3. Workers** (natural persons) working in institutions and organizations of science, research, development and academic work, as well as workers working independently these are professional and research workers in the field of scientific, research or development work, university teachers, students of all levels of university studies, employees of institutions and organizations financially supporting science, research and development from public funds, as well as other entities participating in the processes of assessment and opposition, approval/authorization, and supervision of science, research and development activities.

All scientific research and academic activities of the institutions bound by this Code respect and apply the relevant legal regulations of the Slovak Republic.

Article 3 contains a set of requirements of a moral nature, which apply because of the importance and benefit of professional and expert activities to the whole society and are the content of ethical distinction and guidance. They include:

- 1. General ethical values, principles, and norms: freedom of scientific research, research, development, and academic activity, independence from political, ideological, or religious influences, human dignity, human rights, civil liberties, and legitimate interests of individuals and groups of society in achieving individual and common good, ethical values, principles and standards generally recognized and applied in a democratic society.
- 2. **Ethical values, principles, and norms of scientific integrity** are implemented in the following areas:

- research environment,
- education, supervision, and professional guidance,
- research procedures,
- ethical measures to ensure protection and safety,
- data processing and management,
- cooperation and coordination,
- publication and dissemination of scientific information and research results,
- authorship of scientific discoveries and professional publications,
- evaluation of the scientific and ethical quality of research results and outputs, final and qualification theses, expert review of scientific and professional publications, and editorial activity.

The stated ethical requirements for ensuring the scientific integrity of the research environment are ensured by research institutions, organizations, and universities by promoting awareness, formulating clear rules and procedures of right scientific and research practice, as well as solving their violations. They create an inclusive environment that enables professionals and scientists to work according to the principles of the right scientific and research practice. At the same time, they ensure an adequate infrastructure for the management and protection of research data and research material in all their forms, apply transparent procedures for the recruitment and career growth of research and academic staff, while strictly observing the principle of equal opportunities and non-discrimination and excluding any behavior that may show features of physical or psychological violence and coercion, or abuse of one's position, authority or power.

Ethical requirements *for ensuring the academic integrity of education, professional supervision, and leadership* are ensured by research institutions, organizations, and universities by preparing appropriate and adequate education in the field of ethics and scientific integrity. All participating entities undergo training in ethics and scientific integrity throughout their careers. They lead students, and team members, advise them, provide professional training, and strengthen the culture of scientific integrity through their personal example.

Ethical requirements *for ensuring the integrity of research procedures* are fulfilled by researchers and university teachers by taking into account the latest knowledge achieved in the given field in their research, designing, conducting, analyzing, and documenting research thoroughly and carefully, using financial resources intended for research properly, efficiently and economically and responsibly, they publish the results and interpretation of research honestly, transparently and accurately. In justified cases, they preserve the confidentiality of the data or findings, and describe the results obtained and the methodology used (including the use of external services, artificial intelligence, or automated tools) in a way that allows verification or repetition of the research. They contribute to the strengthening of the culture of scientific integrity, draw attention to cases of its violation, and contribute to their solution. If possible, they publish in an open-access way, are responsible for the quality of research and the credibility of the results obtained, and act in accordance with good scientific and research practice and the principles of scientific integrity. Through public appearances, social networks, and internet portals, they spread only verified, confirmed, and updated scientific information, correctly put into context. They also apply the principles of scientific integrity in all public appearances.

Ethical requirements to *ensure the integrity of the given scientific research and development* are fulfilled in such a way that this research is carried out exclusively using scientific methodology and observing the rules specific to the particular discipline, it is open to doubt, verification, rational and reasoned criticism.

Ethical requirements to *ensure the protection and safety of research* are fulfilled by researchers and university teachers by observing safety standards and regulations, treating research subjects with appropriate respect, and in accordance with valid legal regulations and ethical principles and norms. In doing so, they take due account of the health, safety, personal dignity, and autonomy of all subjects affected by the research and take into account and minimize possible risks and impacts of the research, as well as the importance of differences based on age, gender, social class, culture, religion, and ethnic origin. At the same time, they are particularly responsible for observing all the stated principles of scientific integrity used in research, in which even laypeople – non-professionals – actively participate.

Ethical requirements to *ensure integrity in the acquisition, processing, storage, and management of research data (and databases)* are fulfilled by the subjects in question by ensuring adequate management, method of acquisition, processing, organization, and safe storage of all data with the most open access to data in accordance with intellectual property rights and legislation and regulation related to data protection.

Ethical requirements for *ensuring integrity and ethics in cooperation and coordination of research, development, and academic activities* are fulfilled by all partners of research cooperation and coordination by being jointly responsible for the scientific integrity of their joint research. Before starting the research, they must agree on the objectives and method of conducting the research, on the method of publishing its results and solving intellectual property issues related to joint research, on respecting the principles and standards in the field of scientific integrity, and evaluate the feasibility, potential impact, and ethical consequences of the given research.

Ethical requirements for *ensuring scientific integrity in publication activities and the dissemination of information and data* are fulfilled by the relevant staff by recognizing that the authorship of a scientific or professional publication is based on the significance of the contribution to all phases of research, to the development and reviewing of the manuscript. They are responsible for the entire content of the publication, while the order and definition of responsibility and the degree of contribution of the authors are based on a mutual agreement in advance. Before publication, the work must be available to co-authors in a timely, complete, and transparent manner. Related works, as well as the use of artificial intelligence, must be correctly listed and cited. It is necessary to declare the conflict of interest and to indicate the institutions in which the research was carried out. If necessary, they will request the publication of a correction of the published work, in case of errors or omissions, they will request the withdrawal of the published work. They adhere to the criteria of publication ethics, do not publish in questionable ways, and do not use untrustworthy publication platforms.

Ethical requirements to ensure integrity in the professional assessment of research and development projects and the evaluation of research and development results and in the decision-making processes related to such an assessment are mainly fulfilled by the fact that the relevant entities assess and evaluate all submitted materials, proposals and requests based on predetermined, clearly defined criteria and a transparent, predetermined procedure, while declaring and specifying in advance the method, scope of use and limitations of the use of artificial intelligence applications or duly validated automated tools. They participate in the mentioned activities with full responsibility and in the spirit of the relevant ethical principles and norms, including maintaining professional confidentiality. They declare a potential or actual conflict of interest by a predetermined procedure and in such case, they do not participate in the evaluation, advisory, or decision-making processes. They acknowledge that the published so-called negative research results can be just as important and beneficial to the development of scientific knowledge as the so-called positive results.

Article 4 characterizes violations of scientific integrity and ethics. Violation of the provisions of this Code as a result of unethical actions or behavior of natural persons or legal entities means a violation of scientific (research or academic) integrity, which can be of different scope and severity, but always damages the credibility of science, research, development and academic activities, their proper quality and reputation not only in science, but also in the general public. It includes the following cases:

Serious violations of scientific integrity and ethics, which intentionally distort the procedure, results, and outputs of research and development or their interpretation, or disrupt and impermissibly manipulate various academic activities. They include:

- fabrication of results deceptive creation of fictitious results
- falsification fraudulent manipulation of research material, equipment, or processes, or fraudulent
 alteration, substitution, omission, or disregard of research and development data or results, using
 fake instead of the real ones,
- plagiarism is the deceptive appropriation and use of the work and ideas of others,
- Questionable scientific practices (QSP) represent actions or behavior that contradict the generally accepted requirements of scientific ethics and integrity. They include:

QSP related to research data/data: They represent insufficient or intentionally incorrect (manipulative) management of research data, insufficiently secured or incorrect storage of primary data,

unjustified refusal to provide access to primary data, and destruction of such data before the specified retention period.

QSP related to publication and conference activities or submission of proposals for research or development or educational (grant) projects: This involves manipulation of authorship, use of artificial intelligence applications without proper declaration, re-publishing of substantial parts of one's own publications (self-plagiarism), increasing the number of one's own publications by unjustifiably dividing them into smaller parts and their special publication, intentional provision of false or inaccurate information, unfair attempts to influence the activity, decision-making and decisions of evaluating and assessing entities, unauthorized, deceptive budget increases, selective or purposefully increased citation of selected works, publication of research results or developments at dubious events or in publications or other media that do not comply with generally accepted principles and standards of publication ethics and integrity, organizing, supporting or participating in dubious, pseudo-professional or pseudo-scientific events that do not comply with generally accepted principles and standards of publication ethics and integrity.

QSP related to research methods/practice: They contain the use of inappropriate, harmful, unjustifiably risky, or dangerous research methods and procedures, including inappropriate statistical methods and their incorrect use, faulty or unclearly processed methodology design, purposeful selection of research methods and procedures aimed at achieving results, which do not reflect reality but the wish of the researcher, violation, non-compliance or unapproved changes to the originally adopted research or development protocol, failure to obtain the opinion of the relevant ethics commissions on the proposal of the research or development project.

QSP associated with the work of an evaluator: These practices relate to violation of the required confidentiality, biased assessment, failure to acknowledge a conflict of interest, unjustified refusal to perform the task of an evaluator, misuse of information obtained during evaluation, assessment or review activities for one's own benefit or for the benefit of a third party, recommendation by the author for expedient expanding the list of references in an attempt to increase the citation rate of one's own or otherwise linked publications, bias in the implementation of the evaluation activity against any aspects of the evaluated work.

QSP related to the personal behavior of the researcher and academic worker – characterizes the threat to the independence of the research process or the publication of its results, inadequate conduct of research, unjustified expansion of one's own bibliography, non-transparent use of financial resources provided for research, false accusation or slander of the researcher, purposeful failure to provide or misrepresentation of results and outputs of research or development in relation to their application in practice or in further research and development, delaying or hindering the work of other researchers, abusing one's job position for purposeful violations of the principles of integrity and ethics, ignoring or concealing cases of violations of scientific integrity and research ethics, development or academic activity, neglecting the professional guidance, education, training of students or workers in any type of study, damaging or even sabotaging the preparation, implementation, evaluation or publication of the results of research and development activities, creating obstacles in career progression, targeting workers who reported cases of violations of scientific integrity and ethics or cases of dubious scientific practices, purposeful writing of unreasonably positive or negative recommendations with the aim of purposefully influencing the job opportunities of the given worker and relevant selection procedures, discriminatory, disparaging or other inappropriate actions and behavior.

Article 5 presents the Resolution of violations and accusations of violations of the rules of scientific integrity and ethics. The resolution of cases of reasonable suspicion or cases of accusations of violation of the principles and norms of scientific integrity and ethics, which could mean violations of the provisions of this Code, must respect and consistently apply the general principles of dealing with potential violations of the rules of scientific integrity and ethics.

The verification of the violation must be carried out fairly, comprehensively, and efficiently with the highest possible degree of accuracy, objectivity, and thoroughness and in accordance with the relevant provisions of this Code (principle of integrity) in accordance with the principle of respect for human dignity, rights, and the legitimate interest of persons.

Violation evaluators shall promptly disclose any potential or existing conflict of interest. Violation verification is also carried out in accordance with the following generally applicable dispute resolution principles:

- the principle of confidentiality,
- the principle of determining the degree of fault,
- the principle of respect and protection of human dignity, rights, and legitimate interests of whistleblowers and witnesses,
- the principle of adequate solution time,
- the principle of transparency,
- the principle of justice,
- the principle of presumption of innocence,
- the principle of commission independence,
- the principle of good practice,
- the principle of proportionality,
- the right to a fair trial,
- the principle of not causing harm,
- the principle of rectification of the suffered wrong.

The new code of scientific integrity and ethics in Slovakia is based on valid principles that regulate all phases of scientific research activities and its publication results, as well as the work of university teachers with students of all levels of study. It also affects the evaluation of publications, the qualification process of scientific research and academic teaching staff, as well as selection procedures. The aforementioned principles have so far been contained in the SCST's Declaration on Strengthening the Culture of Scientific Integrity in Slovakia and its annex "National Code of Ethics for Scientific Integrity". In contrast to this code, which contains framework-formulated principles and procedures, the new code provides in great detail the definitions of basic terms related to the issue in question, adjusts the scope of activity of the participating entities, specifies requirements of a moral nature to guide scientific research and academic activities and ensure scientific integrity and characterizes cases of violations of scientific integrity and questionable scientific practices. In the end, it presents solutions to violations and accusations of violating the rules of scientific integrity and ethics, as well as the principles that must be followed in these cases.

4. Conclusions

The culture and principles of scientific integrity and ethics must be implemented in all phases of research activity – in the phases of preparation, evaluation, as well as financing and implementation of scientific knowledge in practice. The reason is that they are a necessary condition for ensuring the quality of the entire scientific research process and for the recognition of the results of scientific research work by society. Based on the analysis of the currently valid documents and rules for ensuring the principles of ethics and scientific integrity in Slovakia and the subsequent comparison with the proposed changes, it can be stated that there is an effort to supplement and develop/refine the existing code and rules and thereby strengthen the importance of the issue of ethics in research work in Slovakia. The aim of the presented current as well as proposed principles of research work, defined criteria for appropriate conduct in research and the elimination of violations of research integrity is to maximize its quality and reliability, because only scientific integrity and ethics are the primary and recognized conditions for quality scientific work in international competition.

Funding: This article is a partial output of the project VEGA MŠ SR No. 1/0836/21 "Creating a corresponding model of behavior for ethics and integrity of institutions in the field of scientific research activities based on international comparison and setting a system of determining attributes for its effective implementation and functioning", author's share 50 and 50%.

References

- 1. ALLEA., 2017. Európsky kódex správania pre integritu výskumu.
- 2. https://allea.org/code-of-conduct/ [accessed 10.9.2023]
- 3. CVTI SR., 2021. Deklarácia o posilnení kultúry vedeckej integrity na Slovensku https://eraportal.sk/wpcontent/uploads/2021/08/DEKLARACIA_3_8_2021_everzia2.pdf [accessed 7.9.2023]
- 4. MŠVVaŠ SR., 2021. Etika a veda v EÚ. https://www.vedatechnika.sk/ SK/VedaASpolocnost/EtikaVoVede/Stranky/EtikaaVedavEU.aspx [accessed 5.9.2023]
- 5. MŠVVaŠ SR., 2023. Kódex vedeckej integrity a etiky na Slovensku. https://www.slov-lex.sk/legislativne-procesy?p_p_id=processDetail_WAR_portletsel&p_p_lifecycle=0&p_p_state=nor-mal&p_p_mode=view&p_p_col_id=column-2&p_p_col_count=1&_processDetail_WAR_portletsel_idact=1&_processDetail_WAR_portletsel_action=files&_processDetail_WAR_portletsel_cisloLP=LP%2F2023%2F543&_processDetail_WAR_portletsel_startact=1693833917000 [accessed 29.9.2023]
- 6. SAV., 2021. EURÓPSKY KÓDEX ETIKY A INTEGRITY VÝSKUMU. https://www.sav.sk/in-dex.php?doc=services-news&source_no=20&news_no=7956[accessed 25. 9.2023]

Social media in HR management

Benita Beláňová 1,* and Anna Hamranová 2

- ¹ Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia; benita.belanova@euba.sk
- ² Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia; anna.hamranova@euba.sk
- * Correspondence: Benita Beláňová, benita.belanova@euba.sk

Abstract: In addition to being used for private purposes, social media is now increasingly used in businesses and organisations not only as a tool for communication between employees, but also for knowledge sharing, creating collaborative systems, as a tool for creating social capital and improving corporate learning. Eurostat surveys for 2021 place Slovakia in a non-leading 25th place (out of 27) in the use of social media in enterprises. Therefore, the main objective of the paper was to examine the approach of enterprises operating in Slovakia to the use of social media. In addition to the standard methods of scientific work (analysis, synthesis, comparison and selection), the main research method was a questionnaire survey, which was conducted in the months of February to June 2021. Statistical methods used to evaluate the results were descriptive statistics and contingency tables. As an important finding (compared to the Eurostat survey) we consider the fact that significantly more Slovak enterprises declare that they use social media (difference of 34.61%). Similar is the case for the evaluation by size of enterprises. Our results are comparable only in the case of medium-sized enterprises (1% difference). Small and large enterprises are overestimated in our survey (small by 28%, large by 11.80%). The differences stem from the different methodology of data acquisition and evaluation, as well as from the focus of the research (Eurostat - all-sector focus, our research - focus on personnel management).

Keywords: social media; social networks; slovak enterprises, questionnaire survey

Introduction

In the last decade, the processes of globalisation and internationalisation have significantly changed the nature of the business environment. Changes in the communication environment reflect changes in all communication vectors. Radical changes in corporate communication systems have been brought about by information and communication technologies, e-communication tools, new communication techniques and strategies based on the application of unified communication codes and communication patterns. The changes that have taken place in communication have set new requirements for the knowledge and communication skills of managers and employees alike. They have also shown that communication in general, and in the enterprise in particular, has long since ceased to be a simple exchange of information. On the contrary, it is now a complex system whose effectiveness and efficiency are in many ways determined by the degree to which scientific knowledge and theoretical experience are applied in business practice.

In the enterprise management system, communication acts on one hand as a management tool and on the other hand as a product of managing and leading people in the enterprise. Its development is directly determined by the development of enterprise management systems, which initiates the development and improvement of intra-enterprise communication systems, communication tools, communication competences and skills of employees. The modern communication tools used by enterprises increasingly include social media.

The term social media encompasses Internet applications such as social networks, blogs, multimedia content sharing sites, but also enterprise social networks that operate on a similar principle, where communication channels, planning calendars, contact directories and the like can be shared. Their integration can also be linked to private platforms, one of the possibilities being the creation of groups within work departments, etc. Businesses in the back end use social media for image building or marketing purposes, to gather information from customers, to find and recruit new employees, but more often to communicate within or outside the business.

The aim of the paper is to examine the approach to the use of social media in enterprises in Slovakia, focusing on the use of social media in personnel management, and to compare the findings with the results of research by other authors.

1. Theoretical background

The issue of using social media in enterprises is a widely elaborated topic in the professional and scientific literature in the world, and naturally also in Slovakia. Publications in Slovakia are mostly focused on the use of social media in the corporate sphere in the field of marketing (Gburová & Fedorko, 2019; Drábek & Halaj, 2010), marketing communication (Trubenová, 2022; Galko, 2021) and advertising (Nastišin, 2021; Horváth et al., 2023). In the international literature, published research has focused on examining the effects of social media adoption on several areas in more detail, in addition to communication (Leonardi et al., 2013; Zhang et al., 2023). Social media as a tool for knowledge sharing (Yee et al., 2021; Liu & Bakici, 2019), for creating collaborative systems (Graupner et al., 2012), social media as a tool for creating social capital and improving corporate learning (Shang & Sun, 2021; Sharma et al., 2021). Factors and constraints of information sharing on enterprise social networks have been published by Laitinen and Sivunen (2021). Impact on employee motivation (Ma et al, 2020; Ng & Yee, 2020), on employee creativity (Wang et al, 2022), on job satisfaction (Fu et al, 2019; Liu et al, 2021). In addition to the positive effects of the use of social media on work, there is also research in the literature on adverse factors, such as the unwillingness to visualise knowledge (Ma et al, 2020) or employee work overload (Chen and Wei, 2019).

Our research was based on published Eurostat surveys (Eurostat, 2021) in the EU Member States, from which we selected:

- Use of social media (social networks) in individual EU countries (Figure 1);
- Social media usage by category for all EU countries (Figure 2);
- Social media usage by company size for all EU countries (Figure 3).

Figure 1 shows the use of social media and social networking in EU Member State enterprises (Eurostat, 2021). In 2021, 59% of EU businesses used at least one type of social media, an increase of 22 percentage points compared to 2015. Percentages vary considerably between countries, ranging from around 80% - Malta (84%) , Sweden (80%), the Netherlands (80%), to less than 40% - Bulgaria (39%) and Romania (36%). Slovak businesses using social media account for 48%, which is 11% points lower than the EU average.

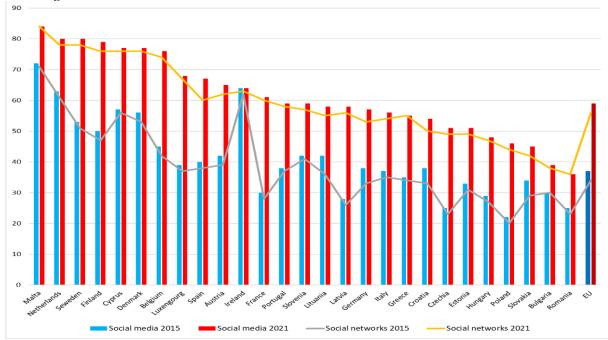


Figure 1. Enterpises EU using social media, social networsks (%), 2015 and 2021.

Source: Modified from Eurostat, 2021

Figure 2 shows the use of social media in EU companies by media category. According to Eurostat (Eurostat, 2021), social media are divided into four main categories:

- 4. Social networks: e.g. Facebook, LinedIn, Xing, etc.;
- 5. Corporate blogs or microblogs; e.g. Twitter, etc;
- 6. Multimedia content sharing websites; e.g. YouTube, Instagram, Flicker, SlideShare, etc.;
- 7. Wiki-based knowledge sharing tools.

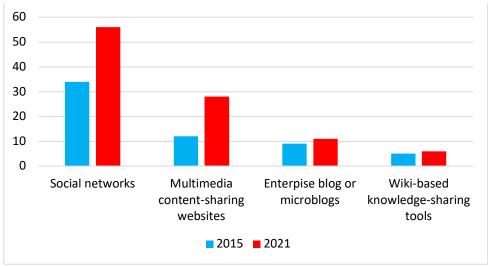


Figure 2. Enterprises EU using social media, by type of social media, 2015 and 2021.

Source: Modified from Eurostat, 2021

Of these social media categories, the use of social networks increased the most across the EU between 2015 and 2021 (by 22 percentage points). Between Member States, Belgium and France saw the highest increases (32 percentage points), followed by Latvia (31 percentage points) and Luxembourg (30 percentage points). The lowest increases were recorded in Bulgaria (by 8 percentage points) and Ireland (by 1 percentage point), although it should be noted that in 2015 social networking use in Ireland was already at a relatively high level compared to other countries (second highest in the EU) (Figure 1, 2). Other social media saw more modest or negligible growth over the same period: multimedia content sharing websites grew by 16%, blogs or microblogs by 2%, and the percentage of EU businesses using wiki-based knowledge sharing tools increased by only 1% (Figure 2).

As can be seen in Figure 3 (Eurostat, 2021), the extent to which an enterprise uses one or more types of social media is strongly influenced by the size of the enterprise. In 2021, 59% of EU businesses used social media. More than 8 out of 10 large enterprises reported using social media, a significantly higher share than for small enterprises (56%). Interestingly, 29% of all EU businesses used only one type of social media and a further 29% used two or more types of social media. Almost one third of small businesses (30%) preferred to use only one type of social media, compared to just over a quarter (26%) using two or more social media. Conversely, the proportion of large EU businesses using more than two social media was almost three times higher than the proportion using only one type (61% and 23% respectively) (Figure 3).

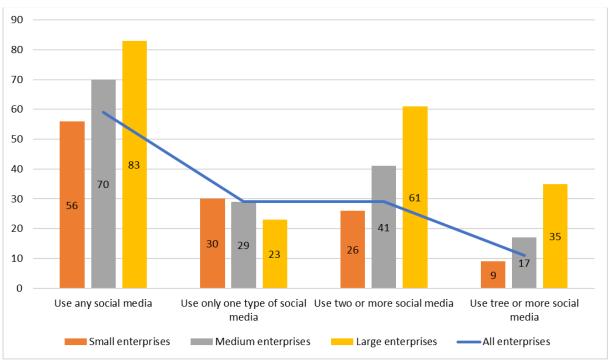


Figure 3. Enterprieses EU using social media (%), by size class, 2021.

Source: Modified from Eurostat, 2021

Based on the above literature and Eurostat surveys, the main objective of the paper was set, which is to examine the approach of enterprises operating in Slovakia to the use of social media, the creation of a research model, the implementation and evaluation of a questionnaire survey in enterprises in Slovakia. In the survey to focus on the approach of enterprises to the use of social media in per-sonal management. We consider the main findings to be the fact that Slovak enterprises evaluate the use of social media much better than in the Eurostat survey (difference of 34.61%). Similar is the case for the evaluation by size of enterprises. Our results are comparable only in the case of medium-sized enterprises (1% difference). Small and large enterprises are overestimated in our survey (small by 28%, large by 11.80%). Other more detailed findings emerge from Table 3 and Table 4.

2. Methods and methodology

The chapter contains the main methods used in the paper, the characteristics of the object of study and the model of the research variables.

The main research method was a questionnaire survey, which was conducted between February and June 2021. 115 respondents participated in the survey. The aim of the survey was to investigate the level of the approach of Slovak enterprises to the use of social media in the HR management based on the research model.

Standard methods of scientific work were used to process the paper, namely:

- analysis, comparison and selection (for the analysis of domestic and foreign literature),
- questionnaire survey in enterprises in Slovakia,
- statistical methods: descriptive statistics, contingency tables (to evaluate the results of the questionnaire survey in MS Excel),
- synthesis (to formulate conclusions and recommendations).

The object of the research was the use of social media in personnel management in Slovak companies. In addition to studying the literature, our research was conducted based on the research variables model. The research variables (Table 1) were divided into two groups. The first group (A1, A3, A4, A5, A8 and A12) consisted of variables that were evaluated on a 5-point Likert scale from 1 to 5, where a rating of 1 corresponded to minimal agreement, and a rating of 5 - to maximum agreement. The second group consisted of variables (A2, A7, A9, A10, A11, A13, A14, and A15) for which respondents were allowed to select any number of multiple-choice options (nominal values).

Table 1. Research variables model

Code	Research variable	Type of variable
A1	The company uses social media	scale
A2	Social media used by the company in personnel management	nominal
A3	Within social media, all employees are communicatively connected	scale
A4	Employees use social media for informal communication	scale
A5	The company / top management supports the use of social media in personnel management	scale
A6	Human resources/personnel management functions in which the company uses social media	nominal
A7	Types of information for HR management purposes provided by social media	nominal
A8	Quality of information provided by social media	scale
A9	Risks of using social media in HRM	nominal
A10	The respondent requires the following information about the employee obtained through social media	nominal
A11	What information about the employee can the HR manager obtain through social media	nominal
A12	Experience with information obtained through social media in HR management	scale
A13	Methods of verifying information obtained through social media	nominal
A14	Methods used to verify information obtained about an employee through social media	nominal
A15	Further developments in the use of social media in personnel management	nominal

Source: Prepared by authors

3. Results

The results are presented in the following structure: research sample, results of evaluation of research variables measured by Likert scale and results of evaluation of research variables measured by nominal values.

3.1 Research sample

The research sample consisted of 115 randomly selected enterprises operating in Slovakia. Their percentage representation based on the set parameters (PT1 - size of the enterprise, PT2 - ownership and PT3 - provision of personnel activities) is presented in Table 2.

Table 2. Research sample

Parameter	Attibute	% incidence
PT1 Size of enterprise	micro	19.13%
	small	21.74%
	medium	25.22%
	large	33.91%
PT2 Ownership	solely domestic owner	33.91%
	solely foreign owner	28.70%
	dominant foreign owner	19.13%
	dominant domestic owner	14.78%
	100% state ownership	3.48%
PT3 Staff activities provided	personnel department	45%
by	company management	26%

personnel manager	23%
external company	5%

Source: Prepared by authors

The highest representation in the research sample was 33.91% of large enterprises, the remaining groups of enterprises had approximately the same representation (from 25.22% - medium-sized enterprises, to 19.13% micro-sub-enterprises). In terms of ownership, in the research sample, there was approximately the same percentage of enterprises of domestic owners (namely 48.78, including 33.91% of exclusive domestic owners and 14.78% of domi-nant domestic owners) and enterprises of foreign owners 47.83%, including 28.72% of exclusive foreign owners and 19.13% of enterprises of dominant foreign owners. 100% state-owned enterprises were only 3.48% in the research sample. The last param-eter PT3 characterizes the unit that provides personnel activities in the enterprise. The highest percentage of respondents (45%) indicated the personnel department, for 26% of enterprises it is the enterprise management, for 23% of enterprises it is the personnel manager, and 5% of enterprises use an external firm to perform personnel activities.

3.2. Results of the evaluation of research variables measured by Likert scale

The appropriate results are shown in Table 3, with the maximum and minimum values highlighted in bold. Respondents scored highest on variable A1 (WAVG = 28.90), which means that they agree that their business uses social media. They rated the quality of information provided by social media the lowest (A8; WAVG = 24.40).

Table 3. Results of the evaluation of research variables measured by Likert scale.

Code	Variable -	R	esponde	nts' asses	ssment (°	%)	- MANC	STDEV
Code	variable	1	2	3	4	5	-WAVG	SIDEV
A1	The company uses social media	5.22	12.17	26.09	13.91	42.61	28.90	15.13
A3	Within social media, all employees are communicatively connected	8.70	23.48	22.61	23.48	21.74	25.00	6.54
A4	Employees use social media for informal communication	6.09	19.13	20.00	24.35	30.43	27.10	9.23
A5	The company / top management sup- ports the use of social media in person- nel management	10.43	13.91	21.74	26.96	26.96	26.50	7.78
A8	Quality of information provided by social media	0.87	13.91	53.91	28.70	2.61	24.40	22.60
A12	Experience with information obtained through social media in HR management	0.87	9.57	57.39	26.96	5.22	25.00	23.80

Source: Prepared by authors

A different view of the results is provided by aggregating the responses for agreeing results only. We can consider the ratings from 3 to 5 as agreeable results, which is 82.61% for variable A1 (The company uses social media), 67.83% for variable A3 (All employees are communicatively connected in social media), and 74% for variable A4 (Employees use social media for informal communication). 78%, for A5 (Company / top management of the subcompany supports the use of social media in HRM) - 75.66%, for A8 (Quality of information provided by social media) - 85.22% and A12 (Experience with information obtained through social media in HRM) - 89.57%.

3.3. Results of the evaluation of research variables measured based on nominal values

The results presented above go into more detail about the use of social media in HRM. The results can be seen in Table 4, sorted by % of occurrence. The highest and lowest % of occurrence are highlighted in bold.

Table 4. Results of the evaluation of research variables measured based on nominal values.

Code	Variable	Variable value	% incidence
		Facebook	86.09
		Instagram	54.78
	Social media used by the	LikedIn	45.22
A2	company in personnel	Youtube	35.65
	management	Twitter	13.04
		žiadne	2.61
		Profesia.sk	1.74
		recruiting staff for vacant posts	66.96
		recruiting staff for the needs of the company	64.35
		staff training	36.52
	T.T	motivating employees	33.04
	Human resources/per-	organising personnel activities	31.30
	sonnel management	planning the company's personnel policy	20.87
A6	functions in which the	OSH	18.26
	company uses social me-	management of personnel work in the company	15.65
	dia	creation of personnel databases	13.91
		deployment of employees in the company	6.09
		outplacment - placement of vacant and redundant employees on	
		the labour market	6.09
		releasing employees from the company	2.61
		on the interests of the employee	52.17
	Types of information for	on the private life of the employee	46.96
	HR management pur-	the attitudes of the employee	40.87
A7	poses provided by social media	the mental level of the employee	40.87
11,		the social context of the employee's life	32.17
		the employee's relationships	21.74
		the sexual orientation of the employee	15.65
	Risks of using social me-	hoauxy/false information	53.91
A9	dia in HRM	inaccurate information	38.26
11)		unverified information	34.78
		about his personality	76.52
		about his skills	73.91
		his interests	66.96
	The respondent requires	his attitudes	64.35
	the following infor-	the community in which he/she lives	38.26
A10	mation about the em-	his/her moral principles (faults)	37.39
AIU	ployee obtained through	his/her relationships	17.39
	social media	his political orientation	4.35
		about his family	2.61
		his/her religious affiliation	1.74
		his sexual orientation	0.87
			71.30
		those that reveal his personal attitudes and interests	
		information about his/her outside contacts and activities	57.39 52.17
		those which characterise him as a person	52.17
	What information should	those which inform about the community in which the staff member is active	52.17
A11	What information about the employee can the	those which cannot be obtained officially (on religious affiliation, political and sexual orientation, etc.)	51.30
	HR manager obtain through social media	information about his views on the enterprise, the enterprise's management, the organisation of work in the enterprise, the per-	33.91
		sonnel policy in the enterprise information on the relationships that the employee has in the un-	32.17
		dertaking	6.06
		information on his/her psychological disorders	6.96

	Methods of verifying in-	verifies only some of the information obtained about the employee	53.04
A13	formation obtained	verifies all the information obtained about the employee through	32.17
	through social networks	other methods -interview, references, etc.	44 =0
		does not verify the information obtained about the employee	14.78
		free interview with the employee	62.61
	Methods used to verify	structured interview with the employee	35.65
	information obtained	references	21.74
A14		semi-structured interview with employee	20.00
A14	about an employee through social networks	a comparison of the data obtained by the questionnaire method	14.70
		and the data obtained by the other methods	14.78
		the Delphi method	1.74
		other	0.00
		it is a source of supplementary information about the employee and will only be used as a supplementary source of information	54.78
A15	Further developments in the use of social media	about the employee when necessary it is a source of information about the employee and will therefore be used	22.61
	in personnel manage- ment	social networks will be used in HR management as a source of inspiration to make HR work more efficient in the company	14.78
		it is not a source of relevant information and therefore will not be used	6.96

Source: Prepared by authors

We consider the following results to be the most important: 86.09% of the companies in our research sample use Facebook in their HR management, the least used is Profesia.sk (1.74%). Enterprises use social media mainly for recruiting staff for vacancies (66.96), finding staff for the needs of the enterprise (64.35%), training (36.52%) and motivating employees (33.04%). For the purpose of personnel management, social media provides information about the employee's interests, private life, attitudes and men-tal level. The least important is information about the employee's sexual orientation. The main risk in using social media is hoaxes/false information (53.91%).

As the quality of information obtained from social media was criticized in Table 3, respondents also commented on the way information was verified. The response that only some information about the employee is verified (53.04%) had the highest % occurrence, followed by the next responses - all the in-formation obtained is verified (32.17%) and not verified (14.78%). Among the methods used to verify the information obtained about the employee, the most used are free interview with the employee (62.61%), structured interview (35.65%) and reference (21.74%).

Regarding the further development in the use of social media in HRM, 54.78% of the respondents said that it is a source of supplementary information about the employee and will be used as a supplementary source of information about the employee only when necessary, 22.61% of the reps trusted the use of social media, 14. 78% stated that social media will be used in HR management as a source of inspiration to make HR work more effective in the company, 6.96% of the respondents do not trust social media and declared that social media is not a relevant source of information and hence will not be used.

4. Discussion

Comments on the results of the research are presented in Chapter 3. We consider the fact that significantly more Slovak enterprises declare that they use social media (34.61% difference) to be an important finding (compared to the Eurostat survey). Similar is the case for the evaluation according to the size of sub-enterprises. Our results are comparable only in the case of medium-sized enterprises (1% difference). Small and large enterprises are overestimated in our survey (small by 28%, large by 11.80%). The differences result from the different methodology of data acquisition and evaluation, as well as from the focus of the research (Eurostat - all-general focus, our research - focus on personnel management).

We consider the use of information from social networks in the field of personnel management as promising, but only as complementary, which needs to be subsequently verified by other methods. Pre-

eminently because of the elimination of the high risk of hoaxes. Some of the functions of per-sonal management that we have studied, such as recruiting personnel for vacancies, searching for personnel for the needs of the company, training and motivating employees, are consistent with the publications of foreign authors.

The main limitation of our research is the size of the research sample and the different methodology of data collection and evaluation compared to the cited publications. For these reasons, for further research we suggest:

- Expand the research sample of enterprises operating in Slovakia;
- Establish criteria comparable to other authors based on the published literature;
- Focus attention on other areas of social media use besides communication, e.g. knowledge sharing, training and motivating employees;
- Also focus on social media using wiki-based knowledge sharing tools;
- To examine in more detail the factors that inhibit the use of social media and the factories that inhibit their use.

Funding: This research was funded by VEGA No. 1/0662/23 Digital transformation of companies and their readiness to integrate the elements of Industry 5.0 – proportion 100 %.

References

- 1. Chen, X., & Wei, S. (2019). Enterprise social media use and overload: A curvilinear relationship. *Journal of Information Technology*, 34(1), 22-38. https://doi.org/10.1177/0268396218802728
- 2. Drábek, J., & Halaj, D. (2010). *Marketingové a investičné rozhodovanie podniku* (Marketing and investment decision making of a company). Zvolen: Technická univerzita vo Zvolene, 2010. 103 s. ISBN 978-80-228-2197-1
- 3. Eurostat (2021). Social media statistics on the use by enterprises. https://ec.europa.eu/eurostat/statistics-ex-plained/index.php?title=Social_media_-_statistics_on_the_use_by_enterprises
- 4. Fu, J., Sawang, S., & Sun, Y. (2019). Enterprise social media adoption: Its impact on social capital in work and job satisfaction. *Sustainability*, 11(16), 4453. https://doi.org/10.3390/su11164453
- 5. Galko, D. (2021). Trendy v marketingovej komunikácii. *Doctoral dissertation*. Brno: AMBIS University. 67 p. https://is.ambis.cz/th/y8rx3/
- 6. Gburová, P. J., & Fedorko, P. I. (2019). Sociálne média ako súčasť elektronickej komercie a ich vplyv na nákupné správanie spotrebiteľa. *Journal of Global Science*, 4(special), 1-6. ISSN 2453-765X
- 7. Graupner, S., Bartolini, C., Motahari, H., & Mirylenka, D. (2012). When social media meet the enterprise. *IEEE 16th International Enterprise Distributed Object Computing Conference*, 201-210. doi: 10.1109/EDOC.2012.31
- 8. Horváth, P. J., Fedorko, P. I., & Rigasová, B. L. (2023). Analytický pohľad na efektivitu reklamy na sociálnych sieťach v post-pandemickom trhovom prostredí. *Journal of Global Science*, 8(2), 1-7. ISSN 2453-765X
- 9. Laitinen, K., & Sivunen, A. (2021). Enablers of and constraints on employees' information sharing on enterprise social media. *Information Technology & People*, 34(2), 642-665. https://doi.org/10.1108/ITP-04-2019-0186
- 10. Leonardi, P. M., Huysman, M., & Steinfield, C. (2013). Enterprise social media: Definition, history, and prospects for the study of social technologies in organizations. Journal of computer-mediated communication, 19(1), 1-19. https://doi.org/10.1111/jcc4.12029
- 11. Liu, D., Hou, B., Liu, Y., & Liu, P. (2021). Falling in love with work: The effect of enterprise social media on thriving at work. *Frontiers in Psychology*, 12, 769054. https://doi.org/10.3389/fpsyg.2021.769054
- 12. Liu, Y., & Bakici, T. (2019). Enterprise social media usage: The motives and the moderating role of public social media experience. *Computers in Human Behavior*, 101, 163-172. https://doi.org/10.1016/j.chb.2019.07.029
- 13. Ma, L., Zhang, X., & Ding, X. (2020). Enterprise social media usage and knowledge hiding: a motivation theory perspective. Journal of Knowledge Management, 24(9), 2149-2169. https://doi.org/10.1108/JKM-03-2020-0234
- 14. Nastišin, Ľ. (2021). Analýza trendov v oblasti reklamy, dosahu príspevkov a výkonu typov obsahu na Facebooku a Instagrame v období pandémie Covid-19. *Journal of Global Science*, 6(1), 1-5. ISSN 2453-765X
- 15. Ng, K. H., & Yee, R. W. (2020). Technological affordance discovery in enterprise social media success. Industrial Management & Data Systems, 120(10), 1797-1812. https://doi.org/10.1108/IMDS-01-2020-0036
- 16. Shang, R. A., & Sun, Y. (2021). So little time for so many ties: fit between the social capital embedded in enterprise social media and individual learning requirements. *Computers in Human Behavior*, 120(1), 106615. https://doi.org/10.1016/j.chb.2020.106615
- 17. Sharma, A., Bhatnagar, J., Jaiswal, M., & Thite, M. (2021). Interplay of enterprise social media and learning at work: a qualitative investigation. *Journal of Enterprise Information Management*, 35(2), 550-565. https://doi.org/10.1108/JEIM-06-2020-0227
- 18. Trubenová, A. (2022). Špecifiká zapojenia influencerov do marketingovej komunikácie na sociálnych sieťach. *Doctoral dissertation*. Brno: AMBIS University. 64 p. https://is.ambis.cz/th/d4774/

- 19. Wang, Z., Hangeldiyeva, M., Ali, A., & Guo, M. (2022). Effect of enterprise social media on employee creativity: social exchange theory perspective. *Frontiers in Psychology*, 12, 812490. https://doi.org/10.3389/fpsyg.2021.812490
- 20. Yee, R. W., Miquel-Romero, M. J., & Cruz-Ros, S. (2021). Why and how to use enterprise social media platforms: The employee's perspective. *Journal of business research*, 137, 517-526. https://doi.org/10.1016/j.jbusres.2021.08.057
- 21. Zhang, W., Yang, Y., & Liang, H. (2023). A Bibliometric Analysis of Enterprise Social Media in Digital Economy: Research Hotspots and Trends. Sustainability, 15(16), 12545. https://doi.org/10.3390/su151612545

Firms and social responsibility: maintaining sustainability through ESG

Andrea Čambalíková 1, Boris Rumanko 2, Branislav Zagoršek 3

- Department of Management, Faculty of Business Management, University of Economics in Bratislava, Slovakia; andrea.cam-balikova@euba.sk
- ² Department of Management, Faculty of Business Management, University of Economics in Bratislava, Slovakia; boris.ru-manko@euba.sk
- ³ Department of Management, Faculty of Business Management, University of Economics in Bratislava, Slovakia; branislav.zagorsek@euba.sk

Abstract: In today's globalized world of increasing importance of sustainability, there is an evident shift from the traditional business focusing only on profits for shareholders towards Corporate Social Responsibility (CSR) and consequently towards the new concept of ESG (Environmental, Social and Governance). The Covid-19 pandemic and economic challenges have underlined the need for sustainability in business. CSR is being transformed into ESG, which emphasizes measurable strategies and transparency of the impact of companies on the world, from ethical behavior to environmental issues. Businesses are not only called upon to minimize negative impacts, but also to actively contribute to society and protect the environment. Integrating the latest technological advances and digital tools into business strategies is key to the future of CSR and ESG. Growing consumer demand, especially from younger generations, for sustainable products and services is pushing businesses to adopt sustainable models. Overall, sustainability can increase the value of companies, influence employee performance and motivation, improve their reputation and strengthen their competitiveness. This paper seeks to chart the historical development of CSR and ESG, highlighting the influence of academic contributions, international policies and major societal events on their understanding and definition.

Keywords: ESG; social responsibility; sustainability

Introduction

In the past few decades, however, more business leaders have recognized that they have a responsibility to do more than simply maximize profits for shareholders and executives. Rather, they have a social responsibility to do what is best, not just for their companies, but people, the planet, and society. The Covid-19 pandemic is severely affecting the world's economies at a time when businesses were already adapting to volatility and uncertainty as a way of life. With the economic outlook and threats of all kinds continuing to test even the strongest organizations, companies are facing a variety of challenges as they strive to find growth and stay competitive. One of the challenges is sustainability, whereas sustainability issues are having an increasingly dramatic impact on businesses, investors, consumers, the workforce and governments. Whilst the Covid-19 pandemic has caused widespread disruption, it has also provided momentum and opportunity to rethink and reconfigure for resilience. Sustainability in business refers to a company's strategy and actions to eliminate the adverse environmental and social impacts caused by business operations. Sustainability has become increasingly critical for organizations to remain relevant and competitive in today's world. Much like digital transformation, driving sustainability requires organizations to transform every division of their business. Today, sustainability should be an integral part of developing corporate strategy (World Economic Forum, 2022). Sustainability is not just for large corporations; businesses of any size can work toward a sustainable business model by following specific practices and adopting a sustainable strategy. The 2030 Agenda, with its 17 Sustainable Development Goals, presents a clear vision for industries and organizations to ensure economic, social and environmental well-being (Richnák & Fidlerová, 2022).

Corporate social responsibility (CSR) refers to businesses taking responsibility for their behavior and its impact on society. This can include employment conditions and labor standards, freedom of

association, well-being at work, non-discrimination and gender balance, stakeholder engagement, human rights, preventing environmental harm, including reducing emissions and pollution, and eliminating bribery and corruption. CSR is considered important for competitiveness and has been shown to yield benefits in terms of risk management, cost savings, access to capital, customer relationships, and human resource management and innovation capacity. Corporate social responsibility was the buzzword for sustainable business practices, and today, everyone seems to be talking about environmental, social, and governance, also known as ESG. Many understand ESG as CSR raised into a measurable strategy bringing transparency and accountability to a company's environmental and social impacts. CSR is a self-regulated strategy employed by organizations to have a positive impact on society and ESG, on the other hand, takes it one-step further by measuring these efforts at a more precise assessment, often demanded by investors. It helps companies set measurable goals to show their process and where they are on their sustainability journeys. In the presented contribution, we will deal with the explanation of the concepts and the difference between CSR and ESG, developing ESG as a cornerstone of achieving sustainability in business practice from a theoretical as well as a practical point of view.

The aim of this paper is to provide a distinctive historical and content perspective on the evolution of CSR and ESG as a conceptual paradigm for maintaining business sustainability by reviewing the most relevant factors that have shaped its understanding and definition, such as academic contributions, international policies and significant social and political events.

1. Theoretical background

The concept of sustainability has expanded and complimented much of the CSR discussion during the past 20 years. Although initially defined and discussed in the 20th century, sustainability has become one of the most enduring topics shaping CSR in the 2000s. Although the idea of sustainability is embedded in CSR and they are interrelated, the term itself has become ever more popular with both the business and the academic communities (Carroll, 2021). The term social responsibility has different definitions and has continued to evolve, in both meaning and practice. Perhaps, the most granular of the existing definitions is the one provided by the International Organization for Standardization (ISO, 2010) where they described social responsibility as "the responsibility of an organization for the impacts of its decisions and activities on society and the environment, through transparent and ethical behavior that contributes to sustainable development". Corporate social responsibility is a management concept in which companies integrate social and environmental concerns into their business strategy, to positively impact society while improving brand reputation. In its modern formulation, corporate social responsibility is a product of the post-World War II period. Given impetus by the changes in social consciousness that came to a crescendo in the 1960s, especially the civil rights, women's, consumers and environmental movements, CSR has grown in relevance and stature ever since. CSR has been in longer-term use as an explicit framework to better understand the business and society relationship. Early on, CSR was used as a general term arguing that managers ought to seriously consider their impacts on society. It was later thought to embrace those actions, which managers and organizations take to protect and improve the welfare of society along with business's own interests. In this view, there are two active aspects of CSR, protecting and improving. To protect society implies that companies need to avoid their negative impacts (e.g., pollution, discrimination, unsafe products). Improving the welfare of society suggests that companies need to create positive benefits for society (e.g., philanthropy, community relations). Another early thought was that companies not only had economic and legal obligations but also certain responsibilities that extended beyond those obligations, though these were not spelled out (Carroll, 2015). A social responsibility initiative does not automatically translate into economic benefit for an organization; in fact, whatever benefits are derivable will be based on consumers' assessment of such initiatives as they relate to the activities of the business, not merely the act. The concept of CSR also requires organizations to create a safe working environment that addresses diversity and encourages the fair distribution of the organization's profit in society in an ethical manner (Zulfiqar et al., 2019). The challenge for most organizations has been how to achieve a balance that works for all the parties. The arguments in favor of CSR are that corporations can only continue to be socially responsible on the strength that the business strives with equally satisfied shareholders and investors (Okafor, 2021). Richnák (2022) describes the sustainability objectives in the context of the development of Industry 5.0 in

logistics, as sustainability is expected to have a significant impact not only on logistics processes and activities, but also on the entire supply chain.

Today, CSR is a global concept that has progressed from the interplay of thought and practice. CSR represents a language and a perspective that is known the world over and has become increasingly vital, as stakeholders have communicated that modern businesses are expected to do more than make money and obey the law. Today, ethics and philanthropy help to round out the socially responsible expectations placed on modern organizations striving to be sustainable in a competitive, dynamic, global marketplace. Socially responsible firms make a special effort to integrate a concern for other stakeholders in their policies, decisions and operations. By the early 2000s, it had become an essential strategy for many companies, both large and small. While CSR is an excellent strategy for driving awareness of an organization's initiatives, indeed today's stakeholders demand transparency and clear evidence showing that you walk the talk.

The future of CSR will also have to take into consideration the latest technological advances and their role as part of new business frameworks and strategies. The adoption and adaptation to new digitalization processes and tools, as well as the incorporation of artificial intelligence into the business environment are relevant challenges not only for the CSR debate, but also for corporations in general. In this sense, business frameworks will have to adapt and evolve in order to embrace the latest tools, but they will need to do so through an overarching and holistic framework that is based on the principles of social responsibility in a way that it combines the notions of sustainability, the generation of shared value, and the belief that companies can redefine their purpose to do what is best for the world (Latapí, 2019).

Companies that do not have the relevant data to support their CSR commitments or solely focus on the wrong things risk being accused of greenwashing. A recent study found that even the companies with a high overall CSR score are involved in some form of greenwashing practice (Aggarwal et al., 2011). Today, transparency is the backbone of a company's sustainability claims, and that is where ESG comes in.

ESG was first proposed by the United Nations Global Compact in the Environmental Planning and Financial Action agency (Wong, 2021). The three letters in the ESG acronym stand for environmental, social, and corporate governance, respectively. In 2015, the United Nations highlighted the role of digital technologies in enhancing sustainability in the 2030 Agenda's Sustainable Development Goals (Bexell & Jönsson, 2022). In 2021, the European Commission adopted the sustainable finance package, which includes the proposed CSRD which reforms, and greatly increases the scope of reporting required compared to the NFRD disclosure requirements. The increase in scope means that from 2023 companies in the EU will now have to report on ESG issues. In sum, the EU is currently the forerunner of ESG regulation, while the United States and Asia are lagging behind.

The economic strength of enterprises is closely connected to sustainable development and ESG concepts. ESG is a process of quantifying an organization's commitment to social and environmental factors. It uses specific metrics related to the intangible assets of an organization that are applied to tabulate a score of the level of this commitment. That is a corporate social credit score. These three criteria are equally important. It is also an ever-changing concept. If one think back to the early days of the ESG phenomena, the E was covered if one took cognizance of the ozone layer, the S was covered if one considered the employees in any other perspective than income-generated objects and the G was ticked if the company had a board of directors. This playing field has changed drastically over the last few years. ESG is more likely a compass to be guided to a destination, rather than the destination itself. Today ESG is an all-inclusive phrase when talking about sustainability in a business and it is not all about the E. The environmental criteria are centered around the energy and resources a company uses, the waste a company creates, and the contribution a company makes to climate change by expelling greenhouse gas emissions. It also looks at a company's use of clean technology and the use of green buildings. The social criteria pertain to the relationships and the reputation of the company within the community where it is situated, which can include the international community and commonly involves matters such as human rights and the reduction of poverty. It also goes further and regards human capital with a focus on health and safety and labor management, product liability and social opportunities such as access to communication, access to finance, access to healthcare and even access to health and nutrition. The governance criteria refer to the internal system of practices, controls and procedures company adopts in order to govern itself, make effective decisions, comply with the law, and meet the needs of external stakeholders, and it can include issues such as fair corporate compensation and anti-corruption. Board diversity, accountability and corporate behavior regarding business ethics and diversity and inclusion policies also play an important role when considering corporate governance of a company (Fenwick, 2022).

ESG literature is founded on three fundamental theories: stakeholder, legitimacy and signaling theory (Santamaria et al., 2021). Stakeholder theory focuses on the potential for long-term success via engagement with various stakeholders (e.g., employees, customers, creditors, society and the environment). Non-financial data may help firms prosper and remain afloat by meeting the requirements of a wide range of stakeholders. On the other hand, other academics believe that stakeholder unhappiness can hurt productivity and jeopardies a company's future. The satisfaction of diverse stakeholder groups significantly incentivizes growing economic performance (Orlitzky et al., 2003). Legitimacy theory is one of the most well-known approaches in social and environmental accounting. As per Suchman (1995), individual firms and the society in which they operate have an implicit social agreement. Companies use disclosure strategies to gain social acceptability in general. Legitimacy is a situation or status that exists when an entity's value system is consistent with the value system of the broader social system of which the entity is a member. The signaling idea was initially proposed by Spence (1973). It is primarily focused on decreasing the imbalance of knowledge between two parties. It refers to situations where two parties have unequal access to information, with one party deciding whether and how to disclose the information.

2. Methods and methodology

The aim of this paper is to provide a distinctive historical and content perspective on the evolution of CSR and ESG as a conceptual paradigm for maintaining business sustainability by reviewing the most relevant factors that have shaped its understanding and definition, such as academic contributions, international policies and significant social and political events. To do so, the method used is a comprehensive literature review that explores the most relevant academic contributions and public events that have influenced the process of CSR and ESG and how they have done so.

3. Results and Discussion

Sustainability has become increasingly critical for organizations to remain relevant and competitive in today's world. Today, sustainability should be an integral part of developing corporate strategy. 90% of executives believe sustainability is important. The issue is a lack of implementation with only 60% of organizations having sustainability strategies. A sustainability strategy and a chief sustainability officer reporting directly to the board is, in fact, imperative (World Economic Forum, 2022). The sustainability balanced scorecard (SBSC), which measures performance and management control, plays a vital role in guiding the company towards sustainability goals (Mio et al., 2022).

One of the most powerful factors shaping the shift towards sustainability is investor pressure. Gartner research (2021) finds that 85% of investors considered ESG factors in their investments in 2020 while 91% of banks monitor ESG performance of investments. With an increasing number of millennials and Gen-Z consumers, demand for sustainable products is increasing, 73% of Gen-Z consumers say they are willing to spend more on sustainable products (First Insight, 2022). The EU's taxonomy which regulates businesses based on how environmentally sustainable they are, affects not only EU businesses but global firms who do business in the EU. Considering the move by many governments toward sustainability, organizations should start transforming their operations to become more sustainable. Being proactive about sustainability will lead to having better relations with regulatory bodies (Spinaci, 2022). Being a sustainable business is important to attract talent. In a Deloitte survey (2021), 49% of Gen-Zs and 44% of millennials said that they had made career choices based on their personal ethics. Being sustainable will lead to employees being more motivated to perform better. Sustainability reduces costs and can affect operating profits by up to 60%, according to McKinsey & Company (2020). A strong environmental proposition can enhance returns by allocating capital to more promising, more sustainable opportunities (for example, renewables, waste reduction, and scrubbers). It can also help companies avoid investments that may not pay off because of longer-term environmental issues (such as writedowns in the value of oil tankers). Taking account of investment returns requires that you start from the proper baseline: A do-nothing approach is usually an eroding line, not a straight line. Continuing to rely on energy-hungry plants and equipment, for example, can drain cash going forward.

In the context of sustainable development goals, innovative business models have brought competitive advantage by improving the sustainability performance of organizations. The process of creating a sustainable business model becomes an innovative part of business strategy. Industries and businesses are using the concept of sustainable business models to achieve their economic, environmental and social goals simultaneously. The popularity and success of sustainable business models in all application areas are increasing with the increasing use of advanced technologies (Mio et al., 2022).

In order to maintain a good reputation and thrive in a competitive business environment, organizations seek to regularly inform their stakeholders about the results of their activities and operations in different areas through a variety of reports, including the disclosure of non-financial information (Lewis et al., 2014). The publication of sustainability reports positively influences stakeholder trust and their view of a company's reputation (Kim, 2019). One such type of disclosure is non-financial sustainability reporting (NFSR) (Zimon et al., 2022). The assumed relationship between sustainability and reputation had limited support in existing evidence. However, findings suggest that better sustainability performance has a positive impact on sustainability reputation (Alon & Vidovic, 2015). Reputation can play an important role in attracting stakeholders and encouraging more active interaction with the company, thereby increasing customer satisfaction, creating greater loyalty and commitment to the company, and strengthening customer trust. It also contributes to attractiveness to potential employees and retention of existing employees, while increasing their work motivation (Zimon et al., 2022). Všeobecne platí, že hodnotenie sociálnych a environmentálnych aktivít spoločností sa zakladá na informáciách, ktoré spoločnosti poskytujú vo svojich správach o udržateľnosti alebo o obchodnej zodpovednosti. To znamená, že udržateľnosť sa javí ako predchodca reputácie spoločnosti a pôsobí ako nástroj na zlepšenie vnímania týchto aktivít zo strany zainteresovaných strán (Gomez-Trujillo et al., 2020).

According to PwC (2023) a company's impact on the world around it has not always been attributed to an economic value or cost. The widely held assumption has been that any actions a business takes that have a negative impact on others, provided those actions stay within the law, are externalities for which society and the environment pay rather than the company. Until a company's impact starts to affect its finances, it will likely have limited effect on its enterprise value. This assumption is, however, starting to be questioned. There is a growing recognition that, over time, externalities will become internalized and directly affect a company's cash flow, its access to finance and, therefore, its enterprise value. For example, in a world of constant scrutiny, a company exposed as behaving in unsustainable ways may face higher costs, lose market share, struggle to attract talent, or even forfeit its license to operate in some communities or countries. Conversely, a company that demonstrates its positive impact consistently over time builds trust with consumers, investors and others, which may create a positive contribution to cash flow and thus to value.

Sustainability clearly improves the quality of our lives, protects our ecosystem and preserves natural resources for future generations. In the corporate world, sustainability is associated with an organization's holistic approach, taking into account everything, from manufacturing to logistics to customer service. Going green and sustainable is not only beneficial for the company, but it also maximizes the benefits from an environmental focus in the long-term. The findings show that the understanding of corporate responsibility has evolved from being limited to the generation of profit to include a broader set of responsibilities to the latest belief that the main responsibility of companies should be the generation of shared value. The findings also indicate that as social expectations of corporate behavior changed, so did the concept of CSR and consequently ESG. The findings suggest that CSR/ESG continues to be relevant within academic literature. Finally, this paper gives way for future academic research to explore how ESG can help address the latest social expectations of generating shared value as a main business objective, which in turn may have practical implications if ESG is implemented with this in mind.

Funding: The paper is a partial output of VEGA No. 1/0010/23 "Adaptability of corporate culture - a factor supporting the resilience and sustainability of businesses in Slovakia in the post-covid period".

References

- 1. Aggarwal, P. & Kadyan, A. (2011). Greenwashing: The Darker Side of CSR. *Indian Journal of Applied Research*. 4. 61-66. https://doi.org/10.15373/2249555X/MAR2014/20.
- 2. Alon, A., & Vidovic, M. (2015). Sustainability performance and assurance: Influence on reputation. *Corporate Reputation Review*, 18, 337-352. https://doi.org/10.1057/crr.2015.17
- 3. Bexell, M. & Jönsson, K. (2022). Realizing the 2030 Agenda for sustainable development–engaging national parliaments? *Policy Studies*, 43(4), 621-639. https://doi.org/10.1080/01442872.2020.1803255.
- 4. Carroll, A.B. (2015). Corporate social responsibility. *Organizational dynamics*, 44(2), 87-96. https://doi.org/10.1016/j.orgdyn.2015.02.002.
- 5. Carroll, A.B. (2021). Corporate social responsibility: Perspectives on the CSR construct's development and future. *Business & Society*, 60(6), 1258-1278. https://doi.org/10.1177/00076503211001765.
- 6. Deloitte (2021). A call for accountability and action. Available at: https://www2.deloitte.com/content/dam/Deloitte/mk/Documents/about-deloitte/2021-deloitte-global-millennial-survey-report.pdf
- 7. European Commission (2021). Proposal for a Directive of the European Parliament and the Council amending Directive 2013/34/EU, Directive 2004/109/EC, Directive 2006/43/EC and Regulation (EU) No 537/2014, as regards corporate sustainability reporting. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0189
- 8. Fenwick, M., Joubert, T., Van Wyk, S., & Vermeulen, E.P. (2022). ESG as a Business Model for SMEs. *European Corporate Governance Institute-Law Working Paper*, (642). http://dx.doi.org/10.2139/ssrn.4098644.
- 9. First Insight (2022). The state of consumer spending: Gen Z shoppers demand sustainable retail. Available at: https://www.firstinsight.com/white-papers-posts/gen-z-shoppers-demand-sustainability
- 10. Gartner (2021). The ESG Imperative: 7 Factors for Finance Leaders to Consider. Available at: https://www.gartner.com/smarterwithgartner/the-esg-imperative-7-factors-for-finance-leaders-to-consider
- 11. Gomez-Trujillo, A. M., Velez-Ocampo, J., & Gonzalez-Perez, M. A. (2020). A literature review on the causality between sustainability and corporate reputation: What goes first? *Management of Environmental Quality: An International Journal*, 31(2), 406-430. https://doi.org/10.1108/MEQ-09-2019-0207.
- 12. International Organization for Standardization. (2010). Guidance on social responsibility.
- 13. Kim, S. (2019). The process model of corporate social responsibility (CSR) communication: CSR communication and its relationship with consumers' CSR knowledge, trust, and corporate reputation perception. *Journal of business ethics*, 154(4), 1143-1159. https://doi.org/10.1007/s10551-017-3433-6
- 14. Latapí Agudelo, M.A., Jóhannsdóttir, L., & Davídsdóttir, B. (2019). A literature review of the history and evolution of corporate social responsibility. *International Journal of Corporate Social Responsibility*, 4(1), 1-23. https://doi.org/10.1186/s40991-018-0039-y.
- 15. Lewis, B. W., Walls, J. L., & Dowell, G. W. (2014). Difference in degrees: CEO characteristics and firm environmental disclosure. *Strategic Management Journal*, 35(5), 712-722. https://doi.org/10.1002/smj.2127.
- 16. McKinsey & Company (2020). How the E in ESG creates business value. Available at: https://www.mckinsey.com/capabilities/sustainability/our-insights/sustainability-blog/how-the-e-in-esg-creates-business-value
- 17. Mio, C., Costantini, A., & Panfilo, S. (2022). Performance measurement tools for sustainable business: A systematic literature review on the sustainability balanced scorecard use. *Corporate social responsibility and environmental management*, 29(2), 367-384. https://doi.org/10.1002/csr.2206.
- 18. Okafor, A., Adeleye, B.N., & Adusei, M. (2021). Corporate social responsibility and financial performance: Evidence from US tech firms. *Journal of Cleaner Production*, 292. https://doi.org/10.1016/j.jclepro.2021.126078.
- 19. Orlitzky, M., Schmidt, F.L. and Rynes, S.L. (2003). Corporate social and environmental responsibility: a meta-analysis. *Organization Studies*, Vol. 24 No. 3, pp. 403-441. https://doi.org/10.1002/csr.2446.
- 20. PwC (2023). Today's externalities, tomorrow's internalities: Why impact matters for company valuations. Available at: https://www.pwc.com/gx/en/services/audit-assurance/corporate-reporting/esg-impact-company-valuation.html
- 21. Richnák, P. (2022). Digital Transformation of Logistics in the Era of Industry 4.0: On the Way to a New Generation of Logistics 4.0. Wolters Kluwer Hungary.
- 22. Richnák, P., & Fidlerová, H. (2022). Impact and Potential of Sustainable Development Goals in Dimension of the Technological Revolution Industry 4.0 within the Analysis of Industrial Enterprises. Energies: *Journal of Related Scientific Research, Technology Development, Engineering, and the Studies in Policy and Management*, 15(10), 1-20. https://doi.org/10.3390/en15103697.
- 23. Santamaria, R., Paolone, F., Cucari, N. and Dezi, L. (2021). Non-financial strategy disclosure and environmental, social and governance score: insight from a configurational approach. *Business Strategy and the Environment*, Vol. 30 No. 4, pp. 1993-2007, doi: 10.1002/bse.2728.
- 24. Spence, A. (1973). Michael Job marketing signaling. *Quarterly Journal of Economics*. Vol. 87 No. 3, pp. 355-3731. doi:10.2307/1882010.

- 25. Spinaci, S. (2022). EU taxonomy: Delegated acts on climate, and nuclear and gas. Available at: https://www.europa.eu/RegData/etudes/BRIE/2022/698935/EPRS BRI(2022)698935 EN.pdf
- 26. Suchman, M.C. (1995). Managing legitimacy: strategic and institutional approaches. *The Academy of Management Review*, Vol. 20 No. 3, pp. 571-610. https://doi.org/10.2307/258788.
- 27. Wong, W.C., Batten, J.A., Mohamed-Arshad, S.B., Nordin, S., & Adzis, A.A. (2021). Does ESG certification add firm value? *Finance Research Letters*, 39, 101593. https://doi.org/10.1016/j.frl.2020.101593.
- 28. World Economic Forum. (2022). Why sustainability is crucial for corporate strategy. Available at: https://www.weforum.org/agenda/2022/06/why-sustainability-is-crucial-for-corporate-strategy/
- 29. Zimon, G., Arianpoor, A., & Salehi, M. (2022). Sustainability reporting and corporate reputation: the moderating effect of CEO opportunistic behavior. *Sustainability*, 14(3), 1257. https://doi.org/10.3390/su14031257.
- 30. Zulfiqar, S., Sadaf, R., Popp, J., Vveinhardt, J., & Máté, D. (2019). An examination of corporate social responsibility and employee behavior: The case of Pakistan. *Sustainability*, 11(13). https://doi.org/10.3390/su11133515.

Software Tools for IT Service Management

Diana Bednarčíková 1,*

- 1* Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia; diana.bednarcikova@euba.sk
- * Correspondence: Diana Bednarčíková, diana.bednarcikova@euba.sk

Abstract: In companies, the currently ongoing industrial revolutions (Industry 4.0 and Industry 5.0) have stimulated the use of digital technologies and their subsequent interaction with employees, which requires proper The Information Technology Service Management (ITSM). Above all, also for reasons of technological innovations and changing processes, for which proper management and organization it is recommended to use frameworks, standards and other tools, including software tools - ITSM software. ITSM software represents tools for managing work and business flows that support IT service management, optimize activities and maximize IT services. The aim of the scientific article is to map the software tools used in the management of information technology services and to obtain an overview of the current and future developments on the market in the field of ITSM software. The scientific article provides an overview of the definition of ITSM software and criteria for their selection, the current and future situation of the global ITSM software market, key providers, the world's ITSM software in use and their basic comparison, features and benefits of ITSM software implementation in enterprises.

Keywords: ITSM; IT Service Management; ITSM Software, ITSM market

Introduction

The fourth industrial revolution (Industry 4.0) stimulated the use of digital technologies in enterprises, and the fifth industrial revolution following it - Industry 5.0, marked by the interaction of people between technology and machines, becomes a source of sustainability for business prosperity, which requires proper IT Management and IT Service Management (ITSM). Industry 5.0, as stated by Paschek, Mocan & Draghici (2019), is to enter the future of everyday business thanks to the speed of further technological development and the changing integration of human processes. Processes are one of the key success factors of management and ITSM. To organize business processes in information technology services (ITS) and in general in their management, the use of: best practices, frameworks, standards, methods and tools that provide guidance for managing ITS throughout their life cycle is emphasized. The most prominent and widely used ITSM framework is ITIL, which provides proven, comprehensive and practical guidance and emphasizes the importance of using tools to support processes.

The scientific article focuses on the review of the existence and analysis of the use of software tools in the management of information technology services.

1. Theoretical background

The implementation of ITSM processes by manual techniques is difficult because, according to Wan & Chan (2007), it can be time-consuming, reactive and not proactive. For these reasons, it is necessary to use adequate techniques and tools in the implementation and management of ITS, the use of which is highlighted by several scientists such as: Stamelos et al. (2000), Brenner, Schaaf & Scherer (2009), Plotnikova et al. (2023).

1.1. ITSM Software

There are many ITSM tools on the market that are primarily specified as software tools. Rouhani (2017) emphasizes the use of adequate tools - ITSM software, on the use of which the successful implementation of ITSM depends. The software tools themselves combine a set of high-performance software components that can be layered on commodity hardware and can be configured to support database management software along with a high-performance execution engine and query optimization to make the most of parallelization and data distribution (Loshin, 2013).

Software tools and solutions in the field of information technology service management are referred to by several scientists (Brenner, Schaaf & Scherer, 2009; Eikebrokk & Iden, 2012; Rouhani & Zare Ravasan, 2014; Rouhani, 2017; Permatasari et al., 2023) as "software ITSM". ITSM software is defined as tools that help organizations more effectively implement their ITSM strategy and regulate how IT services are provided in organizations depending on people, processes, suppliers, budget and results (OpenText, 2023). Also, ITSM software is defined as an ITSM support tool (Jassim, Bader & Safran, 2022; Duce, 2023) or as the right information technology that is needed in companies to optimize activities and maximize IT services (Permatasari et al., 2023). Gartner (2023) ITSM software refers to platforms for ITSM that offer workflow management and enable organizations to design, automate, plan, manage, deliver messages and deliver integrated ITS and related digital experiences.

The existence of standardized procedures, frameworks and other methods in the field of ITSM (e. g.: ITIL and others) has encouraged companies to use software solutions. This is also confirmed by Axelos, 2019; Brenner, Schaaf & Scherer (2009), who state that IT service providers must increasingly rely on ITSM software solutions due to more complex approaches to ITSM. The use of ITSM software in the field of ITIL is also emphasized by Eikebrokk & Iden (2012), especially in the implementation of ITIL, and they refer to them as "ITIL software tools", which:

- are used to record and track cases handled by various processes and include databases for storing data on key ITIL elements such as: assets, configuration items, capacities and availability;
- are based on modules and most often one module per ITIL process.

1.2. Requirements for Choosing ITSM Software

For the successful implementation of an ITSM project, it is necessary to choose the appropriate ITSM software (Rouhani & Zare Ravasan, 2014). The selection of the ITSM tools themselves is conditioned by the initial examination of suitable products on the market and subsequent evaluation of the pros and cons, taking into account the organization's goals, set goals and contractual guidelines (Jassim, Bader & Safran, 2022). The initial examination of software products on the market and the selection itself depends on several criteria. An important criterion according to Wan & Chan (2007) is the sufficient development of software tools and their integrability

To cover the functions of ITSM software or other solution according to Rouhani & Zare Ravasan (2014), functional and non-functional requirements should be supported in order for enterprises to implement ITSM.

- Functional criteria Criteria based on a set of frameworks and best practices in the form of standard processes, because ITSM software as a process enabler as process enabler) should have unique specifications with added value based on standard processes in addition to common automation specifications. Rouhani & Zare Ravasan (2014) based their definition on ITIL v3 (then the latest and most complete ITSM framework) and on the processes of Van Bon et al. (2007), which they divided into five areas according to the life cycle of IT services according to ITIL (Service strategy, Service design, Service transition, Service operation, Continual service improvement). The categories according to the five phases of the life cycle included a total of 25 functionalities based on processes and practices. Rouhani & Zare Ravasan point out that not all ITIL processes are important for companies (depending on the size, complexity of IT systems and criticality of IT) and each should determine the processes first and then the functions of the system when choosing, thus adapting the suggested list of criteria.
- Non-functional criteria These criteria represent ITSM software properties that are related to the capability and resilience of the software or solution. Rouhani & Zare Ravasan (2014) defined them based on universal criteria for all types of software accepted by the International Standard Organization (ISO) for software engineering quality models. Non-functional criteria came from scientists: Jahdav and Sonar (2011) quality, technical, vendor, output and opinion (based on ISO/IEC9126) and from Sen et al. (2009) requirements into quality characteristics, technical factors and socioeconomic factors (business and vendor). Based on the above-mentioned scientists, Rouhani & Zare Ravasan (2014) proposed 4 categories of criteria (quality requirements, technical requirements, vendor factors and implementation factors) with 21 criteria (Table 1).

Category of criteria	Criteria
Ouglitu naguinamanta	reliability, usability, maintainability, efficiency, personalizability,
Quality requirements	portability
	communication protocol, platforms, database management system,
Technical requirements	programming language, documentation, standard configurations,
	security
Van Jan Gastana	vendor reputation, training and support, length of experience, con-
Vendor factors	sulting service
Implementation factors	license price, implementation cost, implementation time, training cost

Table 1. Non-functional criteria of ITSM software according to Rouhani & Zare Ravasan (2014)

Implementation factors license price, implementation cost, implementation time, training cost **Source:** Own processing according to Rouhani & Zare Ravasan (2014)

The above functional and non-functional criteria according to Rouhani & Zare Ravasan (2014) represent a simple fuzzy method for selecting ITSM software - FTOPSIS (Facile Fuzzy Technique for Order Preference by Similarity to Ideal Solution) based on 46 selection criteria according to functional and non-functional requirements. These criteria are also based on Rouhani (2017) in his study regarding a new approach to selecting software solutions, namely: FSIR (Fuzzy Superiority and Inferiority Ranking). In addition to the creator Rouhani himself, scientists such as: Sukmana et al. (2017), Lindner & Leyh (2019) and Sukmana et al. (2019).

Mora et al. (2016) list 32 criteria for the selection of software tools, also referred to as "attribute hierarchy" or "risks" based on FLOSS (Free-Libre Open Source Software) evaluation frameworks. The criteria are divided into 4 categories:

- Financial risks licensing cost effectiveness, new business opportunity, switching costs;
- **Organizational risks** external reviews, internal expertise, interested IT staff, project champion, skilled end-user group, top management support, training, usability, and user involvement;
- **End-user risks** functionality-quality, market image, performance-efficiency, usefulness-relevance:
- Technical risks community support, development process, developer community, developer organizational structure, documentation, interoperability-portability, maintainability, maturity-longevity, project forking, security-reliability, test information, standard compliance, technical environment, and user community.

Kralik, Senkerik & Jasek (2016) list evaluation criteria for software tools in the implementation of ITIL:

- **Product functionality** it varies according to the application category and it is not possible to evaluate the functionality quantitatively as a measurable criterion, but rather as an overview that represents the basic functionalities of the product.
- Requirements for free and open-source project primary criteria related to open source such as: product version and duration, license, activities/activities on e-mail lists community, possibility of commercial support, appropriate documentation (user manual) and demo application trial version.
- **Specifications** technical parameters including: hardware requirements, supported operating systems multi-platform, integration with other software and complexity of configuration.
- **User friendliness** represents the user interface (GUI) and is the main parameter that significantly affects the user's ability to work with the new product and use all functions. The criteria are subjective and based on the practical experience of the user, his localization/used language, which represents the entire GUI.

A more comprehensive review and summary of ITSM software criteria can be found in a scientific study by Sukman et al. (2019), who refer to several studies: already mentioned by us above (Rouhani & Zare Ravasan, 2014; Kralik, Senkerik & Jasek, 2016; Mora et al. 2016; Rouhani, 2017 and also to criteria from: Sukmana et al. (2017) and Encantado Faria & Mira Da Silva (2018). To support the implementation of ITSM in organizations, certain software can be launched: either paid or also freely available / with open source - with open source code (Sukmana et al., 2017). Furthermore, Sukmana et al. (2017) state four ITSM software criteria representing AHP approach based on processes: request fulfillment,

incident management, problem management, event management. Encantado Faria & Mira Da Silva (2018) in their study have criteria based on MCDA (Multiple Criteria Decision Analysis), which includes processes in ITIL v3 such as: service desk, event management, incident management, problem management, request management, change management, service catalog management, service asset and configuration management and service level management.

2. Methods and methodology

The aim of the scientific article is to map the software tools used in the management of information technology services (ITSM) and to obtain an overview of the current and future developments on the market in the field of ITSM software. The subject of the research was software tools used in Information Technology Service Management. The search for literary sources was carried out using research terms such as: "ITSM Tools", "ITSM Software", "IT Service Management Software" in scientific databases (Web of Science, Scopus, Science Direct, IEEE Xplore, Google Scholar and others) and professional portals . After searching for relevant sources, we examined them individually - either by reviewing abstracts or by reading full scientific articles. Subsequently, we used 51 sources in the overall scientific article. Several scientific methods were used in the scientific article, such as: abstraction, analysis, deduction, induction, comparison and synthesis.

3. Results and Discussion

The use of software tools in the field of ITSM can be considered a current topic in the field of ITSM, which is also confirmed by the following comparison of statistical and technological studies in the field of ITSM software. According to GVR (2022) and Gartner (2023), ITSM tools as software are increasingly being adopted because they enable IT operations, especially infrastructure and operations (I&O) managers, to better support the production environment by streamlining the delivery of high-quality IT services. The academic literature also points to large companies that, according to Floerecke (2023), have been using complex IT service management (ITSM) software packages for a long time to provide a wide range of ITSM processes. Jassim, Bader & Safran (2022) encourage organizations to look for the right IT tool that can meet all stakeholders' IT service management needs.

3.1. Global ITSM Software Market

According to GVR (2022), the global ITSM market size was estimated at USD 8.99 billion in 2022 and is expected to grow at a Compound Annual Growth Rate (CAGR) of 9.3% between 2023 and 2030. Growth is driven by: increasing adoption of cloud computing and emerging technologies that require ITSM solutions to manage complex IT environments. The reasons for organizations investing in ITSM solutions are: increasing the quality of ITS and customer satisfaction; compliance with ITSM standards, regulatory compliance and also industry regulatory requirements lead to the implementation of ITSM solutions to ensure compliance. The ITSM software market size was valued at USD 2.64 Billion in 2021 and is projected to grow to USD 6.89 Billion by 2030, growing at a CAGR of 11.23% from 2023 to 2030 (VMR, 2023). The market capitalization of ITSM software reached the value of 2,891.9 million USD in 2023 and is expected to reach the level of 5,358.3 million SD during the following years at a CAGR = 9.1% (Intellect Insights Journal, 2023).

Based on statistical data, various increases were estimated, as changes in development could be conditioned by an unstable business environment and a change in the world economy affected by various events (for example: the COVID-19 pandemic, the war in Ukraine, financial instability, the slowdown in global growth, and others).

The key consumption markets are located in developed countries. Based on 2022 data from GVR (2022), North America dominated, accounting for more than 40% of global revenue, driven by developed countries such as the US and Canada, which represent pioneers and invest in new ITSM solutions. Intellect Insights Journal (2023) also highlights the US, stating that it has a 43% market share, followed by Europe with a 29% share and China with an 8% share, saying that it is currently growing faster.

According to several studies (VMR, 2023; GVR, 2022; Digital Journal, 2022; Intellect Insights Journal, 2023; Medium, 2023; Contritive Datum Insights, 2023), the global ITSM software market is **segmented** on the basis of:

• Type of software: Cloud-based, On-Premises;

- **Type of IT solution provided**: Configuration Management, IT Asset Management, DBMS Management;
- **Geographical locations**: North America, Europe, Asia and, Pacific, Latin America, Middle East and Africa and the rest of the world;
- Size of enterprises: Large enterprises and SMEs (Small and Medium Enterprises)
- **Business sectors**: IT & Telecommunication, Healthcare, Media & Entertainment, Retail and BFSI (Banking, financial services and insurance).

The main global providers of ITSM software on the market are listed by GVR (2022) and include: Atlassian, BMC Software, Inc., Broadcom, Cloud Software Group, Inc., Freshworks Inc., Hewlett Packard Enterprise Development LP, IBM Corporation, Ivanti., Open Text, ServiceNow. According to Intellect Insights Journal, (2023), the world's key and best players in the market for providing ITSM software are: ServiceNow and Atlassian, which have approximately 42% market share. The high position of these providers is also reported by Matamorphant, where we can see in Figure 1 their leading position in 2015 and 2018, where together they had more than 50% market share. From an overall point of view, on these graphs we can notice the changes in the position of other providers, the decrease was mainly for: SAP, Axios systems, ASG Technologies, and on the contrary, the increase was recorded for: SolarWinds, BMC Software Inc., LogMein, Inc. The reasons for the increasing share were a better offer from aspects such as: wider choice of integration, support of ITIL components and processes, functionalities for Enterprise Service Management, adaptation of functionalities and provision of a high level of automation of repetitive processes.

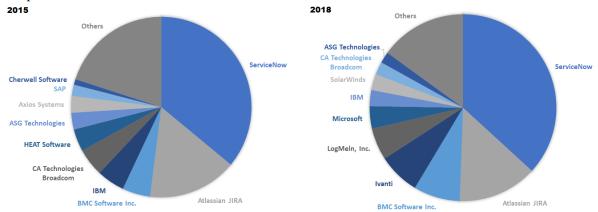


Figure 1. Market shares of ITSM software and application providers in 2015 (graph on the left) and 2018 (graph on the right)

Source: Metamorphant (2020)

In the following Figure 2, according to Pang (2022), the market shares of ITSM software providers from 2020 are visually displayed, where we can notice that the leading positions of ServiceNow and Atlassian remain with their 58% share. The biggest increase was recorded at Atlassian, where its share increased and up to 18.5% of its share is represented by its income through the Jira Service Management product (Contegix, 2022). The third position represents the provider GoTo (originally: LogMain, Inc.), which improved its position by one place, although its total share changed.

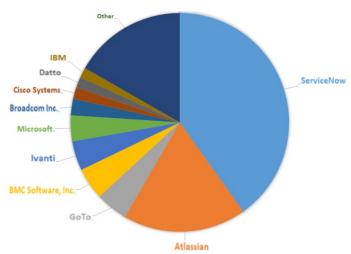


Figure 2. Market shares of ITSM software and application providers in 2020

Source: Pang (2022)

The market leader based on Figure 3 is also ServiceNow and Atlassian, who have a stronger current offering and a stronger strategy. In addition to them, BMC software and Ivanti and IFS have a leading position as well (Contegix, 2022).



Figure 3. ITSM software providers by strategy and offering

Source: Contegix (2022)

3.2. Used ITSM software in the world

Based on analysis by: Scott (2021), Mottesi (2022), White (2022), Paul (2023), PeerSpot (2023), DNSstuff (2023), Trustradius (2023), Capterra (2023), SoftwareAdvice (2023), G2 (2023), Gartner (2023) and STH (2023) are the most used ITSM software from: SolarWinds - ServiceDesk & SolarWinds Web Help Desk, Atlassian - Jira Service Management, Craft - FreshFreshservice and from ServiceNow - Service ITSM.

Table 2. World ITSM software

ITSM Software	White (2022)	Paul (2023)	Scott (2021)	Mottesi (2022)	PeerSpot	DNSstuff (2023)	Trustradius (2023)	Capterra (2023)	SoftwareAd- vice (2023)	G2 (2023)	Gartner (2023)	STH (2023)	Occurrence
SolarWinds													11
Service Desk &		X	X	X	X	X	X	X	X	X	X	X	
Web Help Desk													
Jira Service Management	X	X		X	X	Χ	Χ	Χ	Χ	X	X	X	11
Freshservice	Χ			Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	10
ManageEngine ServiceDesk Plus	X			X	Χ	X		Χ	Χ	X	X	Χ	9
ServiceNow ITSM	Х	Х	Х	X	X				Χ	X	Х	X	9
SysAid	Χ			Χ	Χ		Χ	Χ	Χ	Χ	Χ	Χ	9
Zendesk Suite	Χ			Χ	Χ	Χ		Χ	Χ	Χ		Χ	8
BMC Helix ITSM		Χ	Χ	Χ	Χ		Χ			Χ	Χ	Χ	8
Cherwell Service Management	X		Х	Х						X	Х	X	6
Ivanti		Χ		Χ	Χ		Χ			Χ	Χ		6
TOPdesk	Χ			Χ	Χ	•	Χ				Χ		5

Source: Own processing

The different position of key players on the market and their specific products (For example: SolarWinds Service Now, BMC and others) is due to the offer of several products. Other most common ITSM software on the market are: Atera, NinjaOne, Symphony AI Summit, EasyVista Service Manager and Spiceworks.

Based on the key and leadership position of ITSM software providers, we decided to examine the main features of the products in more detail (Table 3).

Table 3. Comparison of selected ITSM software

Parameter	Jira Service Manage- ment	SolarWinds Service Desk	ServiceNow ITSM
Provider	Atlassian	SolarWinds	ServiceNow
Size of the Busi-	Small to Large Busi-	Small to Large Busi-	Mid-sized to Large
ness	nesses	nesses	Business
Price	from 49 USD	from 19 USD	Quote-based
Type of software	Cloud & On-premises	Cloud & On-premises	Cloud-based
Funkcionalities	Request Management,		AI- and ML-powered
	Incident Management,	Incident Management,	features, Automation
	Problem Management,	Service Portal, Change	features, Mobile fea-
	Change Management,	Management,	tures, Incident Manage-
	Asset Management,	IT Asset Management,	ment, Problem Manage-
	Configuration Manage-	Problem Management,	ment, Change Manage-
	ment, Knowledge Man-	Knowledgebase	ment, Request Manage-
	agement		ment
Support of ITIL	YES	YES	YES
Integration	YES	YES	YES

Source: Own processing

During the selection process, it is first necessary to take into account the requirements of the interested parties in the company (users, technical staff and owners) and, in addition to the above parameters in Table 3, consider other specifications such as: user experience, provision of training, service and support from vendors, legislative aspects, etc.

3.3. Requirements and Benefits of implementing ITSM Software in enterprises

The ITSM software requirements according to OTRS (2023) are: communication and task management, self-service portal, service level management (SLM), Business Process Management (BPM) by ITIL, IT operation management, IT asset management, configuration management, knowledge management, permission and role management, resource management, reporting functions and integration software system.

In the selection process, according to OTRS (2023), it is necessary to consider for ITSM software: the requirements of the business, the service department, the user and any interested party; prices for purchase, maintenance and service; scalability, features and integration options; choosing software from proven vendors, especially with experience; the use of professional service and support after the purchase of the product and to ensure that the software platform complies with regulations and legislation. Key features of ITSM software according to Alemba (2023) include:

- Ticketing System: Enable IT teams to capture, track, and manage incidents, service requests, and
 other IT-related issues, plus provide a structured workflow to route tickets to the appropriate
 teams and track their progress to resolution. This feature can form the basis for incident management processes.
- Service Catalogue: Providing a centralized view of available IT services and enabling users to
 browse and request services according to their requirements, including details of service offerings,
 associated costs, delivery dates and any dependencies or prerequisites.
- Change Management: Enabling the business to manage and control changes in IT systems and IT
 infrastructure, thereby providing workflows for submitting, reviewing, approving and implementing changes, ensuring their proper evaluation and execution with minimal impact on IT services.
- Problem Management: Enabling assistance in identifying the root causes of recurring incidents, solving underlying problems and the ability to implement permanent solutions to prevent future incidents.
- Configuration and Asset Management: Enabling businesses to track and manage IT assets (hardware, software and configurations), providing a centralized repository to store information about assets, their relationships and relevant documentation.
- **Knowledge Base**: An enabling repository representing a self-service online library that helps software/application users and IT teams access self-help resources, find answers to problems, and share knowledge across the organization.
- Reporting and Analysis: Enable analytics to monitor and measure ITS performance, providing
 insight into key metrics, trends and areas for improvement, enabling informed decision-making
 and continuous service optimization.
- **Self-service**: Allowing end users to independently access services, report incidents and seek solutions, reducing their dependence on IT support and increasing overall efficiency.

Infraon (2023) focuses on complex management options in ITSM software tools, which include: Incident management, Problem management, Change management, Service request management, Asset management, and Service level management.

ITSM software brings various benefits in the field of managing processes and IT services and is a great benefit for business. Based on a comparison of several studies and reports (Infraon, 2023; Atlassian, 2023; Atera, 2023; Alemba, 2023) the advantages are:

- improvement of operational efficiency and productivity;
- alignment of IT teams with business priorities;
- alignment of the IT strategy and approach to service operation with the company's goals
- improving communication and enabling cooperation between company departments, connecting IT teams and development teams;
- knowledge sharing and continuous improvement;
- data-based decision making;

- cost reduction and higher ROI (return on investment);
- centralized, standardized, consistent and optimized processes as well as their better scalability;
- improving the coordination of requirements for more efficient services;
- improving visibility through visual display of data;
- improved customer service creation of support for customer orientation through self-service and better processes;
- simplified problem management;
- faster response to incidents, better response time and prevention of future ones;
- reduced security risks;
- increasing employee productivity;
- compliance and audit readiness.

Conclusions

ITSM software represents tools for managing work and business flows that support IT service management, optimize activities and maximize IT services. Currently, from a global point of view, there has been an increase in the value of the market, which is also stimulated by industrial revolutions (Industry 4.0 and Industry 5.0), when digital technologies - Cloud Computing and others - are adopted. The key providers of ITSM software are providers from developing countries such as the USA, where the largest providers (ServiceNow and Atlassian) are also based. The most used software is Jira Service Management from Atlassian and we recommend its use in companies, even in the conditions of the Slovak Republic due to its integration, functionalities also focused on ITIL and scalability. The findings of our paper suggest that there is a need to implement and apply software solutions in enterprises to improve various aspects of business (operational efficiency, productivity, decision-making, incident resolution and prevention, financial health, and others).

Funding: The scientific paper was elaborated within project VEGA No. 1/0662/23 entitled "Digital transformation of companies and their readiness to integrate the elements of Industry 5.0" in proportion 100%.

References

- 1. Axelos. (2019). *Itil Foundation Itil 4 Edition* (1st ed.). The Stationery Office.
- 2. Alemba. (2023). What is an ITSM tool and how can it benefit your business? https://alemba.com/blog/thoughts/what-itsm-tool-and-how-can-it-benefit-your-business
- 3. Atera. (2023). WHAT IS ITSM? WHAT TO KNOW ABOUT IT SERVICE MANAGEMENT. https://www.atera.com/what-is-itsm/
- 4. Atlassian. (2023). What is ITSM? A guide to IT service management. https://www.atlassian.com/itsm
- 5. Brenner, M., Schaaf, T., & Scherer, A. (2009). Towards an information model for ITIL and ISO/IEC 20000 processes. 2009 IFIP/IEEE International Symposium on Integrated Network Management, 113–116. https://doi.org/10.1109/inm.2009.5188795
- 6. Capterra. (2023). ITSM Software. https://www.capterra.com/itsm-software/
- 7. Contegix. (2022). ITSM Two Horse Race: 60% Market Share for Atlassian & ServiceNow. https://www.contegix.com/blog/itsm-two-horse-race-60-market-share-atlassian-servicenow
- 8. Digital Journal. (2022, April 20). ITSM Software Market 2022 industry overview, new market opportunities size, share, demands, Statistics Research Report: ServiceNow, Atlassian, ivanti (heat software), IBM, CA Technologies. https://www.digitaljournal.com/pr/itsm-software-market-2022-industry-overview-new-market-opportunities-size-share-demands-statistics-research-report-servicenow-atlassian-ivanti-heat-software-ibm-catechnologies
- 9. DNSstuff. (2023, July 14). The best it service management tools (ITSM) for 2023. https://www.dnsstuff.com/itsm-tools
- 10. Duce, R. (2023). What is it service management (ITSM)?. FlyForm. https://flyform.com/insights/articles/what-is-itsm
- 11. Eikebrokk, T. R., & Iden, J. (2012). ITIL implementation: The role of itil software and Project Quality. 2012 23rd International Workshop on Database and Expert Systems Applications, 60–64. https://doi.org/10.1109/dexa.2012.17
- 12. Encantado Faria, N., & Mira Da Silva, M. (2018). Selecting a Software Tool for ITIL using a Multiple Criteria Decision Analysis Approach. . 27TH INTERNATIONAL CONFERENCE ON INFORMATION SYSTEMS DE-VELOPMENT (ISD2018 LUND, SWEDEN).
- 13. Floerecke, S. (2021). Self-service-portale mit schwerpunkt service-request-management: Analyse der eignung existierender software-tool-kategorien. *HMD Praxis Der Wirtschaftsinformatik*, 59(2), 683–693. https://doi.org/10.1365/s40702-021-00726-y

- 14. G2. (2023). Best IT Service Management Tools. What are IT Service Management Tools? https://www.g2.com/cate-gories/it-service-management-itsm-tools
- 15. Gartner Inc. (2023). Definition of IT service management (ITSM) tools gartner information technology glossary. Gartner. https://www.gartner.com/en/information-technology/glossary/itssm-tools-it-service-support-management-tools#:~:text=IT%20Service%20Management%20(ITSM)%20Tools%20enable%20IT%20operations%20organizations%2C,delivery%20of%20quality%20IT%20services
- 16. Gartner. (2023). IT Service Managemen Platforms Reviews and Rating. What are IT Service Management Platforms? https://www.gartner.com/reviews/market/it-service-management-platforms
- 17. GlobeNewswire. (2023, January 18). ITSM market is expected to reach around USD 2829.35 million by 2022, grow at a CAGR of 7.50% during forecast period 2023 to 2030: Data by Contrive Datum Insights Pvt Ltd.. GlobeNewswire News Room. https://www.globenewswire.com/en/news-release/2023/01/18/2590942/0/en/ITSM-Market-Is-Expected-To-Reach-around-USD-2829-35-Million-by-2022-Grow-at-a-CAGR-Of-7-50-during-Forecast-Period-2023-To-2030-Data-By-Contrive-Datum-Insights-Pvt-Ltd.html
- 18. GVR . (2022). Information Technology Service Management (ITSM) Market Report, 2030. https://www.grandviewresearch.com/industry-analysis/it-service-management-market-report
- 19. Infraon. (2023). Product guide: It service management software solutions. https://infraon.io/itsm-guide.html
- 20. Intellect Insights Journal. (2023). *It service management (ITSM) Software Market Report* [2023-2030]: *Guide to growth in upcoming years*. LinkedIn. https://www.linkedin.com/pulse/service-management-itsm-software-market-report/
- 21. Jadhav, A. S., & Sonar, R. M. (2011). Framework for evaluation and selection of the software packages: A hybrid knowledge based system approach. *Journal of Systems and Software*, 84(8), 1394–1407. https://doi.org/10.1016/j.jss.2011.03.034
- 22. Jassim, A. A.-S., Bader, A. A.-R., & Safran, A. A.-S. (2022). Business Value in Implementing a Standard ITSM System. *International Journal of Innovative Science and Research Technology*, 7(6), 130–135. https://doi.org/10.5281/zenodo.6694893
- 23. Kralik, L., Senkerik, R., & Jasek, R. (2016). Comparison of MCDM methods with users' evaluation. 2016 11th Iberian Conference on Information Systems and Technologies (CISTI), 1–5. https://doi.org/10.1109/cisti.2016.7521387
- 24. Lindner, D., & Leyh, C. (2019). Digitalisierung von KMU fragestellungen, Handlungsempfehlungen Sowie Implikationen für it-organisation und it-servicemanagement. *HMD Praxis Der Wirtschaftsinformatik*, 56(2), 402–418. https://doi.org/10.1365/s40702-019-00502-z
- 25. Loshin, D. (2013). Developing the big data roadmap. *Big Data Analytics*, 105–120. https://doi.org/10.1016/b978-0-12-417319-4.00011-9
- Medium. (2023, August 19). It service management market growth, trend, and prospects from 2023–2030. https://medium.com/@krishna_35021/it-service-management-market-growth-trend-and-prospects-from-2023-2030-15f0959b393e
- 27. Metamorphant . (2022). *A comparison: Jira service desk vs ServiceNow*. Metamorphant. https://www.metamorphant.de/blog/posts/2020-04-15-jira-service-desk-vs-service-now/
- 28. Mora, M., Gómez, J. M., O', R. V., Connor, N. A., & Gelman, O. (2016). An MADM risk-based evaluation-selection model of free-libre open source software tools. *International Journal of Technology, Policy and Management*, 16(4), 326. https://doi.org/10.1504/ijtpm.2016.081665
- 29. Mottesi, C. (2023). *ITSM tools comparison: Top 16 service desk software alternatives*. IT Management Software. https://blog.invgate.com/itsm-tools-comparison
- 30. OpenText. (2023). What is ITSM? A guide to IT service management. https://www.opentext.com/what-is/itsm#:~:text=ITSM%20software%20are%20the%20tools,ITSM%20processes%2C%20work-flows%20and%20tasks
- 31. OTRS. (2023). ITSM software. https://otrs.com/use-cases/itsm/itsm-software/
- 32. Pang, A. (2022, October 4). *Top 10 ITSM software vendors, market size and market forecast 2021-2026*. Apps Run The World. https://www.appsruntheworld.com/top-10-it-service-management-software-vendors-and-market-forecast/
- 33. Paschek, D., Mocan, A., & Draghici, A. (2019). Industry 5.0—The Expected Impact of Next Industrial Revolution. Thriving on Future Education, Industry, Business, and Society, Proceedings of the MakeLearn and TIIM International Conference., 125–132.
- 34. Paul, J. (2023, July 10). ITSM Software Market 2023 (New Data Insights): Comprehensive Analysis, industry diversification... Medium. https://medium.com/@pauljaydb/itsm-software-market-2023-new-data-insights-comprehensive-analysis-industry-diversification-1176dc0f1ad2
- 35. PeerSpot. (2022, August 12). *Best IT Service Management (ITSM) Solutions*. https://www.peerspot.com/categories/it-service-management-itsm

- 36. Permatasari, R., Ridwandono, D., Afandi, M. I., Zamzami, M. R., Trinanda, F. A., & Wibowo, A. H. (2023). Comparison Analysis of Information Technology Service Management Software. *Proceeding of International E-Conference On Management & Small Medium Enterprise*, 1(1), 240–255.
- 37. Plotnikova, V., Dumas, M., Nolte, A., & Milani, F. (2022). Designing a data mining process for the Financial Services Domain. *Journal of Business Analytics*, 6(2), 140–166. https://doi.org/10.1080/2573234x.2022.2088412
- 38. Rouhani, S. (2017). A fuzzy superiority and inferiority ranking based approach for IT service management software selection. *Kybernetes*, 46(4), 728–746. https://doi.org/10.1108/k-05-2016-0116
- 39. Rouhani, S., & Ravasan, A. Z. (2014). A fuzzy topsis based approach for ITSM Software Selection. *International Journal of IT/Business Alignment and Governance*, 5(2), 1–26. https://doi.org/10.4018/ijitbag.2014070101
- 40. Scott, T. (2021, May 18). *Top IT Service Management (ITSM) Software*. TechnologyAdvice. https://technologyadvice.com/blog/information-technology/itsm-tools/
- 41. Software Advice. (2023). Find the best ITSM Software. Best ITSM Software 2023 Reviews & Pricing. https://www.softwareadvice.com/itsm/
- 42. SoftwareTestingHelp. (2023). *11 best ITSM tools (IT service management software) in 2023*. Software Testing Help. https://www.softwaretestinghelp.com/itsm-tools/
- 43. Stamelos, I., Vlahavas, I., Refanidis, I., & Tsoukiàs, A. (2000). Knowledge based evaluation of software systems: A case study. *Information and Software Technology*, 42(5), 333–345. https://doi.org/10.1016/s0950-5849(99)00093-2
- 44. Sukmana, H. T., Wardhani, L. K., Argantone, R., & Lee, K. (2017). The evaluation of ITSM Open Source Software for small medium organizations based on ITIL v.3 criteria using AHP Method. *International Journal of Control and Automation*, 10(7), 203–216. https://doi.org/10.14257/ijca.2017.10.7.17
- 45. Sukmana, H. T., Wardhani, L. K., Khairunnisa, S., Lee, K. O., & Wati, R. (2019). ITSM software ranking for Small Medium Enterprises based on Itil V3 quick win criteria using Fuzzy Sir Method. *Advances in Science, Technology and Engineering Systems Journal*, 4(2), 288–298. https://doi.org/10.25046/aj040237
- 46. TrustRadius. (2023, July 14). IT Service Management (ITSM) Tools. https://www.trustradius.com/it-service-management-itsm
- 47. Van Bon , J., de Jong, A., Kolthof, A., Pieper, M., Tjassing, R., van der Veen, A., & Verheijen, T. (2007). Foundation of IT Service Management Based on ITIL V3. Van Haren PUBLISHING.
- 48. VMR. (2023, March 10). *It service management (ITSM) software market size, trends, analysis*. Verified Market Research. https://www.verifiedmarketresearch.com/product/it-service-management-software-market/
- 49. Wan, S. H. C., & Chan, Y. (2007). Improving service management in outsourced it operations. *Journal of Facilities Management*, 5(3), 188–204. https://doi.org/10.1108/14725960710775072
- 50. White, S. K. (2022, January 6). Top 12 ITSM tools. CIO. https://www.cio.com/article/222223/top-itsm-tools.html
- 51. Şen, C. G., Baraçlı, H., Şen, S., & Başlıgil, H. (2009). An integrated decision support system dealing with qualitative and quantitative objectives for enterprise software selection. *Expert Systems with Applications*, *36*(3), 5272–5283. https://doi.org/10.1016/j.eswa.2008.06.070

Sustainability of Public Finances of the Slovakia - pandemic and post-pandemic period

Radka Lešková 1, Peter Leško 2

- ¹ Affiliation 1 (Faculty of Business Management, University of Economics in Bratislava, Slovakia); radka.leskova @euba.sk
- ² Affiliation 2 (Faculty of Economics and Finance, University of Economics in Bratislava, Slovakia); peter.lesko @euba.sk
- * Correspondence: radka.leskova @euba.sk

Abstract: According to the Constitutional Act, fiscal sustainability means achieving a state of economy in which the budget balance and general government debt ensure that even the expected change in general government revenues and expenditures according to the baseline scenario in the coming years will not cause an increase in general government debt above the upper limit of general government debt (Act No. 493/2011 Coll.). The topicality of the issue of fiscal sustainability has been emphasized in recent years, especially in connection with the pandemic Covid-19, which has caused considerable pressures on the public finances of all countries, including Slovakia. The aim of the paper is to evaluate the impacts of the pandemic on the fiscal sustainability of Slovakia, as well as to outline the possible development of long-term fiscal sustainability in the post-pandemic period.

Keywords: Fiscal Sustainability, Pandemic Period, Post-pandemic Period, Deficit, Public Debt

Introduction

The Covid-19 pandemic has caused a deep recession and led to the deepening of internal and external macroeconomic imbalances - the growth of fiscal deficits and public debts. In the context of the pandemic, fiscal sustainability has been often emphasized. The issue of long-term fiscal sustainability is currently very relevant, especially because most countries, including Slovakia, are utilizing deficit budgeting instead of surplus, which subsequently reflects in the overall debt increase of individual countries.

Deficit budgeting may not be immediately incorrect. It is a tool that can accelerate economic growth and mitigate the negative consequences of the cyclical development of the economy. On the other hand, it is necessary to realize that the consequences of irresponsible fiscal policy may not be felt immediately, but it is guaranteed that they will manifest negatively sooner or later. Therefore, responsible public officials should use this opportunity wisely and with consideration for the future generations of their country.

The goal of this contribution is to explain the concept of fiscal sustainability and its measurement. The intention of the contribution is also to assess the impacts of the pandemic on the fiscal sustainability of Slovakia and outline possible developments in long-term fiscal sustainability in the post-pandemic period. Apart from the introduction and conclusion, the contribution is divided into three parts. The first part focuses on defining and measuring fiscal sustainability, the second part highlights the impacts of the pandemic on the sustainability of public finances in Slovakia, and the third part is focused on the possible development of long-term fiscal sustainability in the post-pandemic period.

1. Theoretical background

There are several definitions of the concept of *fiscal sustainability*. According to the European Commission (2017), fiscal sustainability can be expressed as the ability of a public government to maintain its current level of government expenditures and the setting of government policies in the long term without jeopardizing the country's ability to meet its obligations from past periods.

The concept of fiscal sustainability, according to the International Monetary Fund (2002), is similar in meaning to the definition by the European Commission, with an emphasis on the requirement for the debtor (state) to repay its obligations without the need for an unrealistic correction of income and expenditure balances in the future. From these generally accepted definitions, it can be inferred that fiscal sustainability and the associated fiscally sustainable policy represent a state in which the present (discounted) value of future primary surpluses equals the current level of public debt (Krejdl, 2006).

In Slovakia, fiscal sustainability is defined in the Constitutional Act on Budgetary Responsibility. According to the law, long-term sustainability is understood as achieving a state of the Slovak Republic's economic management in which the balance of the public administration budget and the public administration debt ensures that the expected change in public revenue and public expenditure according to the basic scenario over the next fifty years does not cause an increase in public administration debt beyond the upper limit of public administration debt (Law No. 493/2011 Coll.).

A more specific delineation of *fiscal sustainability* concerning the debt ratio is provided by Blanchard (1990), who examines the impact of current fiscal policy on the accumulation of public debt. According to him, fiscal policy will be sustainable if it ensures that the debt-to-GDP ratio of the country converges back to its lower initial level. However, it is necessary to add that, in reality, there are no theoretical reasons requiring the debt ratio to converge within fiscal sustainability to its original value and stabilize at another higher or lower stable level (Krejdl, 2006).

In the qualitative assessment of government fiscal policy, *indicators measuring fiscal consolidation* can be utilized, with their main purpose being to express the government's contribution and its fiscal policy to the sustainability of public finances. Fiscal consolidation indicators are divided over time based on the length of the periods they cover. Short-term and medium-term indicators capture the impacts of government measures manifesting in public finances over a range of one to three years, thus encompassing the influences of the current fiscal policy at present or predicting its effects in the next three years.

To capture the long-term effects of government measures, long-term indicators are employed, which, alongside the current impacts of fiscal policy, can also capture the effects of these measures over a three-year medium-term horizon. Long-term fiscal consolidation indicators are more complex and should, therefore, be preferred in formulating and evaluating fiscal policy. However, it should be noted that they are largely dependent on the assumptions used in projecting economic development, which is associated with a higher level of uncertainty in output data compared to short-term and medium-term indicators (RRZ, 2022).

An important concept for understanding fiscal imbalance in the long term is public debt. Public debt mainly arises due to the accumulation of deficits in public budgets from past periods, for which debt financing was utilized. Within public debt, it is necessary to distinguish between gross and net debt. *Gross public debt* represents the total volume of obligations of public administration entities to other economic entities, including foreign entities. Primarily, this includes bonds, government treasury bills, and loans. On the other hand, *net public debt* is calculated by reducing gross debt by liquid financial assets, such as cash in the state's accounts (RRZ, 2022).

The *indicator of long-term sustainability GAP*, based on the principle of the fiscal gap, quantifies the need for an immediate and permanent change in the primary structural balance of public administration so that the public debt of the Slovak Republic does not exceed 50% of the public debt-to-GDP ratio over a 50-year horizon. The calculation of this indicator depends on the prediction of public revenues and expenditures for the next 50 years based on the unchanged policy scenario supplemented by expected future changes in revenues and expenditures due to economic and demographic reasons (RRZ 2014). The resulting indicator of long-term sustainability GAP is then calculated as the difference between the current and the long-term sustainable value of the primary structural balance determined based on the prediction in percentage of GDP (Article 2 letter c) of Constitutional Act 493/2011).

2. Methods and methodology

We drew data on relevant values of fiscal indicators and their interpretation from both Slovak and international institutions such as the Ministry of Finance of the Slovak Republic, the Fiscal Responsibility Council, the European Commission, Eurostat, the International Monetary Fund, and others. We investigate the issue of long-term fiscal sustainability in a time frame divided into three periods. We consider the years 2017 to 2019 as the pre-pandemic period, and the years 2020 to 2022 as the pandemic period. We also distinguish the post-pandemic period, which begins in the year 2023. In connection with this time differentiation, we examine the impact of the COVID-19 pandemic on the long-term sustainability of public finances in selected world countries, the European Union, Visegrad Group countries, and especially Slovakia.

3. Results

3.1. The Impact of the Pandemic on the Fiscal Sustainability of Slovakia

In evaluating the long-term fiscal sustainability of Slovakia within the European Union and the Visegrad Group (VG), we will use the values of the indicator of gross public debt, the overall balance of public administration of the European Union, and the Visegrad Group countries. We will compare these values with the indicators for Slovakia.

Table 1. Comparison of Fiscal Indicators of the EU 27 and Visegrad Group (VG) Countries

	2017	2018	2019	2020	2021	2022
		EU 27				
GROSS DEBT VG	81,9 %	79,8 %	77,7 %	90,0 %	88,0 %	84,0 %
TOTAL BALANCE VG	- 0,8 %	- 0,4 %	- 0,5 %	- 6,7 %	- 4,8 %	- 3,4 %
		SLOVAK	IIA			
GROSS DEBT VG	51,6 %	49,4 %	47,9 %	58,9 %	61,0 %	57,8 %
TOTAL BALANCE VG	- 1,0 %	- 1,0 %	- 1,2 %	- 5,4 %	- 5,5 %	- 2,0 %
	CZECH REPUBLIC					
GROSS DEBT VG	34,2 %	32,1 %	30,0 %	37,7 %	42,0 %	44,1 %
TOTAL BALANCE VG	1,5 %	0,9 %	0,3 %	- 5,8 %	- 5,1 %	- 3,6 %
		HUNGA	RY			
GROSS DEBT VG	72,1 %	69,1 %	65,3 %	79,3 %	76,6 %	73,3 %
TOTAL BALANCE VG	- 2,5 %	- 2,1 %	- 2,0 %	- 7,5 %	- 7,1 %	- 6,2 %
POLAND						
GROSS DEBT VG	50,8 %	48,7 %	45,7 %	57,2 %	53,6 %	49,1 %
TOTAL BALANCE VG	- 1,5 %	- 0,2 %	- 0,7 %	- 6,9 %	- 1,8 %	- 3,7 %

Source: Own processing based on Eurostat data, 2022.

When examining the impact of the pandemic on the public finances of the European Union and the VG countries, including Slovakia, we will utilize the year-on-year changes in these indicators during the pre-pandemic and pandemic periods. In Table No. 1, we observe that during the pre-pandemic period, the aggregated values of the European Union reached lower levels of total deficits in public administration than Slovakia, especially evident in the years 2018 and 2019. Although in 2017, Slovakia's overall public administration deficit exceeded the EU average by only 0.2 percentage points of GDP, in the subsequent years, this difference increased unfavorably for Slovakia by 0.6 to 0.7 percentage points. This suggests that the fiscal policies of other member states during the pre-pandemic period tended more towards steering public finances towards long-term sustainability.

Comparing pre-pandemic data within the VG countries, we find that Hungary reported the worst values for the overall balance of public administration during this period. Unlike other countries, Hungary was unable to reduce the overall deficit in public administration below 2% of GDP during this period. On the other hand, it is evident that, unlike the other VG countries, Czechia showed surpluses in the budget of public administration during the pre-pandemic period, contrary to the aggregated average of the European Union.

Regarding the pandemic period, in 2020, Slovakia achieves a total deficit 1.3 percentage points of GDP lower than the European Union average, displaying the lowest total deficit in public administration among all observed entities. The disadvantage for Slovakia became evident in the second year of the pandemic in 2021 when the year-on-year change in Slovakia's total deficit saw a negligible increase of 0.1 percentage points of GDP. In contrast, the aggregated values of the European Union, as well as the values for Czechia, Poland, and Hungary, showed a year-on-year reduction in the total deficit in public administration. In 2022, we observe a year-on-year decrease in the total deficit in public administration for all examined entities except Poland, which experienced a year-on-year increase of 1.9 percentage points of GDP.

When comparing the aggregated values of gross public debt of the European Union with Slovak data, we find that the ratio of Slovakia's gross public debt is well below the aggregated average of the European Union. Slovakia's gross public debt at the beginning of the pandemic period in 2020 increased by 11.1 percentage points of GDP, which is 1.2 percentage points less than the increase seen in the European Union average. In 2021, Slovakia's gross public debt increased by 2.1 percentage points of GDP, while the debt ratio of the European Union decreased.

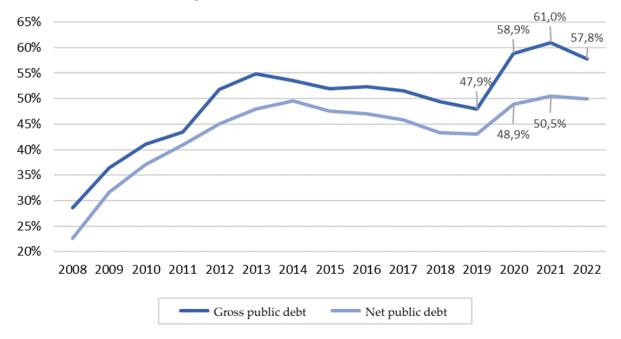


Figure 1. Development of gross and net debt of the Slovak Republic, 2008 - 2022

Source: Own processing based on Eurostat and Ministry of Finance of the Slovak Republic data, 2022.

The most favorable values of gross public debt throughout the entire observed period are reported by the Czech Republic. When comparing the years 2019 and 2020, we find that the Czech Republic, at the beginning of the pandemic period, recorded the lowest year-on-year increase in the level of gross public debt among all observed entities, amounting to 7.7 percentage points of GDP. However, similar to Slovakia, the gross public debt of the Czech Republic in 2021 continued to increase year-on-year, unlike other observed entities, by 4.3 percentage points of GDP. In 2022, we observe a year-on-year reduction in the debt ratio for all examined entities except the Czech Republic, whose gross public debt increased to 44.1% of GDP.

The development of gross public debt, also known as the Maastricht debt, is monitored as a percentage of GDP for Slovakia, referred to as the debt ratio. This indicator is crucial for assessing the long-term sustainability of Slovakia through the Constitutional Act on Budgetary Responsibility, as well as for evaluating compliance with the goals of the European Union's Growth and Stability Pact. Figure No. 1 illustrates this development from 2008 to 2022 (Figure 1).

At the beginning of the examined period, around the turn of 2008 and 2009, we observe the negative impact of the global financial crisis, leading to a year-on-year increase in public administration debt by 7.8 percentage points. For the same reason, public administration debt saw a significant rise in the upcoming year. In 2012, the public administration debt reached 51.8% of GDP. The year-on-year increase by 8.3 percentage points was no longer driven by the effects of the financial crisis but primarily by the level of the structural deficit of public administration around 4.6% of GDP. The increase in the liquidity reserve of the state treasury for liquidity management purposes also influenced the growth of public administration debt in this period (MF SR, 2022). The indicator of net public administration debt suggests that, with the help of the cash reserve and other liquid assets, public administration would be able to immediately repay 6.7% of GDP of the gross public debt in this year.

The development of public administration debt had a positive character after 2013, evident from its annual decline, except for the year 2016 when, compared to 2015, it slightly increased by 0.5 percentage points. In the pre-pandemic period, this positive trend was a result of low values of overall public administration deficits from 2017 to 2019. In 2019, the level of public administration debt even reached 47.9% of GDP, marking its lowest point in the last 8 years. This positive period of development could be attributed to the growth of the Slovak economy and consolidation efforts in public administration, supported by the Constitutional Act on Budgetary Responsibility effective from March 1, 2012.

In the pandemic year of 2020, we observe a year-on-year increase in gross public administration debt by 11 percentage points to the level of 58.9% of GDP, which is the highest year-on-year increase in the observed period. Similarly, we also observe a significant difference of 10 percentage points between gross and net public administration debt. The increase in gross public administration debt in this and the following year was due to high levels of overall deficits, caused by their individual components, especially one-off measures and the structural balance, as discussed in the previous subchapter. In 2021, gross public administration debt reached 61% of GDP, exceeding the 60% threshold of gross public administration debt set by the Growth and Stability Pact. However, this breach did not lead to the initiation of an excessive deficit procedure, as the European Commission (2021) considered the pandemic situation a justified reason for exceeding this threshold. In 2021, we also observe the largest difference between gross and net public administration debt, indicating that Slovakia would be able to immediately repay 10.5% of GDP of gross public administration debt with its liquid assets. In the following year, 2022, we observe a reduction in gross public administration debt to 57.8% of GDP, which is 1.1 percentage points lower than at the beginning of the pandemic period in 2020.

The indicator of long-term sustainability, GAP, quantifies the immediate and permanent change in the primary structural balance necessary to ensure that the gross public administration debt does not exceed the upper limit of public administration debt set by the Constitutional Act on Budgetary Responsibility at 50% of GDP over a fifty-year horizon. Figure 2 illustrates the evolution of this indicator in both the pre-pandemic and pandemic periods (Figure 2).

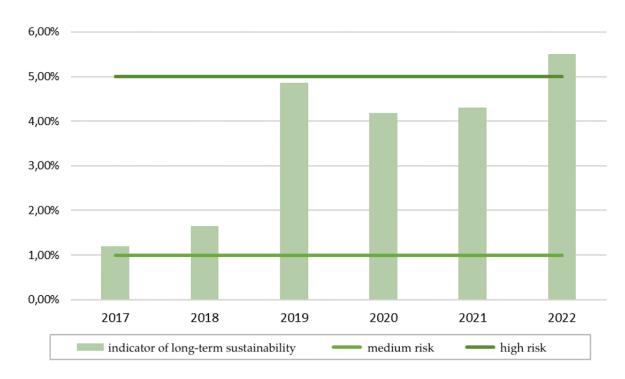


Figure 2. Indicator of long-term sustainability of the Slovak Republic, 2017 - 2022

Source: Own processing according to the Report on long-term sustainability of the SR RRZ 2017 – 2022.

For the year 2017, we record the most favorable value of the indicator in the observed period, reaching 1.2% of GDP, which is only 0.2 percentage points above the threshold of medium risk. The achievement of a primary structural surplus of 0.4% of GDP influenced the relatively positive development of the indicator in this year. However, despite this favorable result, in connection with not exceeding the 50% threshold of public debt as a share of GDP by 2067, the indicator would require a primary structural surplus totaling 1.6% of GDP. The year-on-year change in the indicator in 2018 brought its deterioration by 0.45 percentage points to 1.65% of GDP, but its value remained close to the lower threshold of medium risk. The deterioration was influenced by a worsening of the primary structural balance and the projection of health expenditure (RRZ), as well as the update of the projection of the universal pension system expenditure (RRZ).

In 2019, we observed a significant year-on-year increase in the indicator to a value of 4.86% of GDP, just below the high-risk threshold of long-term sustainability. In addition to the deficit in the primary structural balance, the main reasons for this deterioration were changes to the pension system related to the age limit for retirement and an increase in minimum pensions. The contribution of the pension system to the overall value of the indicator in 2019 was 2.14% of GDP (RRZ).

During the pandemic period in 2020, further deterioration of this indicator was initially expected, reaching a level of 5.63% of GDP, placing it in the high-risk zone of long-term sustainability. The high value of the indicator was influenced by an increase in the primary structural deficit of public administration and the growth of its gross debt, as well as projections of future costs of the pension system. The Council for Budgetary Responsibility quantified the worsening of the indicator due to the pandemic at 1.2 percentage points (RRZ). After updating the data for the year 2020, the value of the indicator was reduced to % of GDP, keeping the indicator within the medium-risk range (RRZ).

In 2021, we observe a year-on-year deterioration in the indicator by approximately 0.1 percentage points to the level of 4.3% of GDP at a moderate risk level. Despite the favorable development of the primary structural balance of public administration compared to the previous year, predicted expenditures on the pension and healthcare systems negatively impacted the indicator of long-term sustainability in this year. In 2021, the Council for Budgetary Responsibility did not quantify the impact of the pandemic on the value of the indicator (RRZ). The reasons for the negative development of the indicator

also included the government's commitment to increase defense spending to 2% of GDP and an increase in expenditures of public administration entities on energy (RRZ).

The value of the indicator of long-term sustainability for the year 2022 deteriorated by 1.2 percentage points of GDP compared to the previous year, reaching the level of high risk for the first time in the observed period. The main reasons for this deterioration are the impact of the security crisis related to the war in Ukraine and the impact of the energy crisis. Due to these two factors, the value of the indicator of long-term sustainability worsened by 0.8 percentage points of GDP on a year-on-year basis. The reforms of the pension system, specifically those in the first and second pension pillars, also influenced the value of the long-term sustainability indicator. While the reform of the first pillar had a positive impact on the indicator's value, the reform of the second pension pillar negatively affected the indicator of long-term sustainability. Despite the current negative contribution of the second pension pillar reform to long-term sustainability, the Council for Budgetary Responsibility evaluates this reform positively, considering that the benefits of the reform will only be apparent over a 50-year horizon, which is the basis for the long-term sustainability indicator (RRZ).

3.2. Fiscal Sustainability of Slovakia in the Post-Pandemic Period

Figure No. 3 provides actual levels of gross and net public debt in Slovakia until 2022. Data for the years 2023 to 2025 are based on the assumptions of the Ministry of Finance of the Slovak Republic (2022b) (Figure 3).

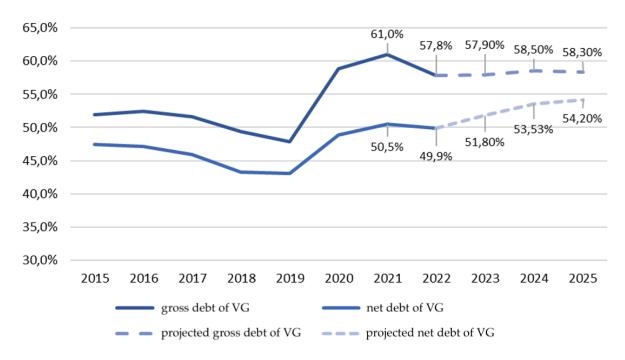


Figure 3. The projected gross and net debt of the Slovak Republic until 2025

Source: Own processing based on Eurostat and Ministry of Finance of the Slovak Republic data (2022a), (2022b)

Let's now look at the levels of gross and net public debt in Slovakia until 2022. The graph is also supplemented with data from the years 2023 to 2025, based on the assumptions of the Ministry of Finance of the Slovak Republic (MF SR). According to the forecast of the MF SR, the level of gross debt in Slovakia is expected to develop at a stable pace over the next few years, and its amount will hover around 58% of GDP, which is in line with the debt limit of the Stability and Growth Pact.

However, this projected level of gross debt does not correspond to the debt brake, the sanctioning tool of the Council for Budgetary Responsibility. Given the expected level of debt from 2023 to 2025, the Slovak government will face sanctions at the highest level of this tool. Therefore, during the monitored

period, the government will not be able to submit a deficit budget of public administration to the National Council and will be obliged to seek a vote of confidence from the parliament.

5. Conclusions

In the context of evaluating the long-term fiscal sustainability of Slovakia within the European Union and the Visegrad Group, we find that the level of gross public debt in Slovakia is below the European Union average. However, Slovakia exhibits a higher level of public debt compared to other VG countries, except for Hungary. Based on the indicator of long-term sustainability S2 used by the European Commission, we observe that in 2022, Slovakia had its worst value among all EU member states. This is mainly due to the projected increase in expenditures related to population aging.

The economic growth of the Slovak economy during the pandemic performed better than originally forecasted. Nevertheless, significant deterioration in fiscal indicators compared to the pre-pandemic period was recorded. This deterioration is attributed to an increased overall deficit of the public administration budget, primarily resulting from one-time measures taken by the public administration to mitigate the impact of the pandemic on the Slovak economy.

The increase in the overall deficit of public administration during the pandemic led to the rise in the gross public debt of Slovakia. Despite its level surpassing the 60% threshold relative to GDP set by the Growth and Stability Pact, no measures were taken by the European Commission against Slovakia. This decision was based on the unfavorable economic situation that affected the entire European Union. Furthermore, the level of Slovakia's public debt returned below the mentioned threshold in 2022. Positively, Slovakia maintained its credibility with creditors during the crisis period and retained a credit rating of A+.

The upper limit for a safe level of gross public debt, set by the Constitutional Act on Budgetary Responsibility at 50% of GDP, was also exceeded during the pandemic. However, due to escape clauses in the Constitutional Act on Budgetary Responsibility, no sanctions from higher sanction levels were imposed on the government.

The indicator of long-term sustainability, the GAP, recorded a negative change even in the prepandemic period. However, the negative impact on this indicator during the observed period was largely due to projections of future increases in pension system expenditures and not the pandemic. The value of the long-term sustainability indicator from the last available year, 2022, indicates that the primary structural balance of public administration must immediately and permanently improve by 5.5 percentage points of GDP for Slovakia's gross public debt to remain below the safe debt level by 2072. Given the current value of the long-term sustainability indicator, it cannot be asserted that Slovakia's public finances are sustainable in the long term under the current fiscal policy.

The Ministry of Finance of the Slovak Republic expects that in the post-pandemic period of 2023, the overall balance of public administration in Slovakia will be negatively affected primarily by the rise in energy prices and the conflict in Ukraine. For the years 2024 and 2025, the government has planned annual consolidation of the structural deficit of public administration by 0.5 percentage points of GDP, for which a consolidation plan of two billion euros needs to be specified. The gross public debt is expected to develop at a stable pace from 2023 to 2025, with its level during this period targeted at around 58% of GDP. However, such a level of gross public debt is not in line with the requirements of the debt brake of the Council for Budgetary Responsibility, and therefore, in the coming years, we can expect the imposition of sanctions by the debt brake against government members and municipalities. According to the Council for Budgetary Responsibility, public finances in the Slovak Republic will be influenced by demographic pressure related to population aging over the next decades. This will involve a gradual increase in public administration expenditures on the pension system, significantly impacting the long-term sustainability of Slovakia's public finances (RRZ 2022c).

The conclusion drawn from this contribution is that the pandemic had a negative impact on the long-term sustainability of Slovakia only from a short-term perspective. However, it has been found that in the next decades, the long-term sustainability of Slovakia will be negatively affected primarily by future expenditures related to population aging.

Funding: This research was funded by VEGA, grant number 1/0462/23, entitled "Circular economy in the context of social requirements and market constraints", grant share: 100%.

References

- Blanchard, O. (1990). The Sustainability of Fiscal Policy: New Answers to an Old Question [online]. OECD Economic Studies, 36 p. [cit. 19.7.2023]. Available at: https://www.researchgate.net/publication/5183200_The_Sustainability_of_Fiscal_Policy_New_Answers_to_An_Old_Question.
- 2. European Commission. (2021). *Omnibus report under Art* 126(3) [online]. Brusseles, 33 p. [cit. 1.7.2023]. Available at: https://economy-finance.ec.europa.eu/system/files/2021-06/com-2021-529-1_en_act_part1_v5.pdf.
- 3. European Commission. (2017). European Semester Thematic Factsheet: Sustainability of Public Finances [online]. 13 p. [cit. 20.7.2023]. Available at: https://commission.europa.eu/ system/files/2020-06/european-semester_thematic-factsheet_public-finance sustainability_en_0.pdf>.
- 4. International Monetary Fund. (2002). *Assessing Sustainability* [online]. Policy Development and Review Department, 60 p. [cit. 20.7.2023]. Available at: https://www.imf.org/external/np/pdr/sus/2002/eng/052802.pdf. pdf>.
- Krejdl, A. (2006). Fiscal Sustainability Definition, Indicators and Assessment of Czech Public Finance Sustainability
 [online]. Czech National Bank Economic Research Department, 29 p. [cit. 6.7.2023]. Available at:
 https://www.cnb.cz/export/sites/cnb/en/economic-research/.galleries/research_publications/cnb_wp/cnbwp_2006_03.pdf.
- Ministry of Finance of the Slovak Republic.. Fiškálne indikátory december 2022 [online], [cit. 5.7.2023]. Available at: https://www.mfsr.sk/sk/financie/institut-financnej-politiky/ekonomicke-statistiky/fiskalne-indikatory.
- 7. Ministry of Finance of the Slovak Republic. *Program stability Slovenskej republiky na roky* 2020 až 2023 [online], 51 p. [cit. 5.7.2023]. Available at: https://www.mfsr.sk/files/archiv/12/ProgramstabilitySlovenskanaroky 2020-2023_final.pdf>.
- 8. Ministry of Finance of the Slovak Republic. *Program stability Slovenskej republiky na roky* 2022 *až* 2025 [online], 68 p. [cit. 5.7.2023]. Available at: https://www.mfsr.sk/files/archiv/62/Program-stability-Slovenska-na-roky-2022-2025_po_pripomienkach_vlady.pdf.
- 9. The Council for Budget Responsibility. *Aktuálny odhad hrubého a čistého dlhu*. [online]. [cit. 7.7.2023]. Available at: https://www.rrz.sk/aktualny-odhad-hrubeho-a-cisteho-dlhu/.
- 10. The Council for Budget Responsibility. *Hospodárenie rozpočtu verejnej správy v roku* 2022 [online]. [cit. 7.7.2023]. Available at: https://www.rrz.sk/hospodarenie-rozpoctu-verejnej-spravy-v-roku-2022/>.
- 11. The Council for Budget Responsibility. (2022). *Správa o dlhodobej udržateľ nosti verejných financií za rok* 2021 [online]. Kancelária Rady pre rozpočtovú zodpovednosť, [cit. 21.7.2023]. Available at: https://www.rrz.sk/sprava-o-dlhodobej-udrzatelnosti-verejnych-financii-za-rok-2021-april-2022/.
- 12. *Ústavný zákon č.* 493/2011 Z. z. *o rozpočtovej zodpovednosti*. [online]. [cit. 6.7.2023]. Available at: https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2011/493/20150101

Supporting Organization Entities of the Circular Economy through Environmental Elements in Transport Taxation

Ivona Ďurinová

 $Faculty\ of\ Business\ Management,\ University\ of\ Economics,\ Bratislava,\ Slovakia;\ ivon a. durinova@euba.sk$

Abstract: The state can make a significant contribution to sustainable development and circular economy through various tax policy instruments. There is currently a wide debate on how to reduce emissions and protect the environment, which is heavily polluted every day due to motor vehicles. The aim of this thesis is to evaluate the use of the motor vehicle tax in the Slovak Republic as a tool to promote the circular economy and sustainable development and to point out the possibilities for more effective use of environmental elements in transport taxation, based on a comparison of the legislation on motor vehicle taxation in the Slovak Republic and in Sweden. In particular, the focus will be on the taxation of passenger cars. The thesis uses the method of comparison, synthesis and deduction. Compared to Slovakia, Sweden has much more complex taxation systems and places more emphasis on environmental aspects.

Keywords: transport taxation; circular economy; environmental elements; tax policy

Introduction

Sustainable consumption and production can be understood as an effort to decouple economic growth from environmental degradation and to apply an approach based on an understanding of the entire life cycle, taking into account all its phases, starting from the use of resources, so as to obtain "more and better for less" (Rybárová, Ďurinová, 2019). The European Commission (2019) states that sustainable development means meeting the needs of present generations without compromising the needs of future generations. It is a comprehensive approach that combines economic, social and environmental aspects in a way that is mutually reinforcing. As stated by Čabinová, Onuferová and Šofranková (2019, p. 13), "From a global perspective, the goal of all initiatives dealing with sustainable development is to correctly define the essence of sustainability, formulate principles and measures for improving and maintaining conditions from an economic, social and environmental point of view, set acceptable goals, contribute to their fulfilment through active interventions, but also to choose the right indicators, indices or other measures of sustainability." Siniak, Koteska Lozanoska (2019) state that in today's global digital world, smart sustainable development, value creation and wealth creation are among the most important goals of society. The scientific concept of the model of sustainable economic development is the circular economy, which encompasses a complex set of tools that give us an answer, for example, on how to manage natural resources. The principle of the circular economy is also that the production of products should consume as few primary resources as possible, less energy, with an emphasis on the use of sustainable and renewable resources and materials.

The state can contribute to sustainable development through various instruments within tax policy. With the help of taxes, the state can promote investment and entrepreneurship, regional development, innovation and scientific and technological development, curb production in certain sectors, etc. (Lénártová, 2014). Through tax policy it is possible to influence the behaviour of taxpayers and therefore also business entities. Harumová (2002) examines how the tax system affects labour but also entrepreneurial activity, the amount of savings and the decision-making of investors.

The development of the business sector is closely linked to the promotion of investments that would create more opportunities for economic growth and job creation (Harumová, 2006). Through appropriately constructed taxes, environmental protection can also be contributed to.

The issue of reducing emissions and protecting the environment, which is also highly polluted on a daily basis due to motor vehicles, is an ever present issue. Businesses can also be encouraged to use environmentally friendly means of transport through taxation. For example, tax exemptions for environmentally friendly vehicles encourage taxpayers to switch to environmentally friendly means of transport. Thus, as a tax policy instrument, the motor vehicle tax can also significantly influence taxpayers in their decision to purchase a motor vehicle.

The thesis examines whether the taxation of transport in the Slovak Republic is designed to sufficiently encourage businesses to purchase environmentally friendly means of transport, which would lead to the promotion of a circular economy and sustainable development, comparing the taxation of motor vehicles in the Slovak Republic and Sweden.

1. Background of the investigated issue

Among the UN programmes, the UN Environment Programme and the UN Development Programme, which hosts several funds, are particularly focused on promoting sustainable development. In 2015, AGENDA 2030 was adopted by UN Member States, which aims for joint coordinated action to address global challenges. The Agenda contains 17 Sustainable Development Goals and 169 related subgoals that balance the economic, social and environmental aspects of sustainable development.

Sustainable development became an EU policy priority after the Cardiff Council of Europe Summit in June 1998. The European Council in Gothenburg in 2001 adopted the first EU Sustainable Development Strategy, which was complemented by a third structural socio-economic pillar at the Barcelona European Council in 2002 in an effort to ensure the integration of environmental policy with economic policy. The Council of Europe set a further strategic objective, namely the establishment of a new economy based on greater competitiveness and knowledge dynamism, with the capacity for sustainable economic growth with a positive impact on employment and social cohesion, one year after the Lisbon Summit. The Stockholm meeting added an environmental dimension to this objective. In 2006, the European Council adopted a renewed EU Sustainable Development Strategy in the face of persistent unsustainable trends, with the main aim of gradually changing the current unsustainable patterns of consumption and production and the non-integrated approach to policy-making in EU countries. In 2010, the European Council endorsed the Europe 2020 Strategy and subsequently the Europe 2030 Strategy. In 2008, the European Commission issued an Action Plan on Sustainable Consumption and Production. These are proposals that will contribute to improving the environmental performance of products and increase demand for more sustainable goods and production technologies (European Commission, 2015). It also seeks to encourage EU industry to seize opportunities for innovation. In order to meet the current challenges, it is essential to change the way goods are produced and consumed. It is necessary to create more added value with fewer inputs, reduce costs and minimise environmental impacts.

The work focuses on transport, which has a negative impact on the environment. Emissions of air pollutants also have an impact on climate change through the emission of greenhouse gases, the main source of which is carbon dioxide (CO2). In the transport sector, the level of emissions is increasing (accounting for more than 25% of EU greenhouse gas emissions). More than 70% of GHG emissions from transport come from cars, vans, trucks and buses. The projected shift towards electrification of transport will contribute to reducing emissions. (European Environment Agency, 2020). Climate change is beginning to take hold in all parts of the world, including European countries. Weather changes, extremely high temperatures in some parts of the Earth, storms, floods and landslides are becoming more and more frequent. These extreme changes in climate are also causing a steady rise in sea levels, with consequent acidification and loss of biodiversity. The warning is not to increase the world's temperature by more than 1.5 degrees Celsius, because the environmental impact and the impact on climate change will be irreversible. Because of this, there is an obligation to achieve carbon neutrality. (European Parliament, 2019). In relation to pollution, the EU is committed to the Paris Climate Agreement, which sets a target of reducing greenhouse gas emissions by at least 55% below 1990 levels by 2030. By 2050, the EU wants to achieve climate neutrality (European Green Deal), i.e. a substantial reduction of 80-95% from 1990 levels. (IFA, 2022). However, the EU has already achieved reductions in emissions of selected air pollutants, mainly thanks to the introduction of EURO emission standards. (European Environment Agency, 2020).

In the context of its efforts to improve the environment, the EU has also set itself other targets, namely to achieve a share of renewable sources in final consumption and to increase energy efficiency. The aim is to reduce greenhouse gases across the EU, with the target set at a 40% reduction by 2030, compared to 2005. Each country has been given a different target, based on a calculation, through GDP per capita and cost-effectiveness. Slovakia has an obligation to reduce emissions by almost 22.7%, Sweden by 50%. (Topspeed, 2022).

EU Member States have different charging systems for road motor vehicles, but must nevertheless apply certain methods to achieve the stated objectives. The common aim is to reduce the amount of harmful substances emitted into the air. The application of environmental elements to charging through EURO emission standards is helpful. Measures aim at stricter emission limits for harmful air pollutants. Given that the majority of pollutant emissions are mainly caused by passenger cars, the aim is to encourage the purchase of more environmentally friendly alternative fuel vehicles. EU Member States are trying to reduce pollution through higher taxes on older or more polluting vehicles.

The aim of the thesis is to assess the use of the motor vehicle tax in the Slovak Republic as a tool to promote circular economy and sustainable development and to point out the possibilities of more effective use of environmental elements in the taxation of transport, based on a comparison of the legal regulation of motor vehicle taxation in the Slovak Republic and Sweden. In particular, the focus will be on the taxation of passenger cars.

2. Methods and methodology

The object of the study is the motor vehicle taxation systems in the Slovak Republic and Sweden. The work is based on domestic literature as well as foreign scientific publications and electronic sources, but mainly on laws:

- Act No. 361/2014 Coll. on Motor Vehicle Tax, as amended, which is applied in the Slovak Republic,
- Act No 2006:228 with special provisions on vehicle tax, as amended, as applied in Sweden.

The thesis uses the method of comparison, which compares the different systems of motor vehicle taxation in the Slovak Republic and Sweden, and the methods of synthesis and deduction, which assess the use of the motor vehicle tax in the Slovak Republic as a tool to promote the circular economy.

3. Results

First, we will look at the vehicle fleet in the two countries under study, namely in the Slovak Republic and in Sweden. Due to the fact that the two countries have different population sizes, it is necessary to calculate the number of vehicles per thousand inhabitants. Table 1 shows the demographic data of both countries and their vehicle fleet, Table 2 the number of vehicles per thousand inhabitants (year 2021).

Table 1. Demographics of Slovakia and Sweden and their fleets (2021).

Country	Population	Total number of vehicles	Of which tax objects	Passenger vehicles
Slovakia	5 434 712	3 436 018	984 456	2 327 986
Sweden	10 481 937	5 245 688	-	4 986 750

Source: Processed according to Eurostat 2021

Table 2. Number of motor vehicles per thousand inhabitants (2021)

Country	Vehicles	Taxable motor vehicles	Passenger cars	Average age
Slovakia	632	181	428	14
Sweden	500	500	476	10, 2

Source: Processed according to ACEA Tax Guide 2022

In Slovakia, there are 632 motor vehicles per thousand inhabitants, which is higher than in Sweden. However, the situation is different for passenger cars. Sweden has 48 more passenger cars per thousand inhabitants than Slovakia. The table also shows that the average age of motor vehicles in Slovakia is 14

years, which is almost 4 years older than in Sweden. On the basis of the above data, Sweden appears to be a better environmental performer.

It should be stressed that in the Slovak Republic, both a natural person and a legal person who is the holder of a motor vehicle registered in the Slovak Republic and used for business activities is obliged to pay tax on motor vehicles. Thus, the subject of the tax is a motor vehicle registered in the SR and used for business or other self-employed activity. For this reason, only 28,7 % of all vehicles are taxed in the Slovak Republic. The tax liability in Sweden is the same for every entity, regardless of the purpose for which the vehicle is used. The number of taxed vehicles is therefore 100 %, resulting in higher tax revenue per thousand inhabitants to the first time they are cited. A caption on a single line should be centered.

In the Slovak Republic, the basic tax rate for passenger cars with a diesel or petrol engine is set on the basis of the engine's cylinder capacity in cm3 and is adjusted in relation to the age of the vehicle. The way passenger cars are taxed in Slovakia is favourable for newer vehicles, where percentage discounts are granted, and on the other hand it is very unfavourable for older vehicles, where it is realistic that the tax rate will be increased by up to 20%. Given the fact that the average age of vehicles in Slovakia is 14 years, it can be assumed that most taxpayers will be subject to the adjusted tax rate. Table 3 shows tax rate for passenger cars in Slovakia.

Table 3. Tax rate for passenger cars in Slovakia

Basic	c tax rate	Tax ac	ljustment
Engine cylinder capacity in cm ³	Annual tax rate in EUR	Vehicle age	Tax discount
to 150	50	0 - 3	- 25%
150 – 900	62	3 – 6	- 20%
900 – 1 200	80	6 – 9	- 15%
1 200 – 1 500	115	9 – 12	annual rate
1 500 – 2 000	148	12 - 13	annual rate + 10%
2 000 – 3 000	180	more than 13	annual rate + 20%
over 3 000	218		

Source: Processed according to § 6 and § 7 of Act No. 361/2014 Coll. on motor vehicle tax

In the case of electric vehicles powered solely by electricity, the annual rate of motor vehicle tax is set according to the power of the engine, which is expressed in kW. The amount of the annual tax rate for electric vehicles of categories L, M, N, which also do not have an energy source other than electricity, is zero. For commercial vehicles and buses, the tax rate is based on the gross vehicle weight (in tonnes) and also depends on the number of axles. Vehicles of diplomatic missions and consular offices, emergency medical, mining, mountain, aviation and fire protection vehicles are exempted from motor vehicle taxation. Also exempted are regular passenger transport vehicles operating under a public service contract and vehicles used exclusively in agricultural production and forestry production. (§ Section 4 of Act No 361/2014 Coll. on Motor Vehicle Tax, as amended).

There are currently three systems of motor vehicle taxation in Sweden. These systems are: a weight-based system, a carbon dioxide-based system and a bonus-malus system. The bonus-malus system (good and bad) was introduced in 2018 and is based on rewarding owners of vehicles that emit relatively small amounts of carbon dioxide and, conversely, burdening vehicle owners whose vehicles emit relatively large amounts of CO² with a higher tax. The tax rate is the sum of a basic flat amount, a green surcharge and a fuel surcharge, and charges for the amount of carbon dioxide emitted expressed in grams. The carbon dioxide-based system was introduced for passenger cars in 2006 and is designed to qualify for certain environmental classifications. In this system, the final tax depends on the type of vehicle, fuel and carbon dioxide emissions, which are expressed in grams per kilometre. Other vehicles

are adapted to the old system (circular tax), where the tax depends on the type of vehicle, fuel and weight. In some cases, the tax also depends on the number of axles, the existence of a steering axle and the obligation to pay a road tax. (European Commission, 2022). The three systems of motor vehicle taxation in Sweden are shown in Tables 4, 5 and 6.

Table 4. Bonus – malus system

Type of charge	Date of first taxation	Amount of grams of CO ² emitted	Amount
Basic amount			360 SEK
Environmental	Before or after		Before 2008= 250 SEK
surcharge	2008		After 2008 = 500 SEK
Charge for the	1.7.2018 -	95 - 140 grams	82 SEK
amount of carbon	31.3.2021	more than 140 grams	107 SEK
dioxide emitted,	1.4.2021 -	90 - 130 grams	107 SEK
measured in	31.5. 2022	more than 130 grams	132 SEK
grams, over a	1.6.2022 and	75 - 125 grams	107 SEK
specified period	later	more than 125 grams	132 SEK
			13,52 - multiplication of the
E 1 1			vehicle's total carbon diox-
Fuel surcharge			ide emissions in grams per
			kilometer in mixed driving

Source: Processed according Skatteverket, Fordonsskatt and ACEA TAX GUIDE 2022

Table 5. Carbon dioxide taxation system

360 SEK	+	22 SEK per gram CO ² over 111g/km 250 SEK	=	petrol
		1.registration after 2008		
petrol x 2,37	+	500 SEK 1.registration before 2008	=	diesel vehicles
360 SEK	+	11 SEK per gram CO ² over 111g/km	=	alternative propulsion
Source: Processed ac	cording Ska	tteverket, Fordonsskatt and ACEA TAX GU	IDE 2022	

 $\textbf{Table 6.} \ \ \textbf{Weight and fuel based taxation system - older than 2005}$

Vehicle weight	Tax rate without diesel (SEK)	Tax rate for diesel vehicles (SEK)
≤900 kg	913	2298
901 – 1 000 kg	1129	2863
For each additional 100 kg	+ 214	+ 564

Source: Processed according Skatteverket, Fordonsskatt and ACEA TAX GUIDE 2022

Compared to Slovakia, Sweden has much more complex taxation systems and places more emphasis on environmental aspects. The systems are similar in particular in that they are split based on the date of first registration of the vehicle and the tax rate depends on the grams of

carbon dioxide emitted per km in mixed driving. Older vehicles that were first registered before 2005 are taxed in Sweden on the basis of weight.

Exemptions from motor vehicle taxation apply to deregistered vehicles, motorcycles and buses, trucks and cars over 30 years old that are not used in commercial transport and in some cases trucks over 30 years old, registered mopeds, in some cases tractors used in agriculture, vehicles used mainly in rescue operations (not cars), heavy work vehicles not exceeding 2,000 kilograms, and trailers weighing more than 3,000 kilograms (if used only by diesel-powered vehicles). In Sweden, a five-year tax exemption applies as long as the vehicles meet the environmental targets set. The aim is to encourage people to buy vehicles that are fuel efficient or run on renewable fuels. Table 7 shows the conditions for the tax exemption.

Table 7. Vehicle tax exemption conditions in Sweden (2022)

First vehicle registra- tion	Type of vehicle	Conditions			
1. 7. 2009 – 31. 12. 2010	- petrol-powered and diesel	- have carbon dioxide emissions of max. 120 g/km - env. class 2005			
1. 1. 2011 – 31. 12. 2012	- passenger cars	Euro 5 or Euro 6 emission classplug-in or electric hybrids			
1. 1. 2013 – 30. 6. 2018	- cars, motorhomes- light trucks	- Euro 5 or Euro 6 emission class - plug-in or electric hybrids			
Source: Processed by Transport styrelsen.					

Vehicles that pollute minimally, i.e. with an energy source other than petrol or diesel, enjoy a number of concessions, benefits and, for some, even purchase subsidies in both countries (see Table 8).

Table 8. Tax rates for alternatively fuelled vehicles (2022)

Country	Registration fee	Reduced tax on motor vehicles				
		Electric vehicles	Hybrid, hydrogen and natural gas			
Slovakia	50%, minimum 33 €	0%	50% reduction			
Sweden	not applicable	0% (5 year exemption)	360 SEK + 11 SEK for g CO2 above			
Sweden			111g/km			

Source: Processed by the Office of the National Council of the Slovak Republic

Electric cars in Slovakia are fully tax exempt, in Sweden the exemption only applies for five years from the first registration of the vehicle. After five years, the tax rate is determined in the same way as for passenger cars. Vehicles are only exempt for five years because there are almost 60 000 registered electric vehicles in Sweden (only about 3 000 in Slovakia). Therefore, the support for these vehicles is only partially applied here. In the case of hybrid, hydrogen or natural gas vehicles, the vehicle tax on these vehicles is reduced. The SR also favours cars that emit the lowest possible emissions, so these alternatively powered vehicles pay half the tax of a conventional passenger car. In Sweden, the tax is calculated as the sum of the basic rate of SEK 360 and SEK 11 per g of CO² above 111g/km.

4. Discussion

It can be concluded that in Slovakia more environmentally friendly vehicles are less promoted than in Sweden, so the environmental policy is better embedded for alternative fuel vehicles in Sweden. It should also be noted that all motor vehicles are subject to motor vehicle tax in Sweden and not only those used for business or self-employment, as is the case in Slovakia.

On the basis of the comparison of the motor vehicle taxation systems of both countries, it is possible to propose recommendations for improvement of the motor vehicle taxation system in the Slovak Republic. The majority of all motor vehicles subject to taxation are passenger cars, so the recommendations will mainly concern this category of vehicles. The method of determining the tax rate on the basis of the engine capacity in cm³ and the age of the vehicle is not sufficiently efficient, given that there are minimal

categorisations in determining the rate on the basis of the engine capacity. The amount of carbon dioxide emissions is higher the higher the engine capacity, but often the tax rates for individual vehicles are high, even for lower emissions. From an environmental policy point of view, it would be more efficient to base tax rates on the amount of carbon dioxide emitted per g/km, as is the case in Sweden. The tax rates would be set at the sum of the basic rate of 50 € and 1.50 € for each extra gram if the vehicle emits more than 100g/km. Vehicles emitting less than 100g/km would be exempt from the tax. Vehicles with higher emissions would have an increased tax rate and vehicles with minimum emissions would be favoured. Taxpayers would pay a higher tax on older vehicles, and the likelihood of changing preferences in favour of buying cleaner vehicles would increase. The system supporting the purchase of electric cars and plug-in hybrids also has reserves. Electric cars are supported through a zero tax rate, as well as by reducing the depreciation period to two years, but support for the purchase of an electric car should also be incorporated through subsidies at the time of purchase and should apply equally to everyone. In selected years, electric cars have indeed been subsidised at the point of purchase, but only for the selected fastest applicants. A subsidy of 8,000 € for an electric car and 5,000 € for a plug-in hybrid has been published and is valid until the funds are exhausted. However, the funds were exhausted almost as soon as this subsidy was made public. It would have been preferable if the financial subsidy for electric vehicles had been higher, had been valid on a permanent basis, and had been the same for all applicants. In addition to the above incentives, it would also be appropriate to introduce free motorway use for electric vehicles and a financial reduction in motorway tolls for plug-in hybrids worth, for example, 40% of the total toll. Higher financial support from the state for EVs and plug-in hybrids would be matched by higher tax revenues from the proposed higher tax on higher-emission passenger cars. The proposed measures would achieve a higher level of environmental policy in the Slovak Republic and would probably increase the demand for electric cars and plug-in hybrids and reduce the demand for older vehicles with internal combustion engines. (Dobáková, 2023).

Funding: This research was funded by VEGA MS SR, grant number 1/0462/23: "Circular Economy in the Context of Societal Demands and Market Constraints" in the scope of 50% and by VEGA MS SR, grant number 1/0836/21: "Establishing an Appropriate Behavioural Model for the Ethics and Integrity of Institutions in the Field of Scientific Research Activities Based on International Comparisons and Setting up a System of Determining Attributes for its Effective Implementation and Operation" in the scope of 50%".

References

- 1. Act No. 361/2014 Coll. on Motor Vehicle Tax, as amended as applied in Slovak Republic
- 2. Act No 2006:228 with special provisions on vehicle tax, as amended, as applied in Sweden
- 3. ACEA Tax Guide 2022, (2022). https://www.acea.auto/files/ACEA Tax Guide 2022.pdf>
- 4. Čabinová, V., Onuferová, E., & Šofranková, B. (2019). Theoretical background approaches on the quantification of sustainable development. *Young Science*. 7(2), 12-25.
- 5. Dobáková, S. (2023). Motor vehicle taxation in the Slovak Republic and in the selected countries. University of Economics in Bratislava. Bachelor thesis, Bratislava: FBM, 2023.
- 6. European Commission, (2015). Action Plan for Sustainable Consumption and Production. http://ec.eu-ropa.eu/environment/eussd/escp_en.htm.
- 7. European Commission, (2019). https://ec.europa.eu/info/strategy/international-strategies/sustainable-development_sk.
- 8. European Commission, (2022). Motor vehicles tax. https://ec.europa.eu/taxation customs/tedb/leg-acy/taxDetail.html?id=517/1329868800&taxType=Other%20indirect%20tax>
- 9. European Environment Agency, (2020). Transport. Building more sustainable transport in Europe. https://www.eea.europa.eu/sk/articles/budovanie-udrzatelnejsej-dopravy-v-europe
- 10. European Parliament, (2019). What is carbon neutrality and how can we achieve it by 2050. https://www.eu-roparl.europa.eu/news/sk/headlines/priorities/klimaticke-zmeny/20190926STO62270/co-je-uhlikova-neutralita-a-ako-ju-mozeme-dosiahnut-do-roku-2050>
- 11. Eurostat, (2021). https://ec.europa.eu/eurostat/web/main/data/database
- 12. Harumová, A. (2002). Impact of Taxes on the Development of Business Sphere. *Journal of Economics*. 50(2), 277-292.
- 13. Harumová, A., & Kubátová, K. (2006). Business taxes. Bratislava: Entrepreneur's Adviser, 2006.
- 14. IFA, (2022). Paris Agreement. < https://www.mzp.cz/cz/parizska_dohoda, >

- Lénártová, G. (2014). Tax stimulation and business environment in Slovakia. In Current Problems of the Corporate Sector 2014. Proceedings of International Scientific Conference. Bratislava: Vydavateľstvo EKONÓM. 269-275.
- 16. Office of the National Council. Comparison of support for alternative fuel vehicles. <fi>ers/one/Downloads/03 21 PA Porovnanie%20podpory%20vozidiel%20s%20alternat%C3%ADvnym%20pohonom%20vo%20vybran%C3%BDch%20krajin%C3%A1ch.pdf
- 17. Rybárová, D., & Ďurinová, I. (2019). The Importance of the Creative Industry for Sustainable Consumption and Production. In *Proceedings of the International Scientific Conference "Current Problems of the Corporate Sector 2019"*. Bratislava: Vydavateľstvo EKONÓM, 382–391.
- 18. Siniak, N., & Koteska Lozanoska, D. (2019). A review of the Application of the Concept of Economic and Smart Sustainable Value Added (SSVA) in Industries Performance Evaluations. *Broad research in Artificial Intelligence and Neuroscience*. 10(1), 129-136.
- 19. Skatteverket. Fordonsskatt. https://www.skatteverket.se/foretag/skatterochavdrag/bilochtrafik/for-donsskatt.106.233f91f71260075abe880008514.html>
- 20. Topspeed. Tighter emissions targets. < https://www.topspeed.sk/novinky/eu-sprisnila-emisne-ciele-clen-skych-statov-slovensku-ich-sprisnila-viac-ako-madarom-a-poliakom/22106>
- 21. Transport styrelsen. Five-year tax exemption. https://www.skatteverket.se/foretag/skatterochavdrag/bi-lochtrafik/fordonsskatt.106.233f91f71260075abe880008514.html

Insights into HR Analytics: Unraveling the Nexus with HRM Practices and HR Dynamics

Soňa Ďurišová 1, Jana Blštáková 2

- ¹ Ing. Soňa Ďurišová, PhD. (Faculty of Business Management, University of Economics in Bratislava, Slovakia); sona.durisova@euba.sk
- ² doc. Ing. Jana Blštáková, PhD. (Faculty of Business Management, University of Economics in Bratislava, Slovakia); <u>jana.blstakova@euba.sk</u>

Abstract: The purpose of this paper is to develop current knowledge about the relationships between HR analytics and HRM practice in the light of international research. Empirical research covered 5899 companies from 38 countries, with the size over 150 employees. Data was collected in 2021/2022 in cooperation with CRANET, the international research network. The results have shown, that companies with more employees use HR analytics to a greater extent, while the number of HR specialists in HR departments decreases. Results have also shown the relevant support of performance management by HR analytics in all of the measured items. The research delivers support to the assumption that companies with deployment of HR analytics, practice formal appraisal systems, utilize appraisal data further in decision-making for related HRM functions, and implement a systematic approach in T&D practice.

Keywords: HR Data analytics, Performance management, HRM practice

Introduction

Information about the first theory input of HR Data analysis in literature partially differs. While some authors cite Fitz-enz's 1984 book How to measure human resources management (Álvarez-Gutiérrez et al., 2022) as a starting point, others cite the introduction into theoretical field on data analysis for 2006, when the *business analytics* was introduced as a part of BI (Chen et al., 2012). The first software for the processing of HR data was created in 1980, however it was mostly oriented to decrease administrative work of HR practices. The analytical functions of IT software raised in 2000s (van den Heuvel & Bondarouk, 2017). It is precisely the rapid growth of significant IT innovations that allows a substantial increase of HR Data analytics in current practice (Welbourne, 2015).

In the works of several authors, could be find research estimating the penetration of HR data analytics into the practices of HRM in companies in the recent period. In 2014, research by Delloite showed that 16% of companies had HR data analytics in place (Marler et al., 2017). A similar survey by Delloite 4 years later showed that 17% of companies have real-time dashboards implemented, and at the same time, 69% of companies implement integrated systems to analyze worker-related data (Álvarez-Gutiérrez et al., 2022). Developments in this area are progressing very rapidly. Autor van den Heuvel suggested in 2017 that, by 2025, HR analytics will have become an established discipline, will have a proven impact on business outcomes, and will have a strong influence in operational and strategic decision making (van den Heuvel & Bondarouk, 2017).

This study aims to contribute to the theory of HRM by recognizing current research in using HR data in compliance with HR dynamics and unraveling the relationships between HR analytics and HRM practice in the light of international research.

1. Theoretical background

1.2. Data-driven HRM

The definition of HR data analytics is partly changing, highlighting its benefits for the organization or HRM. In the simplest context, the HR data analytics can be named as a novel system to collect, analyse, and present information from organizations.(Bonilla-Chaves & Palos-Sánchez, 2023). Sometimes it emerge in literature even as a communication technique, that uses data from variable sources to describe the present condition and forecast the future (Valecha, 2022).

By defining HR data analytics we should bear in mind a few points in which it is characterized – it connects cross-dimensionally data across the company but also external environments; uses IT systems for data collection, editing and reporting with main intention in increasing the efficiency and effectiveness of HR functions as well as the overall performance of the organization (Marler et al., 2017)

Analytics is the discipline, which has developed at the intersection of engineering, computer science, decision-making and quantitative methods to organise, analyse and make sense of the increasing amounts of data being generated by contemporary societies (Mortenson et al., 2015)

Several methods based on information technology are used for data processing in the HR data analytics. Most of them are quantitative methods, connected with data mining, predictive analytics, contextual analysis (Bonilla-Chaves & Palos-Sánchez, 2023) We this new perspective a completely new set of possibilities occur for managers enabling them to make better workforce-related decisions.

This is a view that rapidly changes the possibilities of HR in adding value to organizations. Adding value to organization should be the top priority of HR work, and thanks to HR analytics, line managers and HR professionals can better justify, prioritize and improve HR investments (Ulrich & Dulebohn, 2015).

It is the cross-function focus of HR data analytics that distinguishes it from simple analyses of partial HRM practices and brings added value to strategic decision-making of companies. The main goal of data analytics is to support organizations' decision-making with the aim of economic benefits as productivity, cost-effectiveness, competitiveness or performance growth; as well as social goals of the organization as headcount development and support employee experience (Tursunbayeva et al., 2018).

1.3. Data processing in HR analysis

HR data analysis is not a one-time data evaluation. The process view of data analysis is gaining more and more importance, returning the process to the evaluation and feedback phase, and creating conditions for follow-up actions. HR data analyses as a process could continuously improve through measurement, research models, systematic data analysis and technology support decision making. (McIver et al., 2018)

The process view gain importance in times of change and developing inside and outside conditions of organization. Companies rather create HR data analyses department focused on continuous measurement and follow-up feedback actions to business decisions.

The advantages of data analytics are the ability to evaluate the past decisions and anticipate the effects of future investments. In this regard, HR data analytics could be described as a process composed of three parts: descriptive, predictive and prescriptive (Marler et al., 2017).

The descriptive part is known as HR metrics showing in dashboards, graphs, and scorecards the state in which HR is. Predictive analyses could reveal what will happened next thanks to utilizes statistical techniques, advanced algorithms and machine learning to anticipate what might happen in the future and why (Margherita, 2022). Prescriptive analyses enable to create research models for unveiling impact of future decisions and investments (Welbourne, 2015).

HR analytics help to analyse parameters effecting organization and teach leaders to understand their human capital in the same way they evaluate financial or physical capital (Welbourne, 2015). In this regard Angrave (2016) writes also about the potential negative effect of HR data analytics, where he identified a risk that analytics will further embed finance and engineering perspectives on people management at boardroom level in ways that will damage the quality of working life and employee well-being, without delivering sustainable competitive advantage to the organisations that adopt it (Angrave et al., 2016).

Several authors agree on the benefits of HR data analytics in the following regards:

- a) **Contribution to companies' competitive advantage.** HR data analyses helps companies by analysing turnover, succession planning, and business opportunity data to identify potential shortages or excesses of key capabilities long before they happen (Davenport et al., 2010).
- b) Efficiency and effectiveness of decisions. HR data analytics help companies to obtain crucial knowledge about people operations in day-to-day decision making. This process help organizations to targeted approach in efficient investments and decision making, (Bonilla-Chaves & Palos-Sánchez, 2023)
- c) **Cost reduction**. Targeted data analysis can detect places with inefficient resource spending, as well as predict places with potential growth and high-cost efficiency. Targeted measurements help organizations to increase investments at areas with the highest expected effect; and decrease in areas with low or minimal effect.
- d) **Process improvement.** HR data analytics could help detecting downtime and delays in ongoing processes and define time-leakage in HR processes.
- e) **Productivity**. Several studies have discussed how HR data analytics influences organizational performance, arguing that firms with data-driven strategies tend to be more productive and profitable than their competitors (Brynjolfsson et al., 2011). To illustrate several studies defining the relationship between data analytics and productivity, we have presented the following chapter.

Based on the literature review, we find the relevance in aim of our study proven. Above mentioned current knowledge in HR data analytics, allows us formulation of research questions to address the suggestions for further research in data driven HRM.

2. Methods and methodology

To address the research questions we have used data collected in international survey on Human resources management CRANET. The survey is conducted regularly on a sample of about 40 countries and provides a large-scale, multi-time-point, cross-national data (Parry et al., 2021).

For our research, we used data from the last survey conducted in 2021/2022, which was the ninth round of a questionnaire survey on a sample of 5899 companies with more than 150 employees from 38 countries. For a more detailed description of the questionnaire survey methodology, see Brewster (Brewster et al., 2004). For data processing we used SPSS software.

The database we researched composed of businesses across all sectors and ownership forms, and involved in the research were the following sizes (Table 1.).

		Frequency	Percent	Valid Percent
Valid	150 - 300 Employees	2084	35.3	39.4
	301 - 500 Employees	832	14.1	15.7
	501 - 1000 Employees	861	14.6	16.3
	1001 - 2500 Employees	707	12.0	13.4
	2501 - 5000 Employees	307	5.2	5.8
	over 5001 Employees	502	8.5	9.5
	Total	5293	89.7	100.0
Missing	System	606	10.3	
Total		5899	100.0	

Table 1. Companies by size in the research sample.

For the research of the use of HR analytics in HR practice we have formulated following research questions:

RQ1: How is the use of HR analytics related to the size of a company and HRM department? To address this question, two hypotheses are formulated:

H1: The extent of the use of HR analytics is related to the number of employees.

H2: The extent of the use of HR analytics is related to the size of HR departments.

RQ2: How is the use of HR analytics related to performance management practice? To address this question, three hypotheses are formulated:

H3: Formal appraisal system is related to HR analytics.

H4: Employee appraisal data use in HR functions is related to HR analytics.

H5: Systematic approach to training is related to the use of HR analytics.

Table 2. Variables and measurements

Variable	Item	Measurement
HR analytics (HRA)	Extent of the use in HR practice	Likert scale(ordinal parameter)
Company size	Number of employees	Clustered (cardinal parameter)
HR department	Number of employees in HR	Clustered (cardinal parameter)

PM practice	Existence of formal appraisal sys-	Nominal parameter
	tem	
	Appraisal data for workforce plan-	Likert scale(ordinal parameter)
	ning	
	Appraisal data is used to T&D	Likert scale(ordinal parameter)
	Appraisal data for career moves	Likert scale(ordinal parameter)
	Appraisal data for pay decisions	Likert scale(ordinal parameter)
	Systematic estimation of T&D needs	Yes/No (nominal parameter)
	Systematic evaluation of T&D effect	Yes/No (nominal parameter)

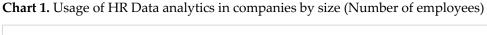
3. Results

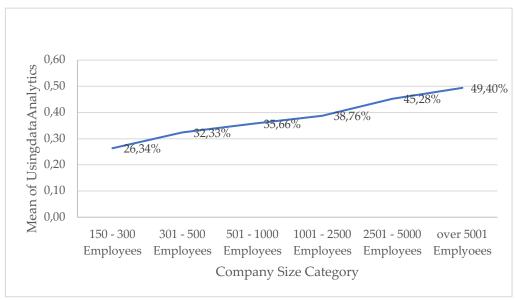
3.1. HR data analytics and HR organization

H1: The extent of the use of HR analytics is related to the number of employees.

Measuring the usage of HR data analytics on the sample of companies included in research we can find strong correlation between Company size and Usage of HR Data analytics. The correlation on significancy level p<0,001 showed, that Company size is relevant in Usage of HR data analytics in positive way (Kendall's $tau_b = 0,165$). See Table 2.

For graphic description we used Company size in groups by Number of Employees and Usage of HR Data analytics in two categories - Not using or only partially usage of HR Data analytics and extensive usage of HR Data analytics. The chart shows, that almost 50% of companies sized 5000 employees and more use the HR Data analytics in extensive way. On the other site, more than 74% of small enterprises does not use HR Data analytics or use it only partially. The average usage in researched sample reached 34,3 % (See Chart 1.)





H2: The extent of the use of HR analytics is related to the size of HR departments.

The indicator itself is greatly influenced by the size of the company - the larger is the company, the more employees there are per employee of the HR department (p<0,001, Kedall's tau_b=0,232). On the research sample we could say that the company size effects number of Employees / HR employee's ratio. Our goal was to find out how HR data analytics enters this relationship. On Significancy level p<0,001 the usage of HR analytics reduces the number of HR employees with negative correlation Kedall's tau_b= -0.095. We accept the hypothesis and can say, that usage of HR data analytics decreases the need of HR employees.

Table 3. Correlation of Number of HR employees to Usage of HR data analytics **Correlations**

			Use of HR analytics	No of employees per HR employee	Company Size Cate- gory
Kendall's	Use of HR analytics	Correlation Coeffi-	1.000	095**	.165**
tau_b		cient			
		Sig. (2-tailed)		<.001	<.001
		N	5632	5052	5070
	No of employees per	Correlation Coeffi-	095**	1.000	.232**
	HR employee	cient			
		Sig. (2-tailed)	<.001		<.001
		N	5052	5253	4755
	Company Size Cate-	Correlation Coeffi-	.165**	.232**	1.000
	gory	cient			
		Sig. (2-tailed)	<.001	<.001	
		N	5070	4755	5293

^{**.} Correlation is significant at the 0.01 level (2-tailed).

3.2. HR data analytics and performance management practice

H3: Formal appraisal system is related to HR analytics.

The difference between companies Using HR Data Analyses and the Companies that do not use the analyses is significant. Almost 80% of companies showed, that they Have a formal appraisal system in place. Compared to companies without HR data analytics it is almost 20% difference (Table 4.). On the significancy level p<0,001 we reached Kedall's tau_b=0,18.

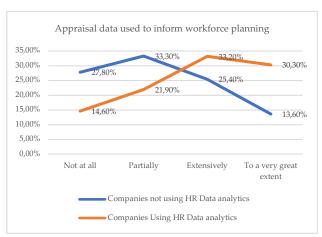
UsingdataAnalytics Not or partially used Usign data analytics Total N % % Do you have a formal ap-1362 36.6% 407 20.5% 1769 31.0% No praisal system? 79.5% Yes 2357 63.4% 1581 3938 69.0% Total 3719 100.0% 1988 100.0% 5707 100.0%

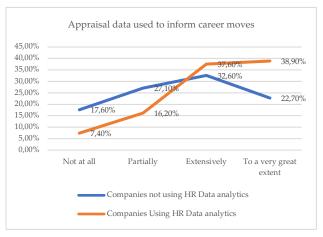
Table 4. Existence of formal appraisal system

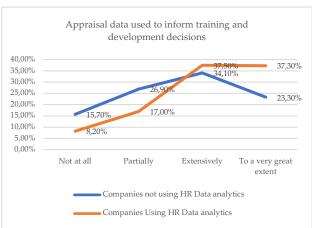
Having a formal appraisal system generates relevant data for effective training, career development and workforce planning of companies, if this data are systematically used in these HR functions.

H4: Employee appraisal data use in HR functions is related to HR analytics.

On significance level p<0,001 we can see positive correlation between HR data Analytics and usage of appraisal information in pay Kedall's tau_b=0,14; Training and development Kedall's tau_b=0,186; HR planning Kedall's tau_b=0,244; Career moves Kedall's tau_b=0,232. For graphical illustration we used grouping of companies See Chart 2.







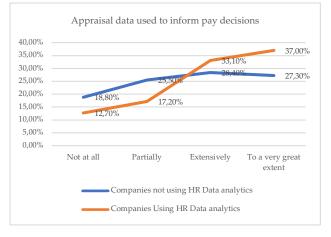


Chart 2. Usage of data generated in formal appraisal system in HR functions.

H5: Systematic approach to training is related to the use of HR analytics.

Companies that have HR Data analytics in place much more often estimate training need and perform training effectiveness evaluation. The difference reached 20%. On significance level p<0,001 we can see positive correlations Training need estimation Kedall's tau_b=0,205; Training effectiveness evaluation Kedall's tau_b=0,252. For graphical illustration we used grouping of companies See Chart 3.



Chart 3. Estimation of training need and evaluation of training effectiveness



4. Discussion

The study delivers research on HR analytics relation to HRM practices based on robust international data collection. Results have proven all measured relationships significant. This, research endeavors to provide a nuanced understanding of the multifaceted connections between HR analytics usage, organizational characteristics, and performance management practices, contributing valuable insights to both academic literature and practical HR management.

Knowledge about development of the size of HR departments in relation to extent of use of HRA is complementary to the study results by Bonilla-Chaves & Palos-Sánchez (2023), which describe variety of methodology in developed HR analytics, enabling contextual and predictive analysis. We suggest implication that departments with developed HRA will be more focused on strategic role and shift implementations on line management or use self-serviced solutions for employees. As Álvarez-Gutiérrez et al. (2022) have proven analysis of HR practices and strategies will enable growth of efficiency of HR practices.

The study has answered the call for more research in HR analytics. Batistič (2019) stated that it is difficult to prove a direct link between the use of HR data analytics and the organizations performance due to lack of research, at least in terms of academic discourse on the value of big data analyses. Our findings bring more light into the impact of HRA to the practice in performance management. We revealed significant relationship between systemic approach to employee appraisal and HRA, measured by the level of formalism of PM, further use of the appraisal data for decision making in related HR functions, and planning and evaluation of T&D needs. We found that companies using HRA are implementing systematic approach to performance management in all of its components measured for the

purpose of this study. Relationship is stronger for decisions about career planning, and related T&D practice. We imply, that HRA has high impact to managing performance and competence development, therefore we find HRA managerial tool of company capacity building. We find this knowledge complementary to the findings by McCartney (2022), who has recognized HR analytics facilitating organization evidence-based management, leading to higher organizational performance.

Current results have implications for theory of HRM as well as for HR practice by delivering knowledge confirming the relevance of development HR analytics, methodologically and applicationwise. The study has introduced reasons for building infrastructure for HR data management. Eventually, the study has supported current challenge of digital era for development of competency models of HR leaders, to build competence for the strategic perspective, and line managers and employees for the implementation.

5. Conclusions

Human resources analytic is a relatively new phenomenon in the practice of human resource management (HRM), which pass through all functions of HRM and helps to acquire the strategic importance of HRM for organization management. Its benefits are based on the ability to analyze existing data, but also by guiding strategic decisions regarding HRM and predicting their future impact.

In conclusion, this research has made significant contributions to the understanding of the relationship between HR analytics and HRM practices based on a robust international dataset. The findings underscore the importance of HR analytics in shaping organizational characteristics and influencing performance management practices. Our results, demonstrating the significance of all measured relationships, offer nuanced insights into the multifaceted connections between the utilization of HR analytics, organizational attributes, and performance management. This contribution not only enhances academic literature but also provides practical implications for HR management.

Acknowledgement

This research was supported by Slovak Academy of Sciences VEGA project No. 1/0623/22 Virtualization in people management– employee life cycle in businesses in the era of digital transformation.

References:

- 1. Álvarez-Gutiérrez, F. J., Stone, D. L., Castaño, A. M., & García-Izquierdo, A. L. (2022). Human Resources Analytics: A systematic Review from a Sustainable Management Approach. *Revista de Psicología Del Trabajo y de Las Organizaciones*, 38(3), 129–147. https://doi.org/10.5093/jwop2022a18
- 2. Angrave, D., Charlwood, A., Kirkpatrick, I., Lawrence, M., & Stuart, M. (2016). HR and analytics: Why HR is set to fail the big data challenge: Why HR is set to fail the big data challenge. *Human Resource Management Journal*, 26(1), 1–11. https://doi.org/10.1111/1748-8583.12090
- 3. Batistič, S., & Van Der Laken, P. (2019). History, Evolution and Future of Big Data and Analytics: A Bibliometric Analysis of Its Relationship to Performance in Organizations. *British Journal of Management*, 30(2), 229–251. https://doi.org/10.1111/1467-8551.12340
- 4. Bonilla-Chaves, E. F., & Palos-Sánchez, P. R. (2023). Exploring the Evolution of Human Resource Analytics: A Bibliometric Study. *Behavioral Sciences*, 13(3), 244. https://doi.org/10.3390/bs13030244
- 5. Brewster, C., Mayrhofer, W., & Morley, M. (2004). *Human Resource Management in Europe: Evidence of Convergence?* Routledge.

- 6. Brynjolfsson, E., Hitt, L. M., & Kim, H. H. (2011). *Strength in Numbers: How Does Data-Driven Decisionmaking Affect Firm Performance?* (SSRN Scholarly Paper 1819486). https://doi.org/10.2139/ssrn.1819486
- 7. Davenport, T. H., Harris, J., & Shapiro, J. (2010, október 1). Competing on Talent Analytics. *Harvard Business Review*. https://hbr.org/2010/10/competing-on-talent-analytics
- 8. Chen, H., Chiang, R., & Storey, V. (2012). Business Intelligence and Analytics: From Big Data to Big Impact. *MIS Quarterly*, *36*, 1165–1188. https://doi.org/10.2307/41703503
- 9. Margherita, A. (2022). Human resources analytics: A systematization of research topics and directions for future research. *Human Resource Management Review*, 32(2), 100795. https://doi.org/10.1016/j.hrmr.2020.100795
- 10. Marler, J. H., Cronemberger, F., & Tao, C. (2017). HR Analytics: Here to Stay or Short Lived Management Fashion? V T. Bondarouk, H. J. M. Ruël, & E. Parry (Ed.), *Electronic HRM in the Smart Era* (s. 59–85). Emerald Publishing Limited. https://doi.org/10.1108/978-1-78714-315-920161003
- 11. McCartney, S., & Fu, N. (2022). Bridging the gap: Why, how and when HR analytics can impact organizational performance. *Management Decision*, 60(13), 25–47. https://doi.org/10.1108/MD-12-2020-1581
- 12. McIver, D., Lengnick-Hall, M. L., & Lengnick-Hall, C. A. (2018). A strategic approach to workforce analytics: Integrating science and agility. *Business Horizons*, 61(3), 397–407. https://doi.org/10.1016/j.bushor.2018.01.005
- 13. Mortenson, M. J., Doherty, N. F., & Robinson, S. (2015). Operational research from Taylorism to Terabytes: A research agenda for the analytics age. *European Journal of Operational Research*, 241(3), 583–595. https://doi.org/10.1016/j.ejor.2014.08.029
- Parry, E., Farndale, E., Brewster, C., & Morley, M. J. (2021). Balancing Rigour and Relevance: The Case for Methodological Pragmatism in Conducting Large-Scale, Multi-country and Comparative Management Studies. *British Journal of Management*, 32(2), 273–282. https://doi.org/10.1111/1467-8551.12405
- 15. Tursunbayeva, A., Di Lauro, S., & Pagliari, C. (2018). People analytics—A scoping review of conceptual boundaries and value propositions. *International Journal of Information Management*, 43, 224–247. https://doi.org/10.1016/j.ijinfomgt.2018.08.002
- 16. Ulrich, D., & Dulebohn, J. H. (2015). Are we there yet? What's next for HR? *Human Resource Management Review*, 25(2), 188–204. https://doi.org/10.1016/j.hrmr.2015.01.004
- 17. Valecha, N. (2022). Transforming human resource management with HR analytics: A critical Analysis of Benefits and challenges. *International Journal for Global Academic & Scientific Research*, 1(2), Article 2. https://doi.org/10.55938/ijgasr.v1i2.16
- 18. van den Heuvel, S., & Bondarouk, T. (2017). The rise (and fall?) of HR analytics. *Journal of Organizational Effectiveness: People and Performance*, 4(2), 157–178. https://doi.org/10.1108/JOEPP-03-2017-0022
- 19. Welbourne, T. (2015). Data-Driven Storytelling: The Missing Link in HR Data Analytics. *Employment Relations Today*, 41. https://doi.org/10.1002/ert.21471

Work Engagement of University Lecturers as a Prerequisite for the Quality of Higher Education in Slovakia

Nadežda Jankelová 1, Zuzana Joniaková 2*

- ¹ Faculty of Business Management, University of Economics in Bratislava, Slovak Republic; nadezda.jankelova@euba.sk
- ² Faculty of Business Management, University of Economics in Bratislava, Slovak Republic; zuzana.joniakova@euba.sk
- * Correspondence: zuzana.joniakova@euba.sk

Abstract: Universities in Slovakia are currently facing challenges related to their transformation and increasing demands on the quality of education. High demands are placed on university teachers in terms of their professionalism and scientific and pedagogical activities. This requires them to maintain a high level of commitment. This paper aims to identify the factors that influence the work engagement of university teachers in the environment of Slovak universities and to examine their interrelationships. A questionnaire survey was used to collect data, and the data were evaluated using the PLS-SEM method with SmartPLS 3.3 software support. The findings show that perceptions of organizational support and psychological empowerment play a role in increasing the work engagement of HE teachers. This offers HEI management tools that they can use to positively influence the work engagement of their key staff.

Keywords: universities, management, work engagement, perceived organizational support, psychological empowerment, information sharing

Introduction

Higher education plays an indispensable role in the development of modern society. In the context of the increasing complexity of the world and the speed of technological change, its importance is constantly growing. Slovakia's higher education sector undergoing significant changes as a result of efforts to harmonize with foreign systems. There is talk of systemic change, which has been supported by the adoption of a new Higher Education Act. The aim is to increase the performance of Slovak higher education institutions, promote their profiling and diversification, and cooperate with foreign countries, the public and private sectors, while preserving academic rights and freedoms, thanks to which higher education institutions will contribute to strengthening the quality of human capital, social inclusion, the innovative potential of Slovakia, higher competitiveness of the economy, economic growth and sustainable jobs.

The new Higher Education Act introduces changes in the management of public universities to modernize them and make decision-making processes more flexible at the level of universities and faculties themselves. Another reform is a change in the financing of universities, including the introduction of performance contracts. The methodology for allocating subsidies is adjusted to take greater account of quality and inclusive education, excellent research, graduate employability, cooperation with the private sector, and internationalization of teachers and students, and is aligned with the forthcoming methodology for assessing university performance. A system of periodic evaluation of scientific performance involving international evaluators is being introduced to ensure the diversification of universities and the identification of excellent research teams at individual universities in the medium and long term. An important element of the reforms is a new approach to the accreditation of higher education. The new standards and criteria for accreditation of study programs tighten the conditions for guaranteeing and delivering study programs and thus improve their quality.

University teachers play a key role in the higher education process. They are the pillars of the academic community and have the responsibility for shaping future generations of professionals who will significantly influence Slovak society. They are also active researchers, and their research work contributes to the development of technology and innovation. Therefore, universities' management is

faced with the question of how to increase their work engagement. While job satisfaction is an important indicator of effective management, it is not enough in an era of systemic change. There is a need to combine job satisfaction with enthusiasm for work so that academic demands can be managed effectively.

Many scholarly studies have addressed the precursors and consequences of work engagement. They are based on the job demands-resources theory, according to which its main antecedents are job and personal resources. Drawing on organizational support theory and social exchange theory, the general perception of employees about the extent to which the organization values their contribution and cares about their well-being is also an important factor. However, not enough attention is paid to various positive types of organizational behavior in academia and the work environment that goes with it. The studies reviewed point to partial confirmation of positive associations between perceived organizational support and work engagement in the higher education sector (Kristiana et al., 2018), information sharing in achieving innovation in higher education (Fauzi et al., 2019), psychological empowerment and work engagement, but only in the service sector (Monje et al., 2021). A more comprehensive model that identifies influences on work engagement in the broader context of the organizational pro-centre of HEIs has not been explored. This creates a research gap that we seek to fill with our research. The main aim is to explore the factors that influence the work engagement of university educators and also to uncover the deeper mechanisms of action of these factors.

1. Theoretical background

1.1 Work engagement as a tool for improving the quality of HE education

Work engagement (WE) as a construct used in work settings was coined by Schaufeli et al. (2006). The authors defined WE as "a positive, fulfilling work-related state of mind that is characterized by enthusiasm, dedication, and interest". As a whole, all three aspects that make up the WE variable represent not only energy, enthusiasm, and focus, but also a sense of inspiration and new challenges. Engagement reflects a persistent emotional-cognitive state rather than a momentary and specific state. It is characterized by a high level of energy and mental resilience alongside work, a willingness to invest the individual's effort in the work, and perseverance even when the individual faces difficulties.

The WE brings many positive consequences. Studies have documented the positive impact of WE on high school teachers on their job performance, and job satisfaction, as well as the satisfaction of stakeholders, especially students (Park, 2012). On the other hand, some studies examine factors that influence job engagement. Some of the most prominent include the personality of the employee's direct supervisor (Buckingham & Goodall, 2019; Hitka et al., 2019), transformational leadership and perceived organizational support (Kristiana et al., 2018).

1.2 Perceived organizational support

Perceived organizational support (POS) is an important element that promotes employee work engagement. As a theoretical construct, it was developed by Eisenberger et al. (1986), and however has been further developed and researched by many authors (Caesens et al., 2017; Kurtessis et al., 2017). POS is closely associated with a sense of connection to the organization, which in the context of education implies a commitment to the profession itself, to learning, to the work team, and the institution (Honig, 2021). Very simply, POS was introduced by Sun (2019) as "what an employer does for his or her employee, what he or she provides to the employee in return for his or her performance, skills, knowledge, experience, and how the employee responds to, values, and perceives all of this."

POS has had a significant impact on organization and workplace behavior as a result of understanding the nature of social exchange theory (Caesens & Stinglhamber, 2020). This is because employees feel a kind of intrinsic obligation to reciprocate the favorable and supportive treatment they receive from the employer to the organization. Therefore, they express affection, loyalty, and a positive attitude toward the organization (Eisenberger et al., 1986, 1997; Sihag, 2021) and help the organization to achieve its goals (Eisenberger et al., 1986). POS has positive effects on many aspects of work behavior. Positive associations between POS and WE have also been documented (Bonaiuto et al., 2022; Caesens et al., 2017; Kristiana et al., 2018; Dai et al., 2016).

Based on the above, we hypothesize that there is an association between POS and WE variables. *H1: POS is positively related to WE of university lecturers*.

1.3 Psychological empowerment

Psychological empowerment (PE) as a construct at the level of individual work behavior was developed by Spreitzer (1995) and is based on positive psychology. According to Maynard et al. (2012), it represents an individual's perception of competence, meaning, self-determination, and ability to influence organizational outcomes. The study of PE has received a great deal of attention in the scientific realm because of the many documented influences on outcomes not only for the organization itself but also for the individual (Shah et al., 2019). It is due to the growth of the competitive environment in higher education, the high professional level of staff, the knowledge environment, and the pressure for quality and innovation (Abbas & Raja, 2015) that developing PE is of great importance.

Psychological empowerment is positively associated with many factors such as organizational attitudes and employees' perceptions of them (Malik et al., 2021), perceived organizational support (Maynard et al., 2012; Chiang & Hsieh, 2012), management practices (Chamberlin et al., 2018), leadership style (Khatoon et al., 2022; Dust et al., 2018), as well as work engagement (Monje et al., 2021). Based on the above, we hypothesize that:

H2: The relationship between POS and WE of university educators is mediated by PP.

1.4 Information sharing

In turbulent times, continuous information sharing (IS) is a priority in achieving goals (Al-Kurdi et al., 2020). In the academic literature, much attention has been paid to the area of knowledge sharing in academic settings. It is the sharing of professional topics, and conclusions from research studies among individual employees, since universities as knowledge-based organizations inevitably require this skill for their development, advancement, and innovation (Fauzi et al., 2019). Charband and Jafari Navimipour (2018) identify this area as problematic in academic institutions due to the specificities of this environment. In our model, we consider sharing information about the mission, goals, changes, causes of change, and steps to be taken in achieving the goals, and this information should be disseminated and shared by university management across the organization (Vainieri et al., 2019). Information sharing is a continuous process of communicating the intentions and implications of change, leading to employee engagement, innovative behaviors, and ultimately improved organizational performance (Brake et al., 2020; Roohi et al., 2020). By being regularly informed, employees perceive to a greater extent management's interest in their attitudes, opinions, and POS increases.

Based on the above, we hypothesize that:

H3: The relationship between university teachers' POS and WE is mediated by IS.

And at the same time

H4: The relationship between university teachers' POS and WE is mediated by IS and PE at the same time.

The study intends to investigate whether the relationship between POS and WE of university teachers is mediated by PE and IS.

2. Methods and methodology

2.1 Data collection

The data collection took the form of a questionnaire survey, focusing on the issues of job satisfaction and engagement of university teachers and the various factors that may influence these two variables. Dissemination of the questionnaires was electronic, as was their collection. The target group was university lecturers from public HEIs in Slovakia. The questionnaire contained all the necessary information about the purpose of the research, anonymity, and consent to data processing. A total of 34 faculties out of 113 public universities (faculties) participated in the survey, which was evenly distributed throughout Slovakia. Questionnaires were sent to 1050 faculty members at their e-mail addresses. The return rate of the questionnaires was relatively high (62%) considering the generally low

return rate for questionnaire surveys. In total, we received 651 completed questionnaires with varying proportions of professors (16%), associate professors (28%), and assistant professors (56%). Men comprised 45% of the sample, the rest women. In terms of age and length of experience, the descriptive data are as follows: mean age 45.22 years, mean experience 16.01 years.

2.2 Variables

The following variables were used to test the theoretical model:

Perceived organizational support (POS). The instrument used to measure POS was the standardized instrument of Eisenberger et al. (1986), which is widely used to measure this variable. It contains 5 items that are rated using a Likert scale (from 1 to 5, where 1 = strongly disagree; 5 = strongly agree). As an example of the items, we give the following: "My organization is willing to help me if I need help. Help is available from the organization when I have a problem".

Work Engagement (WE). The WE is traditionally and in almost all studies measured using the 9-item Utrecht Work Engagement Scale (UWES), which is a shortened version of the original instrument (Schaufeli et al., 2006). It contains three core dimensions of work engagement (energy, commitment, and absorption) - Each of which contains 3 items in the abbreviated version. A Likert scale from 1 to 5 was used, where 1 ("never") to 5 ("always").

Information sharing (IS) is a variable we adopted from a study by Ketokivi and Castañer (2004). It contains 5 items that are rated on a 5-point Likert scale (from 1 to 5, where 1 = completely disagree; 5 = completely agree). Example items: 'University management regularly informs employees of requirements related to their job performance. The university management regularly informs employees about the plans of their faculties."

Psychological empowerment (PE) is a variable taken from an instrument developed by Spreitzer (1995). It contains 4 dimensions - importance, competence, self-determination, and impact and 12 items in total, which are rated on a 5-point Likert scale (from 1 to 5, where 1 = strongly disagree; 5 = strongly agree) Example items: "I am confident in my ability to do my job; the work I do is important to me; my impact on the happenings in my department is of great importance."

The control variables were years of experience and teaching status (professor, associate professor, assistant professor) since we assumed the possibility of their influence on the relationships under study. The questionnaire contained a total of 31 items within the four summary variables.

2.3 Data analysis

We used the PLS-SEM (Partial Least Squares Structural Equation Modeling) method (Hair Jr. et al., 2014) to analyze the data using SmartPLS 3.3 software support. In this software, we evaluated the measurement model and the structural model. Hypotheses were statistically tested at a significance level of α = 0.05.

3. Results

3.1 Measurement model

The first step in analyzing the data of the developed theoretical model is to evaluate whether the model meets all the criteria of validity and reliability. The authors of Smart Pls recommend that both validity and reliability be measured by analyzing the external weights of all variables and their items. Our model meets this requirement because almost all external weights do not exceed the value of 0.7. For two items, they range from 0.5 to 0.7, which is equally acceptable for a small number of given items.

Another indicator is the internal reliability of the construct. We measured it using several indicators, namely Cronbach's alpha (satisfactory - ranging from 0.767 to 0.955); composite reliability (satisfactory - ranging from 0.61 to 0.947) (Diamantopoulos et al., 2012); rho_A indicator (satisfactory - ranging from 0.650 to 0.948) (Ringle et al., 2020). To assess convergent validity, we used the indicator mean extracted variance (satisfying - exceeds the 0.5 level) (Hair et al., 2019) for all constructs. The discriminant validity analysis is also satisfactory according to both criteria (Forner Lacker and HTMT criterion).

3.2 Structural model

Before examining each of the determined paths to verify the predictive ability and predictive relevance of the model, we verified the coefficient of determination R2(R-squared) and Q2. According to the studies by Raithel et al. (2012) and Sharma et al. (2019), the values for R2 should be as low as 0.10, but not too high. Our results show that R2 values are satisfactory (Hair Jr. et al., 2014). Q2 values should be above 0 (Hair Jr et al., 2018) which our model satisfies and thus has predictive significance. We also assessed the accuracy of the model using the SRMR indicator. The obtained value (0.087) in our model is less than 0.100 (Hair Jr et al., 2018), thus we conclude sufficient accuracy of the model.

3.3 Hypothesis verification

The hypotheses (H1, H2, H3, and H4) were tested by bootstrapping. All examined relationships (paths) are presented in the following tables and figures. The direct effect between POS and WE is valid - H1 is confirmed. In each of the following tables, the direct effect is shown.

Hypothesis H2 concerns mediation through PE. Table 1 shows the relationships obtained. It is clear that the indirect effect is significant and accounts for 45 percent of the total effect. Thus, it is not a complete mediation, which would have to involve more than 80% of the mediator, but PE does contribute significantly to the overall effect. Thus, there is support for hypothesis H2.

Hypothesis H3 concerns mediation through IS. The relationships are shown in Table 2.

Table 1. Mediation through PP

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P Values
POS -> WE (overall impact)	0.768	0.772	0.048	16.149	0.000
PE -> WE (direct impact)	0.453	0.424	0.150	3.009	0.003
POS -> WE (overall indirect impact)	0.348	0.318	0.107	3.262	0.001
POS -> PE	0.768	0.760	0.050	15.476	0.000
POS -> WE	0.420	0.453	0.142	2.950	0.003

^{*} WE = Work Engagement, POS = Perceived Organizational Support, IS = Information Sharing, PE = Psychological Empowerment

Source: own elaboration

Table 2. Mediation through IS

	Original	Sample	Standard	T statistics	P Values
	sample	mean	deviation	(O/STDEV)	
	(O)	(M)	(STDEV)		
POS -> WE (overall impact)	0.773	0.782	0.042	18.280	0.000
POS -> WE (direct impact)	0.772	0.778	0.044	17.689	0.000
POS -> WE (indirect impact)	0.001	0.004	0.015	0.082	0.935
POS -> IS	0.156	0.129	0.161	0.972	0.332
IS -> WE	0.008	0.011	0.076	0.101	0.919

^{*} WE = Work Engagement, POS = Perceived Organizational Support, IS = Information Sharing

Source: own elaboration

It is clear that the indirect effect is not significant and contributes very little to the overall effect. The mediation condition is not met and hypothesis 3 is not confirmed. However, we investigated how the relationships change when both mediators act simultaneously since in real practice they act simultaneously. The results obtained are shown in Table 3. The H4 hypothesis was confirmed. The indirect effect is significant when both mediators act simultaneously. In examining the relationships, we were also interested in the moderating effects of the control variables, namely the status of the university teacher and his/her practice. The results are shown in Tables 4 and 5.

Table 3 Mediation through PE and IS simultaneously

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P Values
POS -> WE (overall impact)	E	0.770	0.047	16.215	0.000
POS -> WE (direct impact)	0.419	0.441	0.142	2.957	0.003
POS -> WE (overall indirect	0.348	0.329	0.108	3.214	0.001
impact)	0.004	0.012	0.024	2.224	0.025
POS -> IS -> WE (specific indirect impact)	-0.004	-0.012	0.021	0.206	0.837
POS -> PE -> WE (specific indirect	0.352	0.341	0.113	3.105	0.002
impact)					
PE -> WE	0.459	0.454	0.158	2.901	0.004
POS -> PE	0.768	0.761	0.053	14.536	0.000
POS -> IS	0.154	0.137	0.155	0.998	0.319
IS -> WE	-0.028	-0.020	0.100	0.284	0.777

^{*} WE = Work Engagement, POS = Perceived Organizational Support, IS = Information Sharing, PE = Psychological Empowerment

Source: own elaboration

Table 4 The moderating effect of status

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P Values
Moderating effect of status -> WE	-0.065	-0.064	0.018	3.575	0.000
POS -> WE	0.709	0.712	0.050	14.112	0.000
status -> WE	0.210	0.206	0.055	3.790	0.000

^{*} WE = Work Engagement, POS = Perceived Organizational Support

Source: own elaboration

Table 5 The moderating effect of practice

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P Values
The moderating effect of practice-> WE	-0.073	-0.074	0.018	4.162	0.000
POS -> WE	0.863	0.860	0.040	21.765	0.000
practice -> WE	0.049	0.051	0.040	1.207	0.228

^{*} WE = Work Engagement, POS = Perceived Organizational Support

Source: own elaboration

Both results are negative, indicating that the relationship between POS and WE variables is strengthened by lower status and lower experience.

4. Discussion

The main purpose of our study was to examine the factors that influence the work engagement of university teachers and also to uncover the deeper mechanism of action of these factors. We explored the deeper mechanism of action by incorporating other variables into the interrelationship between POS and WE namely PE and IS. H1 verified whether POS is positively related to the WE of college educators. The hypothesis has support. POS is significantly related to the WE of academics in HEIs in Slovakia,

which implies an implication for university management to orient their attention to the development of this management tool. H2 on the relationship between POS and WE of university academics mediated by PE was confirmed. It means that PE plays a significant role in the overall relationship between POS and WE and almost half of it. Our results are consistent with the results of other studies that declare this relationship and indicate that PE in terms of individual perceived competence, meaning, self-determination, and ability to influence organizational outcomes is important for organizational success (Maynard et al., 2012; Shah et al., 2019). H3 on the correlation between POS and WE of university educators that is mediated by IS was not confirmed. This means that information sharing does not play such a significant role in the effect of POS on WE in the academic sector. However, our results in this regard differ from other studies that have been conducted in different sectors (Al-Kurdi et al., 2020; Fauzi et al., 2019). No such studies have been conducted in the university sector, and we believe that since information distribution takes place in universities through different councils, committees, and academic bodies, this variable does not play as significant a role as in other sectors.

By examining the effect of both factors simultaneously, we confirmed the fourth hypothesis, which means that the effect of PE is so significant that even when the mediator IS is insignificant, the overall indirect effect is still significant. Examination of the moderating relationships revealed that the relationship between POS and WE is more pronounced for educators with shorter experience who are at the lower rungs of the career ladder. The latter are likely to feel even less autonomy and the perceived support from the management and the college reinforces their commitment to a greater extent.

5. Conclusions

The role of university teachers is crucial for ensuring the quality of higher education and for the future development of the country in all its spheres. Teachers must be well prepared, committed, and supported in their work to enable them to fulfill their roles effectively. Contemporary higher education in Slovakia is undergoing significant changes that place high demands on university teachers in their combined roles as educators, researchers, and project manager, as well as high demands on university management to ensure a committed workforce capable of meeting these demands. The results highlight the importance of perceived organizational support in increasing the work engagement of HE educators, and also the role of enhancing their psychological empowerment. These are managerial implications that need to be considered when implementing systemic change in HEIs. In this way, HEI management can work effectively with WE, especially with novice educators.

Despite the significant findings, our research also has several limitations. One of them may be the failure to use the pilot survey as one of the best practices for verifying the validity and methodological soundness of the constructs used. However, other recommended practices were used, which we considered sufficient. Despite the procedural and statistical precautions taken, we acknowledge the potential risk of common method bias as a further limitation of this study. In our study, we worked with cross-sectional data, which limits us in drawing causal inferences from the results. Cross-sectional data essentially only allows us to formulate correlational and non-directional inferences. As a dependent variable, we examined work engagement, which is often used as a manifestation of positive organizational behavior. In future research, it will be useful to explore the potential influence of the above relationships on other outcomes.

Funding: This research was funded by KEGA No. 001EU-4/2021 "Project of a study program in the field of economics and management, which reflects conditions of digital age, appeal of sustainability of economic activity and global citizenship and VEGA No. 1/0010/23 Adaptability of corporate culture - a factor supporting resilience and sustainability of enterprises in Slovakia in the post-covid period.

References

1. Abbas, M., & Raja, U. (2015). Impact of psychological capital on innovative performance and job stress. *Canadian Journal of Administrative Sciences / Revue Canadianne des Sciences de l'Administration*, 32(2), 128–138. https://doi.org/10.1002/cjas.1314

- 2. Al-Kurdi, O. F., El-Haddadeh, R., & Eldabi, T. (2020). The role of organizational climate in managing knowledge sharing among academics in higher education. *International Journal of Information Management*, 50, 217–227. https://doi.org/10.1016/j.ijinfomgt.2019.05.018
- 3. <u>Bonaiuto, F., Fantinelli, S., Milani, A., Cortini, M., Vitiello, M.C.</u> & <u>Bonaiuto, M.</u> (2022), "Perceived organizational support and work engagement: the role of psychosocial variables", <u>Journal of Workplace Learning</u>, Vol. 34 No. 5, pp. 418-436. <u>https://doi.org/10.1108/JWL-11-2021-0140</u>
- 4. Brake, H. J., Walter, F., Rink, F. A., Essens, P. J. M. D., & Vegt, G. S. (2020). Multiple team membership and job performance: The role of employees' information-sharing networks. Journal of Occupational and Organizational Psychology. doi:10.1111/joop.12326
- 5. Buckingham, M., & Goodall, A. (2019, May 14). The Power of Hidden Teams. *Harvard Business Review*. https://hbr.org/2019/05/the-power-of-hidden-teams
- 6. Caesens, G., Stinglhamber, F., Demoulin, S., & De Wilde, M. (2017). Perceived organizational support and employees' well-being: The mediating role of organizational dehumanization. *European Journal of Work and Organizational Psychology*, 26(4), 527–540. https://doi.org/10.1080/1359432X.2017.1319817
- 7. Caesens, G., & Stinglhamber, F. (2020). Toward a More Nuanced View on Organizational Support Theory. Frontiers in Psychology, 11. doi:10.3389/fpsyg.2020.00476
- 8. Cropanzano, R., & Mitchell, M. S. (2005). Social Exchange Theory: An Interdisciplinary Review. *Journal of Management*, 31(6), 874–900. https://doi.org/10.1177/0149206305279602
- 9. Dai, K. and Qin, X. (2016) Perceived Organizational Support and Employee Engagement: Based on the Research of Organizational Identification and Organizational Justice. *Open Journal of Social Sciences*, **4**, 46-57. doi: 10.4236/jss.2016.412005.
- 10. Diamantopoulos, A., Sarstedt, M., Fuchs, C., Wilczynski, P., & Kaiser, S. (2012). Guidelines for choosing between multi-item and single-item scales for construct measurement: A predictive validity perspective. *Journal of the Academy of Marketing Science*, 40(3), 434–449. https://doi.org/10.1007/s11747-011-0300-3
- 11. Dust, S. B., Resick, C. J., Margolis, J. A., Mawritz, M. B., & Greenbaum, R. L. (2018). Ethical leadership and employee success: Examining the roles of psychological empowerment and emotional exhaustion. *The Leadership Quarterly*, 29(5), 570–583. https://doi.org/10.1016/j.leaqua.2018.02.002
- 12. Eisenberger, R., Cummings, J., Armeli, S., & Lynch, P. (1997). Perceived organizational support, discretionary treatment, and job satisfaction. *Journal of Applied Psychology*, 82(5), 812–820. https://doi.org/10.1037/0021-9010.82.5.812
- 13. Eisenberger, R., Huntington, R., Hutchison, S., & Sowa, D. (1986). Perceived organizational support. *Journal of Applied Psychology*, 71(3), 500–507. https://doi.org/10.1037/0021-9010.71.3.500
- 14. Hair F. Jr, Sarstedt, J., Hopkins, M., & Kuppelwieser, V. (2014). Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *European Business Review*, 26(2), 106–121. https://doi.org/10.1108/EBR-10-2013-0128
- 15. Fauzi, M. A., Tan, C. N. L., Thurasamy, R., & Ojo, A. O. (2019). Evaluating academics' knowledge sharing intentions in Malaysian public universities. *Malaysian Journal of Library & Information Science*, 24(1), Article 1. https://doi.org/10.22452/mjlis.vol24no1.7
- 16. <u>Hair, J.F.</u>, <u>Risher, J.J.</u>, <u>Sarstedt, M.</u> and <u>Ringle, C.M.</u> (2019), When to use and how to report the results of PLS-SEM. <u>European Business Review</u>, Vol. 31 No. 1, pp. 2-24. <u>https://doi.org/10.1108/EBR-11-2018-0203</u>
- 17. Hair, J. F., Sarstedt, M., Ringle, C. M., & Gudergan, S. P. (2018). Advanced Issues in Partial Least Squares Structural Equation Modeling (PLS-SEM). *Thousand Oaks, CA: Sage.* https://doi.org/10.3926/oss.37
- 18. Hitka, M., Rozsa, Z., Potkány, M., & Ližbetinova, L. (2019). Factors forming employee motivation influenced by regional and age-related differences. *Journal of business economics and management*. 20(4), 674-693. http://doi.org/10.3846/jbem.2019.6586
- 19. Honig, D. (2021). Supportive management practice and intrinsic motivation go together in the public service. *Proceedings of the National Academy of Sciences*, 118(13), e2015124118. https://doi.org/10.1073/pnas.2015124118
- 20. Chamberlin, M., Newton, D. W., & LePine, J. A. (2018). A meta-analysis of empowerment and voice as transmitters of high-performance managerial practices to job performance. *Journal of Organizational Behavior*, 39, 1296–1313. https://doi.org/10.1002/job.2295
- 21. Charband, Y., & Jafari Navimipour, N. (2018). Knowledge sharing mechanisms in the education: A systematic review of the state of the art literature and recommendations for future research. *Kybernetes*, 47(7), 1456–1490. https://doi.org/10.1108/K-06-2017-0227
- 22. Chiang, C.-F., & Hsieh, T.-S. (2012). The impacts of perceived organizational support and psychological empowerment on job performance: The mediating effects of organizational citizenship behavior. International Journal of Hospitality Management, 31(1), 180–190. https://doi:10.1016/j.ijhm.2011.04.011
- 23. Ketokivi, M., & Castañer, X. (2004). Strategic Planning as an Integrative Device. *Administrative Science Quarterly*, 49(3), 337–365. https://doi:10.2307/4131439

- 24. Khatoon, A., Rehman, S.U., Islam, T. and Ashraf, Y. (2022), "Knowledge sharing through empowering leadership: the roles of psychological empowerment and learning goal orientation", *Global Knowledge*, *Memory and Communication*, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/GKMC-08-2022-0194
- 25. Kristiana, I. F., Ardi, R., & Hendriani, W. (2018). What's behind Work Engagement in Teaching Practice? *Proceedings of the 3rd International Conference on Psychology in Health, Educational, Social, and Organizational Settings*, 267–275. https://doi.org/10.5220/0008588102670275
- 26. Kurtessis, J.N., Eisenberger, R., Ford, M.T., et al. (2017) Perceived Organizational Support: A Meta-Analytic Evaluation of Organizational Support Theory. *Journal of Management*, 43, 1854-1884. https://doi.org/10.1177/0149206315575554
- 27. Malik, M., Sarwar, S., & Orr, S. (2021). Agile practices and performance: Examining the role of psychological empowerment. *International Journal of Project Management*, 39(1), 10–20. https://doi.org/10.1016/j.ijproman.2020.09.002
- 28. Maynard, M. T., Gilson, L. L., & Mathieu, J. E. (2012). Empowerment—Fad or Fab? A Multilevel Review of the Past Two Decades of Research. *Journal of Management*, 38(4), 1231–1281. https://doi.org/10.1177/0149206312438773
- 29. Monje, A. A., Xanthopoulou, D., Calvo, N. Structural empowerment, psychological empowerment, and work engagement: A cross-country study, *European Management Journal*, https://doi.org/10.1016/j.emj.2021.01.005
- 30. Park, R. (2012). Cognitive and affective approaches to employee participation: Integration of the two approaches. Journal of World Business, 47, 450–458. https://doi.org/10.1016/j.jwb.2011.05.011
- 31. Raithel, S., Sarstedt, M., Scharf, S., & Schwaiger, M. (2012). On the value relevance of customer satisfaction. Multiple drivers and multiple markets. *Journal of the Academy of Marketing Science*, 40(4), 509–525. https://doi.org/10.1007/s11747-011-0247-4
- 32. Ringle, C. M., Sarstedt, M., Mitchell, R., & Gudergan, S. P. (2020). Partial least squares structural equation modeling in HRM research. *The International Journal of Human Resource Management*, 31(12), 1617–1643. https://doi.org/10.1080/09585192.2017.1416655
- 33. Roohi, G., Mahmoodi, G., & Khoddam, H. (2020). Knowledge implementation in health care management: A qualitative study. *BMC Health Services Research*, 20(1), 188. https://doi.org/10.1186/s12913-020-5043-8
- 34. Schaufeli, W. B., Bakker, A. B., & Salanova, M. (2006). The Measurement of Work Engagement With a Short Questionnaire. *Educational and Psychological Measurement*, 66(4), 701–716. https://doi:10.1177/0013164405282471
- 35. Shah, T. A., Khattak, M. N., Zolin, R., & Shah, S. Z. A. (2019). Psychological empowerment and employee attitudinal outcomes: The pivotal role of psychological capital. *Management Research Review*, 42(7), 797–817. https://doi.org/10.1108/MRR-05-2018-0194
- 36. Sharma, P., Sarstedt, M., Shmueli, G., Kim, K., & Thiele, K. (2019). PLS-Based Model Selection: The Role of Alternative Explanations in Information Systems Research. *Journal of the Association for Information Systems*, 20(4). https://doi.org/10.17005/1.jais.00538
- 37. Sihag, P. (2021). The Impact of Perceived Organizational Support on Employee Engagement: A Study of Indian IT Industry. *International Journal of Human Capital and Information Technology Professionals*, 12(2), 35–52. https://doi.org/10.4018/IJHCITP.2021040103
- 38. Spreitzer, G. M. (1995). Psychological, empowerment in the workplace: dimensions measurement and validation. *Academy of Management Journal*, 38(5), 1442–1465. https://doi.org/10.2307/256865
- 39. Sun, L. (2019). Perceived Organizational Support: A Literature Review. *International Journal of Human Resource Studies*, 9(3), 155. https://doi:10.5296/ijhrs.v9i3.15102
- 40. Vainieri, M., Ferrè, F., Giacomelli, G., & Nuti, S. (2019). Explaining performance in health care: How and when top management competencies make the difference. *Health Care Management Review*, 44(4), 306–317. https://doi.org/10.1097/HMR.0000000000000164

Application of information systems in the new technologies-based firms' growth factors qualitative research

Veronika Bednárová 1, Štefan Slávik 2

- ¹ Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia; veronika.bednarova@euba.sk
- ² Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia; stefan.slavik@euba.sk

Abstract: New technologies-based firms (NTBFs) are companies that business activity is concentrated on the generation of innovative technologies and turning them into value and utility for the customers. Their technological know-how is the basis of sustainable economic growth and competitiveness of the country which has already exhausted the driving forces of production factors and investments and now must focus on innovation. They have huge innovative potential and are expected to exploit it and achieve high and exponential business growth. It is the main reason why the researchers examined these companies and focused on factors affecting their business growth. The main aim of the paper is to provide a systematic literature review to summarize the current state of the most used information systems for qualitative research in examining factors of NTBFs' growth and discuss their potential for improvement of research in this area. Such results could be useful for scholars and researchers who study the NTBFs and are interested in how to bring more effectiveness, clearness, and relevance to the examination of factors influencing their business growth. The results of the systematic literature review present a summarization of possible information systems for qualitative NTBFs' growth factors research and examination of their use so far which can contribute to a compilation of an appropriate research tool for understanding the growth factors of NTBFs and addressing them.

Keywords: new technologies-based firms, growth factors, qualitative analysis, information systems

Introduction

New technologies and innovations are becoming crucial preconditions of macroeconomic growth and competitiveness of the country. New technology-based firms (NTBFs), which are usually from the category of small and medium-sized enterprises and mature startups (scale-ups), generate innovative technologies, turn them into value and utility for the customer and contribute to economic growth. To have a chance to exploit their potential, they need to survive and grow. That is the reason why there is an increasing researchers' interest in the examination of factors and conditions influencing their survival and growth.

Even though these companies invent breakthrough technologies, they often lack the resources, capabilities, and competencies to turn invented advanced technologies into business earnings. The inability to successfully transform technological capabilities into valuable products and service offerings limits their business growth and even threatens their market survival. The business growth of NTBFs is usually long and slow, which does not correspond to the potential and quality of invented technology, especially when we consider the high competition in the technological industry.

It is very important not only what researchers and scholars are studying, but also how they are studying it. In the context of uncovering which factors influence the growth of NTBFs, qualitative approaches could increase the value of findings by providing a more informed understanding of where, when, and for whom the results do and do not matter. By employing not only quantitative approaches but also qualitative ones, the research could reveal interesting insights and thus more effectively address the important factors of NTBFs' growth. Quantitative research largely determines the results, if not their content, then at least their structure. Qualitative research works with much smaller limitations, predispositions and prejudices and can thus bring more revealing knowledge.

The paper is organized as follows. Section 1 presents a definition of the term NTBFs based on current scientific literature, and socio-economic contribution of them and discusses their survival and growth issues. There is also presented the NTBFs' growth factors examined by the most cited authors in this field of research and their sampling into the groups. Section 2 describes the main aim and the research methodology. Section 3 presents the results of the paper which is the systematic literature review presentation of so far used information systems for qualitative NTBFs' growth factors research in context with their sampling based on the theoretical summary. Section 4 is a discussion of the findings and recommendations for future research.

1. Theoretical background

1.1. Definition of new technologies-based firms

NTBFs are important for the long-term development and growth of the economy through employment, research, development, and innovation. Zapata, Fernandez, Neira, and Rey (2017) report that NTBFs help convert innovative ideas into business opportunities, stimulate competition and increase productivity. Kanani and Goodarzi (2017) emphasize their contribution to the creation of highly qualified jobs, thereby slowing down the so-called "brain drain". Coad and Reid (2012) present other benefits of NTBFs, which may include new processes and products, knowledge spillovers, human capital formation, productivity growth, reduction of negative environmental impact, such as resource depletion. Technology can improve job satisfaction and life satisfaction in ways that are not easily measured economically. This is also confirmed by the authors Choi, Sung, and Park (2020). Their study encourages support for technology companies because it has shown that they contribute to sustainable economic growth through innovation and employment. They highlight the positive effect of NTBFs on the quality of employment in connection with job satisfaction. Due to the lack of resources and other factors affecting their survival and growth, they may not fulfill their potential. Many of them will not succeed in the market during the first years. Ramaciotti, Muscio, and Rizzo (2017) state that many of them exit the market at the beginning of their life cycle when they are still young and small. Even if they manage to survive in the market, very few of them experience exponential growth. Rannikko, Tornikoski, Isaksson, and Löfsten (2019) investigated the survival and growth rates of NTBFs in Sweden. The findings show that 72% of NTBFs from 2006 were still active at the end of 2014, but very few of them experienced high growth during the first seven years.

Even though the term of new technologies-based has been the object of scientific research for several decades, researchers still cannot agree on its generally accepted definition. In the majority of scientific articles and publications, it is stated that the definition of NTBFs is a methodological dilemma. It turns out that there is no universal definition of this term. Arthur D. Little Group (1977) provides the first definition of NTBFs as an independently owned company, which is established not more than 25 years and based on the exploitation of an invention or technological innovation that implies substantial technological risks. This initial definition has been significantly modified and expanded in recent decades, but there is still no universally accepted definition of this term.

Autio and Yli-Renko (1998) define NTBFs as small and medium companies operating in high-technology sectors. Luggen and Tschirky (2003) consider as NTBFs all firms working in a high-technology sector, established in less than 10 years, and led by the founder team. Virasa (2007) states that NTBFs are companies that have been established between one and fifteen years based on the creation of new technology and its use to create new or substantially improved products or services. Grilli and Murtinu (2011) define them as young and high-tech start-ups. Piccarozzi (2017) defines NTBFs as companies using scientific and technological knowledge for systematic and continuous production of new goods or services with high added value. NTBFs usually operate in top-level strategic sectors, such as microelectronics, biotechnology, medical devices, and nanotechnology.

Researchers tend to emphasize different aspects of these companies. Buganza, Gerst, and Verganti (2010) NTBFs pay attention to technological development processes. Ganotakis and Love (2011) underline their uniqueness, especially for their high growth and highly innovative nature, distinguishing them from other companies, while also highlighting the challenges they face in the commercialization of highly innovative products. Saemundsson and Candi (2017) stress the newness of these companies and the intensity of internal research and development. Based on Fudickar, and Hottenrott (2019)

NTBFs typically compete in knowledge-intensive industries characterized by rapid technological change. That is why these companies require continuous investments in skilled personnel and equipment with high asset specificity. Camisón-Haba, Clemente-Almendros, and Gonzalez-Cruz (2019) high-light their involvement in technology-based industries and the development of innovative and valuable business ideas. Contreras and García (2021) argue that these companies are characterized by a predominance of intellectual work, technology, and innovation systems.

Other researchers try to identify the term through the content characteristic of these companies. Torrecilla García, Skotnicka, and Zamora (2015) specify the three main aspects of NTBs which are independent firm property, technology-based strategy, and new or recent creation. Boudlaie, Kenarroodi, and Nik (2020) identified the five characteristics of NTBFs which are newness, possessing high technology, independence in the sense of capital funding by company founders, and small size in terms of employees and volume of sales, and characteristics of human capital and founding team.

It turns out that the methodological dilemma is mainly brought about by the term "novelty" and "technology-based". Bergek and Norrman (2015) point out that it is not clear whether "new" refers to a technology or a company. Candi and Saemundsson (2008) try to clarify the newness dilemma of NTBFs and define them as new firms that are based on technology, where the technology may or may not be new. In his work, Luggen (2004) points out that the main difference between technology-based and non-technology-based companies is the strong orientation of NTBFs toward internal research and development. The basis is the innovation process as the transformation of scientific knowledge and results of research into technological products, which are then commercialized on the market. The scientific debate on the qualitative and quantitative criteria for the definition of NTBFs is still ongoing, and therefore it remains for researchers to rigorously determine and justify the criteria for selecting research samples of NTBFs concerning the research objectives.

1.2. NTBFs' growth factors

Achieving exponential growth is a necessary condition for NTBFs for their long-term successful survival on the market. At the same time, the fulfillment of this obligation relates to the necessity to solve complex tasks and cope with many obstacles and limitations. Precisely for the above reasons, it is important to know the factors and conditions that help NTBFs grow, but also those that hinder their growth.

Based on the results of a systematic literature search consisting of the study and analysis of available scientific articles found in the databases Web of Science, Scopus, Science Direct, and IEEE Xplore from the most cited authors in this field of research, the researched growth factors can be divided into the groups of commercialization of technology, personnel factors (founder, team), financial factors, capabilities and processes, and business model.

The technology on which NTBFs are based is a prerequisite for success in the market, but it is not a guarantee of growth, which is why commercialization of the developed technology belongs to the researched growth factors. Research concentrates on how to effectively transform technology into a valuable and useful product for the customer, achieve product-market fit, and the challenges involved. Points of researchers' interest here are commercialization strategy (Symeonidou, Bruneel, Autio, 2017), marketing capabilities (Qureshi, Aziz, Mian, 2017), the influence of market and technology orientation (Giones, Miralles, König, Baltes, 2015).

The founder (entrepreneur), his age, gender, education, experience, but also abilities, ambitions, personality traits, and contacts take a dominant position in terms of NTBFs' growth factors. A significant growth factor is the work team, its composition in terms of gender, age, education, experience, and skills, as well as communication between team members, cooperation, cooperation, motivation, flexibility, and adaptability of the team. Examined factors and conditions in this area included founding team and human capital size, experience, education (Siepel, Cowling, Coad, 2017), access to external sources of knowledge (García-Cabrera, García-Soto, Nieves, 2021), entrepreneur' gender, age, education, employment status, national income bracket, entrepreneurship skills, knowing entrepreneurs (Zapata Huamaní, Fernández López, Neira Gómez, Rey Ares,2017), technical, procedural and managerial skills, motivation (Fini, Grimaldi, Marzocchi, Sobrero,2012), teamwork capability and relational capability of the entrepreneurial team (Brinckmann, Hoegl, 2011), team formation (Dautzenberg, Reger, 2010), team composition (Jin, Madison, Kraiczy, Kellermanns, Crook & Xi, 2017).

Funding is a fundamental part of the NTBFs' survival and growth. Research focuses on sources of finance, capital structure, and problems associated with obtaining finance. NTBFs most often get their financial resources from angel investors or venture capital funds. The examined financial factors of NTBFs' growth included capital structure (Kedzior, Grabinska, Grabinski, Kedzior, 2020), financing (Rannikko, Buffart, Isaksson, Löfsten, Tornikoski, 2022), venture capital and business angels (Kaminski, Hopp & Tykvova, 2019; Grilli, & Murtinu, 2011; Bilau & Sarkar (2016).

Researchers' attention is also given to a wide range of NTBFs' capabilities and processes, such as problem-solving, resilience, adaptability, innovativeness, internationalization, and ambidexterity. These companies should benefit from these capabilities, but research is focused on why they do not. Factors examined regarding the capabilities and processes of NTBFs are innovativeness (Acosta-Prado, Severiche & Tafur-Mendoza, 2020), resilience, and adaptability (Bueno Campos, Murcia Rivera & Merino Moreno, 2019; Teixeira, Moura, Lopes, Marconatto & Fischmann, 2021), absorptive capability and problem-solving (Saemundsson & Candi, 2017), ambidexterity (Jensen & Clausen, 2017), internationalization (Cahen, Jr & Borini, 2017).

The interest of researchers is also focused on the business model, all its components, the development of the business model, and its innovation. NTBFs are associated with a lack of resources, which makes them dependent on support from partners, networks, science parks, ecosystems, and institutions. The following factors are examined in connection with the business model. Business model CANVAS (Isaksson, Löfsten, Rannikko, 2021), internal resources (business experience and growth orientation), and external resources (proximity and R&D networks)(Rydehell, Isaksson, Löfsten,2019), Effectuation and causation in business model development (Reymen, Berends, Oudehand Stultiëns, 2017), the importance of the network of collaborations with other firms, research institutions, and business associations (Scandura, Bolzani, 2020), The roles of external stakeholders (Rydehell, 2020), Business networks and localization effects (Rydehell, Isaksson, Löfsten, 2019), Direct interactions with public research institutions (Fudickar, Hottenrott, 2019), Effects of Science Parks (Ramírez-Alesón, Fernández-Olmos, 2018).

To sum up, NTBFs are very specific companies marked with innovativeness and dynamism, they are still a new and underexplored phenomenon, which means that research should accumulate as much knowledge as possible about their creation, survival, and growth. The comprehensive knowledge about the growth factors of NTBFs is shown to be insufficient or missing. Most researchers deal with specific and concrete growth factors, or a group of growth factors, despite being aware of the wider dimension of the problem under investigation. Wong (2008) emphasizes that qualitative research is research that helps to increase the understanding of a new phenomenon by making sense of huge amounts of data by reducing the volume of raw information, followed by identifying significant patterns and finally drawing meaning, which corresponds well NTBFs' growth factors research.

2. Methods and methodology

The main aim of the paper is to provide a systematic literature review to summarize the current state of the most used information systems for qualitative research in examining factors of NTBFs' growth divided into groups of growth factors in general, commercialization of technology, personnel factors (founder, team), financial factors, capabilities and processes, and business model and discuss their potential for improvement of research in this area. The main aim has been chosen to discuss the research approach for better understanding the growth factors of NTBFs and addressing them.

To fulfil the main aim of the paper, firstly, it was conducted the literature review of NTBFs' definition, the main characteristics of these companies, their socio-economic contribution, and their survival and growth to understand the methodological dilemma connected to their definition and to understand the importance of examining growth factors of these companies. In concern to the growth factors of these companies, the paper provides a compilation of examined factors and their systematic configuration into groups of factors. In the part of results of the paper, it was used a systematic literature review to organize the current NTBFs literature in context with above mention groups of NTBFs' growth factors, qualitative analysis, and mostly used and in the literature mentioned information systems for qualitative analysis. To achieve a collection of a wide range of potentially relevant studies and research, it was used Google Scholar. The process of systematic review in this paper is based on searching through Google Scholar for terms NTBFs in context with concrete information systems. Then, according to

groups of growth factors, from the results were selected the ones who correspond to the criteria. The criteria were one of the groups of NTBFs' growth factors, which were growth factors in general, commercialization of technology, personnel factors (founder, team), financial factors, capabilities and processes, business model, qualitative approach, and data analyzed, evaluated, and interpreted using information systems for qualitative analysis. Following the defined procedure, the first step was to find results for NTBFs in connection with a concrete information system, then all cases were analyzed, and selected those which used a qualitative approach with information system support in an examination of one of the previously discussed groups of NTBFs' growth factors. In the first step, there were found 142 research articles and after selecting and pairing them with these growth factors, the remaining were 32 results. The systematic literature review enables to analyze the findings, address them, compare them with statements of other researchers, and finally lead to suggestions for future research in this area.

3. Results

The quantitative approaches could be employed to test and validate hypotheses in all cases, so the approach should only be used if it aligns with the underlying research question and design of the study (Newbert, Kher, Yang 2022). Qualitative approaches are used to gain a richer understanding of participants' responses and thus to see connections and patterns that are hard to capture or measure. Welter, Baker, and Wirsching (2019) state that these approaches are appropriate for understanding the full complexity and diversity of contexts and processes. Qualitative approaches might be challenging because they are dependent on the skills of researchers. With the support of information systems for qualitative analysis this challenge could easily be a break.

Information systems for qualitative analysis hold the source data such as transcripts videos, audio, memos, and any other documents that are available in electronic form to support the annotation, coding, sorting, and other manipulations of them and keep a record of all this activity. Most frequently it is used in coding, which enables researchers quickly to retrieve and collect all the text and other data that they have associated with some thematic idea so that they can be examined together, and different cases can be compared. Nevertheless, the information system does not do the analysis instead of the researchers do. They still must create the categories, code, decide what to collate, identify the patterns and draw meaning from the data. The use of information systems in qualitative data analysis is limited due to the nature of qualitative research itself in terms of the complexity of its unstructured data, the richness of the data, and how findings and theories emerge from the data. Information systems are made for making the organization, reduction, and storage of data more efficient and manageable (Wong, 2008). The most frequently used information systems for qualitative analysis based on Gibbs (2014) belongs Atlas.ti. MAXQDA, NVivo, HyperRESEARCH, QDA Miner, Qualrus. Freitas, Ribeiro, Brandão, Reis, de Souza, Costa (2017) stated NVivo, Atlas.ti, Dedoose, webQDA, MAXQDA, and QDA Miner. Kalpokas and Radivojevic (2022) mention ATLAS.ti, MAXQDA, and NVivo. Pappas and Woodside (2021) also bring up the importance to use the fsQCA. Information systems NVivo, fsQCA, Atlas.ti, and MAXQDA are the most frequently mentioned in research articles based on qualitative approaches and it could be concluded they are also the most important information system in qualitative approaches in the NTBFs' research area. When we use Google Scholar and search for the term NTBFs in context with all these information systems, we could find 60 results for NVivo, 43 results for fsQCA, 28 results for Atlas.ti, and 9 for MAXQDA. For the QuestionPro there are 2 results and for others above-mentioned information systems, such as HyperRESEARCH, QDA Miner, Qualrus, Dedoose, and webQDA, there are no results. In the table below there is an overview of in literature examining NTBFs 'growth factors merged into a group based on a theoretical summary by using a qualitative approach with the support of information systems. Results of the systematic literature review show that there are 32 research articles where NTBFs' growth factors are divided into groups of general growth factors, commercialization of technology, personnel factors (founder, team), financial factors, capabilities and processes, and business model presented in the theoretical background are analyzed, evaluated, and interpreted using information systems for qualitative analysis. Information system NVivo is used in 18 cases, Atlas.ti in 7 cases, MAXQDA in 5 cases, and QuestionPro and fsQCA both in 2 cases.

Table 1. Overview of in literature NTBFs 'growth factors examined by qualitative approach with support of information systems.

Growth factors	Title	Authors	Information system
	Growth in g	general	
Growth paths	Governmental origin: why NTBFs grow in a transi- tional economy	Farnoodi, Ghazinoory, Radfar & Tabatabaian (2020)	MAXQDA, fsQCA
Factors influencing sustainability	The factors that influence the sustainability of Malay- sian Bumiputera (indige- nous) new technology- based small firms	Kohar (2013)	NVivo
	Commercialization	of technology	
Market orientation	Behavioral market orienta- tion in new technology busi- ness firms in the wireless telecommunications sector	Potter (2010)	QuestionPro
Product development tools	New Product Development: a Study of the Adoption, Usage and Impact of Tools Among Small High Technology Firms	De Waal (2011)	NVivo
Commercialization of research and technology	Commercialisation of research and technology: A multiple case study of university technology business incubators	Nkosinathi & Robert (2014)	Atlas.ti
Product develop- ment	Exploring the role of project management in product de- velopment of new technol- ogy-based firms	Sońta-Drączkowska & Mrożewski (2020)	MAXQDA
Commercialization strategy	Commercialization done differently	Brunnström (2021)	NVivo
Commercialization innovation strategies	A framework to manage the innovation strategies of new technology-based firms	Davey, Brennan, Meenan & McAdam (2011)	NVivo

Personnel factors (founder, team)					
Female business owners experience	Female entrepreneurial experience in a male-dominated space	Bwatou (2020)	NVivo		
Manager's learning	Identifying the methods for manager's learning in ntbfs: a qualitative approach	Zeynoddini Bid- meshki, Abolghasemi, Rezaizade & Khoras- ani (2019)	MAXQDA		
Entrepreneurship in context with technological education	Engineers who become entrepreneurs; how to study them through phenomenology	Farsi, Baradaran, Hejazi & Akbari (2018)	MAXQDA		
Technology entre- preneurship	Competence at technology entrepreneurship: an interpretive view	Baradaran, Farsi, Hejazi & Akbari (2020)	MAXQDA		
	Financial f	actors			
Credit allocation	Strategies to Minimize Profit Loss from Small Busi- ness Enterprise Credit Re- jections	Nwagbo (2018)	NVivo		
Financing scheme	The green technology financing scheme (GTFS) in Malaysia: revealing the competency trap	Zaharudin (2017)	NVivo, Atlas.ti		
Financing order and founder preference	New venture financing or- der and founder preference: A multi-case study of Aus- trian Tech startups	Dulovits & Tewelu (2020)	Atlas.ti		
Financing challenges	New Technology-Based Firms and Grants: Too Much of a Good Thing?	Pary & Witmeur (2018)	NVivo		
Venture capital investors	Bringing a letter of intent or not? A qualitative study on the influence of Letters of Intent on venture capital investors' intention to invest in new technology-based firms without proof of prototype yet	Verdonk (2021)	Atlas.ti		

Capabilities and processes					
Growth and development innovation processes Technological and	Using Mixed Methods to Evaluate the Role and Contribution of Disciplined Innovation Processes (DIPs) for Start-Up Growth and Development The impact of technological	Ahmed, Buckley & Behan (2021) Fakhimi & Miremadi	NVivo fsQCA		
social capabilities	and social capabilities on in- novation performance: a technological catch-up per- spective	(2022)	ISQCA		
Internationalization	Knowledge-based network ties in early rapidly internationalising small firms: a missing link?	Masango & Mari- nova (2014)	NVivo		
Disruptive innovation capability	Disruptive Innovation at the Base-of-the-Pyramid: Nego- tiating the Missing Links	Dzimba & Poll (2022)	Atlas.ti		
Decision-making	Empirical insights into the black box of decision-making in new ventures: a study based on biotechnology companies in Australia and India.	Sardana (2007)	NVivo		
	Business n	nodel			
Business model	Governance and business models at the HTCE: Dis- rupting science parks	Van der Borgh, W. (2007)	NVivo		
Resource accumulation	Resource accumulation for opportunity identification and exploitation by lead academic and non-academic entrepreneurs	Farquharson (2009)	NVivo		
Technology parks	Exploratory study of strate- gic visionary management of innovation, research and technology parks affiliated with universities	Turky (2019)	NVivo		

Sustainability strategy	Small Business Sustainabil- ity Strategies in the Mari- time Industry in Lagos, Ni- geria	Olorunshola (2019)	NVivo
Business plan	Applying Text Analytics to Business Plans in New Technology-Based Firm Survival Research	Ungerer, Baltes & König (2021)	NVivo
Resource need	You can't always get what you want: How entrepre- neur's perceived resource needs affect the incubator's assertiveness	Van Weele, Van Rijnsoever & Nauta (2017)	NVivo
Ecosystem	Digital technologies, techno-entrepreneurship and regional ecosystems: The case of The Net Value.	Frau & Moi (2019)	NVivo
Science parks	The VEGA-VEnice GAteway for Science and Technology Park: Is It a Generative Infrastructure?	Cozza (2016)	Atlas.ti
Relationship with stakeholders	Building Trust and Manag- ing Brand Relationships with Stakeholders	Matejun & Ratajczak (2021)	QuestionPro
Technology business incubator	All that glitters is not gold: The role of stringent and admission of new technology-based firms within a university technology business incubator	Sithole (2015)	Atlas.ti

Source: Own research

4. Discussion

Nowadays, the research is mostly based on quantitative analysis. With the increase of advanced information technologies and big data, researchers can examine their phenomenon on large samples which allows them to include more variables in the analysis. The use of quantitative approaches means having massively supported the research findings with large samples of firms and a large amount of firm quantitative data. The value of designing quantitative research is the potential to produce generalizable findings. Researchers before elaborated qualitative approaches for examination now can use quantitative approaches for testing the theory. However, the knowledge from these findings could be insufficient to explain without recognition of the fact that each context is unique. In the social and economic sciences, qualitative approaches should be used to interpret variation and precisely place cases relative to one another. On the other hand, information technologies not only increase the qualification

of a researched phenomenon, but they also make it easier to use qualitative approaches and so to improve understanding of contexts, complexity, sensemaking processes, and theory emergence of an examined object as well.

Qualitative research fits well with studying new and underexplored phenomena which are hard to measure. These correspond to the NTBFs' growth factors. Maybe there is the main reason why we could be found in Google Scholar in context with NTBFs a little more qualitative research than the quantitative ones. Qualitative research has an important value for better understanding and addressing not only the main and clear tendency, but also catching less frequent, inconspicuous, and non-distinct factors and conditions affecting the growth, characteristic for only a small number of companies based on new technologies. Researchers and scholars should be aware of the fact that qualitative methods become more and more diverse and sophisticated. There is a massive need to broaden the set of methods using and employing methods, where the information systems are irreplaceable in context to advance the NTBFs' research in the future. In context with NTBFs' growth factors, the most used information systems are NVivo, Atlas.ti, fsQCA, MAXQDA, and QuestionPro, which corresponds with the opinion of (Gibbs, 2014; Freitas, Ribeiro, Brandão, Reis, de Souza, Costa, 2017; Kalpokas and Radivojevic, 2022) about most frequently used information systems in qualitative analysis. The choice of an information system must be careful in connection with the object of research, research questions aim of the research, and anticipated finding. The researchers should deal with their knowledge of specific information systems and methods used in the qualitative approach. They should renew their methods and tools knowledge base and learn practical skills to employ them in their research. There are lots of research articles dedicated to qualitative approaches, the use of information systems in qualitative approaches, and practical guides for researchers on how to employ them. It could be helpful to make own systematic literature review on what approach suit best for the researched phenomenon, which approaches had been used so far, how could it be improved in future research, and based on the results create own research approach. The decision of choosing an information system for qualitative analysis is a decision that should be well-planned and evaluated. It is necessary not only to evaluate the offering information systems based on the list of tools offered by them but also to study and analyze some methodological evaluations of offered information systems, especially in the concrete research area. It is important for scholars to choose the information system with the most appropriate tool package for concrete research design but consider the tasks and processes in the data management and analysis process, forms of data (text, video, and mixed data), structures of the data and learn how each step in the analysis process for each task could be supported by the information system, is elementary. The information system does not do the analysis instead of the researchers. They still need to create the categories, code, decide what to collate, identify the patterns and draw meaning from the data. The use of information system in qualitative data analysis is limited due to the nature of qualitative research itself in terms of the complexity of its unstructured data, the richness of the data and the way in which findings and theories emerge from the data (Roberts and Wilson, 2002). Using information system in qualitative analysis making organization, reduction, and storage of data more efficient and manageable, but the researchers need to synthesize the finding and interpret them.

Both quantitative and qualitative approaches have their strengths and weaknesses. To gain a richer understanding of NTBFs' growth factors, and reveal the relationships between them and the interrelationships, mixed method approaches are the best option. The mixed-method approach is the one where quantitative and qualitative studies follow one from the other. In mixed-methods research, qualitative methods are often employed to help explain and expand quantitative findings, which is also supported by Pappas, and Woodside (2021).

5. Conclusions

Qualitative data analysis information systems make repetitive and mechanical aspects of qualitative research easier and more efficient. In addition, the information systems offer researchers an abundance of tools that, when used appropriately, will enhance the research aim. Results of conducted systematic literature review show that there are 32 research articles where NTBFs' growth factors are divided into groups of growth factors in general, commercialization of technology, personnel factors (founder, team), financial factors, capabilities and processes, and business model presented in the

theoretical background are analyzed, evaluated, and interpreted using information systems for qualitative analysis. Most frequently it is used NVivo, then Atlas.ti, and then MAXQDA.

It is necessary to empower researchers to employ qualitative research with the intentional use of information systems. With increasing digitalization, information systems and their use in research are only going to continue growing, and the number of methods, approaches and informational systems which could be used will increase. This is a reason why methodological guidance research articles are important to extend knowledge and scientific use of information systems in an examination of concrete research objects and subjects. Sometimes our knowledge of possible methodology used in this case and support potential of information systems are limited improvement of research. By bridging the gap between information systems and qualitative approaches, researchers can draw important contributions to a better understanding of examined phenomena that are required to be analyzed also qualitatively, like NTBFs' growth factors, and thus advance knowledge in the future.

The paper has also some limitations and the presented results need to be interpreted with some caution. Important limitations relate to the quantity of examined research articles and studies. To interpret the paper correctly, we should be aware of the fact that more research articles examined NTBFs employing qualitative analysis by using information systems but not in context with growth factors or not with factors in one of the theoretical summaries arising merging group.

Funding: This research was funded by VEGA MŠ SR No. 1/0006/22 (2022 – 2024) entitled Accelerating the growth of innovative enterprises – scaling up scale-ups and new technologies-based firms (NTBFs).

References

- Acosta-Prado, J. C., Romero Severiche, A. K., & Tafur-Mendoza, A. A. (2020). Conditions of knowledge management, innovation capability and firm performance in Colombian NTBFs: A measurement scale. VINE Journal of Information and Knowledge Management Systems. doi:10.1108/VJIKMS-09-2019-0142
- 2. Ahmed, S., Buckley, A. P., & Behan, F. (2021, June). Using Mixed Methods to Evaluate the Role and Contribtion of Disciplined Innovation Processes (DIPs) for Start-Up Growth and Development. In European Conference on Research Methodology for Business and Management Studies (pp. 311-IX). Academic Conferences International Limited.
- 3. Arthur D. Little Group (1977), New Technology-based Firms in the UK and Federal Republic of Germany: A Report for the Anglo-German Foundation for the Study of Industrial Society, Arthur D. Little Group, London.
- 4. Autio, E., & Yli-Renko, H. (1998). New, technology-based firms in small open economies—an analysis based on the Finnish experience. *Research policy*, 26(9), 973-987. https://doi.org/10.1016/S0048-7333(97)00054-1
- 5. Baradaran, M. S., Farsi, J. Y., Hejazi, S. R., & Akbari, M. (2020). Competence at technology entrepreneurship: an interpretive view. *Journal of Economic and Administrative Sciences*, 38(1), 1-17. https://doi.org/10.1108/JEAS-08-2018-0095
- 6. Bergek, A., & Norrman, C. (2015). Integrating the supply and demand sides of public support to new technology-based firms. *Science and Public Policy*, 42(4), 514-529. https://doi.org/10.1093/scipol/scu072
- 7. Bilau, J., & Sarkar, S. (2016). Financing innovative start-ups in Portuguese context: what is the role of business angels networks? *Journal of the Knowledge Economy*, 7(4), 920-934. doi: 10.1007/s13132-015-0304-1
- 8. Boudlaie, H., Kenarroodi, M., & Nik, B. K. (2020). Studying the content characteristics of New Technology-Based Firms. *Technium Soc. Sci. J.*, *3*, 94. doi:10.47577/tssj.v3i1.77
- 9. Brinckmann, J., & Hoegl, M. (2011). Effects of initial teamwork capability and initial relational capability on the development of new technology-based firms. *Strategic Entrepreneurship Journal*, 5(1), 37-57. doi:10.1002/sej.106
- 10. Brunnström, L. (2021). Commercialization done differently: How Swedish university incubators facilitate the formation of knowledge-intensive entrepreneurial firms.
- 11. Bueno Campos, E., Murcia Rivera, C., & Merino Moreno, C. (2019). Resilient organizational capabilities in NTBFs. Concept and variables as dynamic and adaptive capabilities. *Small Business International Review* (SBIR), 3(2), 1-16. doi:10.26784/sbir.v3i2.196
- 12. Buganza, T., Gerst, M., & Verganti, R. (2010). Adoption of NPD flexibility practices in new technology-based firms. *European Journal of Innovation Management*, 13(1), 62-80. doi:10.1108/14601061011013230
- 13. Bwatou, R. (2020). Female entrepreneurial experience in a male-dominated space "YOU'RE TOO EARLY, COME BACK IN A YEAR" (Master's thesis).
- 14. Cahen, F. R., Jr, M. D. M. O., & Borini, F. M. (2017). The internationalisation of new technology-based firms from emerging markets. *International Journal of Technology Management*, 74(1-4), 23-44. https://doi.org/10.1504/IJTM.2017.083607

- 15. Camisón-Haba, S., Clemente-Almendros, J. A., & Gonzalez-Cruz, T. (2019). How technology-based firms become also highly innovative firms? The role of knowledge, technological and managerial capabilities, and entrepreneurs' background. *Journal of Innovation & Knowledge*, 4(3), 162-170. doi: 10.1016/j.jik.2018.12.001
- 16. Candi, M., & Saemundsson, R. J. (2008). How different? Comparing the use of design in service innovation in Nordic and American new technology-based firms. *Design Studies*, 29(5), 478-499. doi: 10.1016/j.destud.2008.05.003
- 17. Choi, D. S., Sung, C. S., & Park, J. Y. (2020). How does technology startups increase innovative performance? The study of technology startups on innovation focusing on employment change in Korea. *Sustainability*, 12(2), 551. doi:10.3390/su12020551
- 18. Coad, A., & Reid, A. (2012). The role of technology and technology-based firms in economic development. *Final Report for Scottish Enterprise, Glasgow*.
- 19. Contreras, Ó. F., & García, M. (2021). KIBS and NTBF in Mexico: Combining GVC and RIS to study market entry mechanisms and upgrading.
- 20. Cozza, M. (2016). The VEGA-VEnice GAteway for Science and Technology Park: Is It a Generative Infrastructure?. In *Knowledge-creating Milieus in Europe* (pp. 139-156). Springer, Berlin, Heidelberg.
- 21. Dautzenberg, K., & Reger, G. (2010). Entrepreneurial team characteristics and success of new technology-based firms in Germany. *International Journal of Business and Globalisation*, 4(1), 71-94. doi:10.1504/IJBG.2010.029525
- 22. Davey, S. M., Brennan, M., Meenan, B. J., & McAdam, R. (2011, June). A framework to manage the innovation strategies of new technology based firms. In *First International Technology Management Conference* (pp. 1007-1013). IEEE.
- 23. De Waal, G. A. (2011). New Product Development: a Study of the Adoption, Usage and Impact of Tools Among Small High Technology Firms.
- 24. Dulovits, S., & Tewelu, Y. H. (2020). New venture financing order and founder preference: A multi-case study of Austrian Tech startups.
- Dzimba, E., & Poll, J. A. V. D. (2022). Disruptive Innovation at the Base-of-the-Pyramid: Negotiating the Missing Links. *Journal of Open Innovation: Technology, Market, and Complexity*, 8(4), 171. https://doi.org/10.3390/joitmc8040171
- Fakhimi, M., & Miremadi, I. (2022). The impact of technological and social capabilities on innovation performance: a technological catch-up perspective. *Technology in Society*, 68, 101890. https://doi.org/10.1016/j.techsoc.2022.101890
- 27. Farnoodi, S., Ghazinoory, S., Radfar, R., & Tabatabaian, S. H. (2020). Governmental origin: why NTBFs grow in a transitional economy. *Economic research-Ekonomska istraživanja*, 33(1), 379-398. https://doi.org/10.1080/1331677X.2019.1674173
- 28. Farquharson, M. H. (2009). Resource accumulation for opportunity identification and exploitation by lead academic and non-academic entrepreneurs (Doctoral dissertation, University of Nottingham).
- 29. Farsi, J. Y., Baradaran, M. S., Hejazi, S. R., & Akbari, M. (2018). Engineers who become entrepreneurs; how to study them through phenomenology. *International Journal of Economics and Financial Issues*, 8(2), 331.
- 30. Fini, R., Grimaldi, R., Marzocchi, G. L., & Sobrero, M. (2012). The determinants of corporate entrepreneurial intention within small and newly established firms. *Entrepreneurship Theory and Practice*, 36(2), 387-414. doi:10.1111%2Fj.1540-6520.2010.00411.x
- 31. Frau, M., & Moi, L. (2019). Digital technologies, techno-entrepreneurship and regional ecosystems: the case of The Net Value. In *Handbook of Research on Techno-Entrepreneurship, Third Edition*. Edward Elgar Publishing.
- 32. Freitas, F., Ribeiro, J., Brandão, C., Reis, L. P., de Souza, F. N., & Costa, A. P. (2017). Learn for yourself: The self-learning tools for qualitative analysis software packages. *Digital Education Review*, (32), 97-117.
- 33. Fudickar, R., & Hottenrott, H. (2019). Public research and the innovation performance of new technology-based firms. *The Journal of Technology Transfer*, 44(2), 326-358. doi:10.1007/s10961-018-9695-z
- 34. Ganotakis, P., & Love, J. H. (2011). R&D, product innovation, and exporting: evidence from UK new technology-based firms. *Oxford Economic Papers*, 63(2), 279-306. doi: 10.1093/oep/gpq027
- 35. García-Cabrera, A. M., García-Soto, M. G., & Nieves, J. (2021). Knowledge, innovation and NTBF short-and long-term performance. *International Entrepreneurship and Management Journal*, 17(3), 1067-1089. doi: 10.1007/s11365-020-00656-z
- 36. Gibbs, G. R. (2014). Using software in qualitative analysis. *The SAGE handbook of qualitative data analysis*, 277-294.
- 37. Giones, F., Miralles, F., König, M., & Baltes, G. (2015). Do all paths lead to Rome? Technology and Market Orientation influence on the growth of new technology-based firms. In 2015 IEEE International Conference on Engineering, Technology and Innovation/ International Technology Management Conference (ICE/ITMC) (pp. 1-8). IEEE. doi:10.1109/ICE.2015.7438660
- 38. Grilli, L., & Murtinu, S. (2011). Turning European new technology-based firms into 'gazelles': the role of public (and private) venture capital. In VICO Final Conference, Stresa, Italy, June.

- 39. Isaksson, A., Löfsten, H., & Rannikko, H. (2021). The Influence Of Initial Business Models On Early Business Performance: A Study Of 589 New High-Tech Firms. *International Journal of Innovation Management*, 25(05), 2150055. doi: 10.1142/S1363919621500559
- 40. Jensen, A., & Clausen, T. H. (2017). Origins and emergence of exploration and exploitation capabilities in new technology-based firms. *Technological Forecasting and Social Change*, 120, 163-175. doi: 10.1016/j.techfore.2017.03.004
- 41. Jin, L., Madison, K., Kraiczy, N. D., Kellermanns, F. W., Crook, T. R., & Xi, J. (2017). Entrepreneurial team composition characteristics and new venture performance: A meta–analysis. *Entrepreneurship Theory and Practice*, 41(5), 743-771.
- 42. Kalpokas, N., & Radivojevic, I. (2022). Bridging the gap between methodology and qualitative data analysis software: A practical guide for educators and qualitative researchers. *Sociological Research Online*, 27(2), 313-341. https://doi.org/10.1177/13607804211003579.
- 43. Kaminski, J., Hopp, C., & Tykvova, T. (2019). New technology assessment in entrepreneurial financing–Does crowdfunding predict venture capital investments?. *Technological Forecasting and Social Change*, 139, 287-302. https://doi.org/10.1016/j.techfore.2018.11.015
- 44. Kanani, M., & Goodarzi, M. (2017). Fostering new technology-based firms in Iran: Inspiration of world models in solving domestic challenges. In *The development of science and technology in Iran* (pp. 29-43). Palgrave Macmillan, New York.
- 45. Kedzior, M., Grabinska, B., Grabinski, K., & Kedzior, D. (2020). Capital structure choices in technology firms: Empirical results from Polish listed companies. *Journal of Risk and Financial management*, 13(9), 221. doi: 10.3390/jrfm13090221
- 46. Kohar, U. H. A. (2013). The factors that influence the sustainability of Malaysian Bumiputera (indigenous) new technology-based small firms (Doctoral dissertation, RMIT University).
- 47. Luggen, M. (2004). Technology and innovation management in new technology-based firms: Introducing the PockeTM concept (Doctoral dissertation, ETH Zurich).
- 48. Luggen, M., & Tschirky, H. (2003). A conceptual framework for technology and innovation management in new technology-based firms (NTBF). In *PICMET'03: Portland International Conference on Management of Engineering and Technology Technology Management for Reshaping the World, 2003.* (pp. 342-347). IEEE. doi: 10.1109/PICMET.2003.1222812
- 49. Masango, S., & Marinova, S. (2014). Knowledge-based network ties in early rapidly internationalising small firms: a missing link?. *International Entrepreneurship and Management Journal*, 10(3), 471-486. doi:10.1007/s11365-014-0311-x.
- 50. Matejun, M., & Ratajczak, M. (2021). Building Trust and Managing Brand Relationships with Stakeholders. In *Trust, Organizations and the Digital Economy* (pp. 214-231). Routledge.
- 51. Newbert, S. L., Kher, R., & Yang, S. (2022). Now that's interesting and important! Moving beyond averages to increase the inferential value of empirical findings in entrepreneurship research. *Journal of Business Venturing*, 37(2), 106185. https://doi.org/10.1016/j.jbusvent.2021.106185
- 52. Nkosinathi, S., & Robert, O. R. (2014). Commercialisation of research and technology: A multiple case study of university technology business incubators. *African Journal of Business Management*, 8(16), 641-659.
- 53. Nwagbo, A. (2018). Strategies to Minimize Profit Loss From Small Business Enterprise Credit Rejections (Doctoral dissertation, Walden University).
- 54. Olorunshola, O. (2019). Small Business Sustainability Strategies in the Maritime Industry in Lagos, Nigeria (Doctoral dissertation, Walden University).
- 55. Pappas, I. O., & Woodside, A. G. (2021). Fuzzy-set Qualitative Comparative Analysis (fsQCA): Guidelines for research practice in Information Systems and marketing. *International Journal of Information Management*, 58, 102310. doi: 10.1016/j.ijinfomgt.2021.102310
- 56. Pary, N., & Witmeur, O. (2018). New Technology-Based Firms and Grants: Too Much of a Good Thing?. In *Technology Entrepreneurship* (pp. 177-200). Springer, Cham.
- 57. Piccarozzi, M. (2017). Does social innovation contribute to sustainability? The case of Italian innovative start-ups. *Sustainability*, 9(12), 2376. doi:10.3390/su9122376
- 58. Potter, S. (2010). Behavioral market orientation in new technology business firms in the wireless telecommunications sector (Doctoral dissertation, Fielding Graduate University).
- 59. Qureshi, M. S., Aziz, N., & Mian, S. A. (2017). How marketing capabilities shape entrepreneurial firm's performance? Evidence from new technology-based firms in turkey. *Journal of Global Entrepreneurship Research*, 7(1), 1-15. doi: 10.1186/s40497-017-0071-5
- 60. Ramaciotti, L., Muscio, A., & Rizzo, U. (2017). The impact of hard and soft policy measures on new technology-based firms. *Regional Studies*, 51(4), 629-642. doi: 10.1080/00343404.2016.1255319
- 61. Ramírez-Alesón, M., & Fernández-Olmos, M. (2018). Unravelling the effects of Science Parks on the innovation performance of NTBFs. *The Journal of Technology Transfer*, 43(2), 482-505. https://doi.org/10.1007/s10961-017-9559-y

- 62. Rannikko, H., Buffart, M., Isaksson, A., Löfsten, H., & Tornikoski, E. T. (2022). Mobilising finance and achieving early growth in new technology-based firms: a legitimacy perspective. *International Journal of Entrepreneurial Behavior & Research*. doi: 10.1108/IJEBR-09-2021-0687
- 63. Rannikko, H., Tornikoski, E. T., Isaksson, A., & Löfsten, H. (2019). Survival and growth patterns among new technology-based firms: Empirical study of cohort 2006 in Sweden. *Journal of Small Business Management*, 57(2), 640-657. doi:10.1111/jsbm.12428
- 64. Reymen, I., Berends, H., Oudehand, R., & Stultiëns, R. (2017). Decision making for business model development: a process study of effectuation and causation in new technology-based ventures. *R&D Management*, 47(4), 595-606. doi: 10.1111/radm.12249
- 65. Roberts, K. A., & Wilson, R. W. (2002). ICT and the research process: Issues around the compatibility of technology with qualitative data analysis. In *Forum Qualitative Social forschung/Forum: Qualitative Social Research* (Vol. 3, No. 2).
- 66. Rydehell, H. (2020). Stakeholder roles in business model development in new technology-based firms. *International Journal of Innovation Management*, 24(04), 2050031. doi: 10.1142/S1363919620500310
- 67. Rydehell, H., Isaksson, A., & Löfsten, H. (2019). Business networks and localization effects for new Swedish technology-based firms' innovation performance. *The Journal of Technology Transfer*, 44(5), 1547-1576. doi:10.1007/s10961-018-9668-2
- 68. Rydehell, H., Isaksson, A., & Löfsten, H. (2019). Effects of internal and external resource dimensions on the business performance of new technology-based firms. *International Journal of Innovation Management*, 23(01), 1950001. doi: 10.1142/S1363919619500014
- 69. Saemundsson, R. J., & Candi, M. (2017). Absorptive capacity and the identification of opportunities in new technology-based firms. *Technovation*, 64, 43-49. doi: 10.1016/j.technovation.2017.06.001
- 70. Saillard, E. K. (2011). Systematic versus interpretive analysis with two CAQDAS packages: NVivo and MAXQDA. In *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research* (Vol. 12, No. 1, p. 21). DEU.
- 71. Sardana, D. (2007). Empirical insights into the black box of decision-making in new ventures: a study based on biotechnology companies in Australia and India.
- 72. Scandura, A., & Bolzani, D. (2020). The Role of Collaboration Networks for Innovation in Immigrant-Owned New Technology-Based Firms (No. 202021). University of Turin.
- 73. Siepel, J., Cowling, M., & Coad, A. (2017). Non-founder human capital and the long-run growth and survival of high-tech ventures. *Technovation*, 59, 34-43. doi: 10.1016/j.technovation.2016.09.001
- 74. Sithole, M. N. (2015) All that glitters is not gold: The role of stringent and admission of new technology based firms within a university technology business incubator. *Management in Southern Africa: Chance, Challenge, Opportunity*. 554 -573. ISBN 978-0-620-66504-9.
- 75. Sońta-Drączkowska, E., & Mrożewski, M. (2020). Exploring the role of project management in product development of new technology-based firms. *Project Management Journal*, 51(3), 294-311. https://doi.org/10.1177/8756972819851939
- 76. Symeonidou, N., Bruneel, J., & Autio, E. (2017). Commercialization strategy and internationalization outcomes in technology-based new ventures. *Journal of Business Venturing*, 32(3), 302-317. doi: 10.1016/j.jbusvent.2017.02.004
- 77. Teixeira, E. G., Moura, G. L. D., Lopes, L. F. D., Marconatto, D. A. B., & Fischmann, A. A. (2021). The influence of dynamic capabilities on startup growth. *RAUSP Management Journal*, *56*, 88-108. https://doi.org/10.1108/RAUSP-08-2019-0176
- 78. Torrecilla García, J. A., Skotnicka, A. G., & Zamora, D. T. (2015). The new technology-based firm profile required for a delimitation of its definition in empirical studies. *International Journal of Engineering Management and Economics*, 5(1-2), 114-128. doi: 10.1504/IJEME.2015.069903
- 79. Turky, R. H. (2019). Exploratory study of strategic visionary management of innovation, research and technology parks affiliated with universities (Doctoral dissertation, University of Southampton).
- 80. Ungerer, C., Baltes, G., & König, M. (2021, June). Applying Text Analytics to Business Plans in New Technology-Based Firm Survival Research. In 2021 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC) (pp. 1-19). IEEE. https://doi.org/10.1109/ICE/ITMC52061.2021.9570212
- 81. Van der Borgh, W. (2007). Governance and business models at the HTCE: Disrupting science parks. *TUE: Department Technology Management, series master thesis innovation management.*
- 82. Van Weele, M., van Rijnsoever, F. J., & Nauta, F. (2017). You can't always get what you want: How entrepreneur's perceived resource needs affect the incubator's assertiveness. *Technovation*, 59, 18-33. http://dx.doi.org/10.1016/j.technovation.2016.08.004
- 83. Verdonk, N. (2021). BRINGING A LETTER OF INTENT OR NOT? A qualitative study on the influence of Letters of Intent on venture capital investors' intention to invest in new technology-based firms without proof of prototype yet.

- 84. Virasa, T. (2007). A gap-analysis model for identifying effective government support for new technology-based firms in Thailand. *International Journal of Technoentrepreneurship*, 1(2), 165-182. https://doi.org/10.1504/IJTE.2007.016954
- 85. Welter, F., Baker, T., & Wirsching, K. (2019). Three waves and counting: The rising tide of contextualization in entrepreneurship research. Small Business Economics, 52(2), 319–330. https://doi.org/10.1007/s11187-018-0094-5
- 86. Wong, L. P. (2008). Data analysis in qualitative research: A brief guide to using NVivo. *Malaysian family physician: the official journal of the Academy of Family Physicians of Malaysia*, 3(1), 14.
- 87. Zaharudin, M. A. (2017). The green technology financing scheme (GTFS) in Malaysia: revealing the competency trap (Doctoral dissertation, University of Nottingham).
- 88. Zapata Huamaní, G. A, Fernández López, S., Neira Gómez, I., & Rey Ares, L. (2017). The role of the entrepreneur in new technology-based firms (NTBFs): An analysis according to context development. *Regional and Sectoral Economic Studies*, 17(2), 25-42.
- 89. Zeynoddini Bidmeshki, Z., Abolghasemi, M., Rezaizade, M., & Khorasani, A. (2019). Identifying the methods for manager's learning in ntbfs: a qualitative approach. *Journal of Science and Technology Policy*, 12(3), 63-76. doi: 10.22034/JSTP.2019.11.3.1026

Starting points for the application of new trends in waste management

Júlia Rakovská 1*

- ¹ Affiliation 1 (Faculty of Business Management, University of Economics, Bratislava, Slovakia); julia.rakovska@euba.sk
- * Correspondence: julia.rakovska@euba.sk

Abstract: Background: In this paper we analyse the development of municipal waste production in Slovakia and in the world, pointing out possible solutions in the field of waste management. Methods: When examining the basis for the application of modern trends in waste management, we focused on comparing the development of municipal waste production in the world and in Slovakia. Results: In the framework of the research, we addressed the issue of implementation of modern trends in waste management. The amount of waste produced is increasing every year. In 2021, up to 2,7 million tonnes of municipal waste will be produced in Slovakia, which represents 497 kilograms of waste per person. Conclusions: The introduction of modern trends in waste management is currently mainly preceded by tackling the high rate of landfilling, reducing the volume of waste produced and increasing the sorting rate of municipal waste.

Keywords: waste management, development of municipal waste production, circular economy

Introduction

We live in a world where people's values and ways of life have changed considerably compared to the recent past. In this context, environmental issues, including how to deal with the waste produced, which has a significant impact on the environment, are at the forefront of current questions about the future functioning of life on Earth. In examining the basis for the application of modern trends in waste management, we have focused in this article on the analysis of the development of municipal waste production in the world and in Slovakia. From the available forecasts, which we have used for the elaboration of the article, it is clear that the development of municipal waste production both globally and in Slovakia will continuously increase. The implementation of modern principles and methods of waste management brings many positive benefits in relation to the environment, but currently also faces several barriers. In this article we analyse this fact in more detail and in numerical terms.

1. Theoretical background

The concept of the environment can be understood in different ways, so there is no universally valid single definition. The term environment has been defined by several foreign and domestic authors. The best known definition is that of the Norwegian biologist Wiko, which was adopted by UNESCO in 1967. According to Wiko, the environment is "the part of the world (universe) with which man interacts, i.e. which he uses, influences and adapts to." Act No 17/1992 Coll. on the environment states that the environment is everything that creates natural conditions for the existence of organisms, including humans, and is a prerequisite for their further development. Environment in the broad sense, as stated by Noskovič et al. (2007), is such an environment that provides conditions for the basic manifestations and biological functions of a living organism. It is the external world of organisms with which they have mutual relations (interactions). Every organism has its environment without which it cannot exist. It is in this environment that it originates, develops and reproduces. The 2030 Agenda, with its 17 Sustainable Development Goals, presents a clear vision for industries and organisations to ensure economic, social and environmental well-being. Richnák, P., & Fidlerová, H. (2022)

1.1. Impact of waste production on the environment

However, the environment is currently burdened by many negative impacts, most notably waste production. Waste produced by man has no living consumer who can process it in accordance with nature and use it further for his own benefit. This is the essential difference between the waste that nature itself produces, which it can easily process, and the waste that human society produces.

The Waste Act No 79/2015 Coll. states that waste is a movable object which the holder disposes of, wants to dispose of, or is obliged to dispose of in accordance with this Act or special regulations. Thus, waste is generally unnecessary material resulting from industrial processes or household waste, waste arising from municipal activities and from the maintenance of public green spaces (municipal waste). The increase in waste is mainly due to the rise in industrial production, the expansion of cities and the mass use of plastics, materials that mankind is not able to use 100 % of, or even dispose of without residue. The different types of waste can be divided into the following groups:

- municipal waste,
- industrial waste,
- wastes from the extraction of raw materials,
- forestry and agricultural waste,
- wastes from the energy sector,
- sludges from municipal and industrial waste water treatment plants,
- water treatment and sediment,
- radioactive waste.

For comparison, while in 1950 there was 0,5 ml of garbage per person, twenty years later there is three times as much, i.e. 1,5 ml of garbage per person. Another problem is the lack of interest of some companies or countries in the production using zero-waste technologies or the subsequent disposal of the waste produced. For a number of companies, the primary objective is simply to make a profit, often at the expense of the environmental impact. For them, waste disposal is a non-profit investment. There are also gaps in national legislation that should oversee and guide waste production or disposal. The following are the main contributors to the increase in waste:

- population growth,
- increasing personal consumption,
- the level of production technology.

In the following, we briefly characterize some of the modern approaches to solving problematics related to waste that are applicable in today's conditions.

1.2. Waste-free and low-waste technologies

If we address the problem of recycling waste back into production to create a new product, we are not dealing with a zero-waste technology, but with a low-waste technology, where the "low" is given by the minimum necessary amount of energy actually consumed to reuse the waste. Thus, zero-waste technologies cannot be understood as technologies for the production of useful products from the waste of other technologies, regardless of their value or the costs involved. While low-waste technologies involve a high degree of raw material recovery and a substantial reduction in processing waste, zero-waste technologies create closed techno-technological cycles in which waste is recycled and returned to production. A very important factor in the design of zero-waste technologies is the amount of energy required. The point is that energy production is associated with the use of limited natural resources and in most cases also with pollution of individual components of the environment.

Ways of introducing zero-waste technologies include:

- comprehensive use of raw materials,
- waste reduction and reuse,
- reuse of secondary raw materials,
- reusing products for another purpose,
- production of products with a longer service life,
- worn-out, unusable products should be easy to break down into parts that can be reused as secondary raw materials,
- minimising energy consumption.

In order to introduce low-waste technologies, the development focuses in particular on the following areas:

- the use of the waste generated as raw material for further production,
- the use of waste as a source of secondary energy,
- the application of low-waste technologies.

The European Association for the Research of Future Enterprises in its strategy document Factories of the Future - Multi Annual roadmap for the contractual PPP under Horizon 2020 has defined four basic aspects of sustainability of future enterprises:

- 1. production of products of the future,
- 2. social sustainability of production,
- 3. economic sustainability of production,
- 4. environmental sustainability of production.

1.3. Sustainable production

The environmental sustainability of production is a significant trend that affects every transformation process in today's businesses and is even more of a focus for the businesses of the future. This is due to significant public pressure to protect the environment and improve it for the future. Many businesses have significant problems in meeting environmental standards. This is why the transformation into the enterprise of the future should also help them significantly in their development and in gaining a competitive advantage in the market. Enterprises of the future reduce the following environmental impacts resulting from their economic activities:

- · reducing energy consumption and using renewable energy sources,
- reducing the consumption of water and other resources in the production process,
- · optimising the use of materials in the production process,
- reducing waste and increasing the use of recyclable materials.

In his research from 2022, Richnák describes sustainability development goals in the con-text of the Industry 5.0 concept, as he believes that sustainability will have a significant impact not only on logistics processes and activities, but on the entire supply chain. Richnák, P. (2022)

If a company wants to be successful and competitive, it is not enough to produce quality products or provide adequate services. It is also necessary to manage its activities in such a way that they benefit not only its surroundings, but also society as a whole, in a way that respects the ethical approach to individuals, other organisations or entities, as well as the environment as a whole. The environmentally responsible behaviour of companies must now be seen as a necessity in their business. The principles of responsible behaviour are based on the premise that businesses will minimise pollution, that their economic activities must be characterised by responsibility towards society and that the products or services they produce will contribute to a safe and healthy environment.

1.4. Circular economics

The linear model of the economy is reaching its limits. A linear economy means that products are produced from new raw materials which, after use, are discarded as waste without any effort to reuse the products, or parts of them. The impact of human activity on the environment has become more pronounced in recent years as natural resources are being used up. The essence of the circular economy is to maximise the lifetime of products, consequently reducing consumption and minimising waste.

In order to implement the circular economy, it is necessary to know what motivates businesses to switch to this model and also what the barriers to implementation are. The available literature suggests that the main motives for circular economy include: diminishing natural resources, avoiding environmental degradation, complying with legislation and regulations, consumer pressure, co-operation with customers or improving business performance (Govindan et al., 2015, Geng and Debersteinm, 2008, Abubakar, 2018).

When implementing the circular economy, it is also important to examine the barriers that slow down or prevent the transition to this economic model. Preston (2012) identified the following barriers to the transition to a circular economy:

- high initial costs,
- complex international supply chains,
- infrastructure,

- failures in cooperation between companies,
- lack of consumer enthusiasm,
- limited diffusion of innovation in both emerging and developed countries.

Barriers identified by Bicket et al. (2014) include, in particular, lack of in-investment in the technology, lack of acceptance by consumers and businesses, lack of awareness and information, and limited government incentives. Regarding circular economy principles in SMEs, Rizos et al. (2015) mentioned environmental culture, information deficit, administrative burden and relatively low technical skills as barriers to circular economy implementation.

2. Methods and methodology

The preparation of the present article was preceded by collecting and studying available information from professional books, electronic information sources and websites. The criterion for the selection of sources was mainly their topicality, narrative ability and relevance to the issue under study. In the processing of the issue we used mainly the methods of analysis and subsequent synthesis, the relevant data were processed into tabular summaries with a uniform graphical layout. In order to compare data from individual geographical areas, regions and also their interpretation in time sequence, we used the method of comparison. Among the mathematical methods we used the calculation of percentages.

3. Results

3.1. Global waste production trends

Worldwide, 2,01 billion tonnes of municipal solid waste are generated annually, and at least 33 % is not managed in an environmentally safe manner. Globally, waste produced per person per dayaverages 0,74 kilograms. High-income countries produce about 34 % or 683 million tonnes of the world's waste. Looking to the future, global waste is expected to rise to 3,40 billion tonnes by 2050, more than double the post-population increase over the same period. In the graph below, we can see that the trend in municipal solid waste production worldwide tends to increase. This is documented in more detail by geographical area in Figure 1 and Table 1.



Figure 1. Estimated waste production in the world by geographical area (million tonnes/year).

Source: Trends in solid waste management. datatopics.worldbank.org.

Table 1. Estimated waste production in the world by geographical area (million tonnes/year).

Geographical area	2016	2030	2050
Middle East & North Africa	129	177	255
Sub-Saharan Africa	174	289	516
Latin America & Caribbean	231	290	369
North America	289	342	396
South Asia	334	466	661

Europe & Central Asia	392	440	490
East Asia & Pacific	468	602	714

Source: Own processing according to Trends in solid waste management. datatopics.worldbank.org.

3.2. Waste production trends in Slovak Republic

The Circular Economy Institute (2021) states that the Slovak Republic is one of the least environmentally friendly countries in terms of waste management. Slovakia is one of the countries with the lowest waste sorting and recycling rates. The average recycling rate in the EU is 45 %, while in Slovakia it is only 39 %. 50 % of waste ends up in landfills without prior treatment and only 9 % of waste is energy-harvested. As an EU Member State, Slovakia has committed to meet the common waste sorting and recycling targets of sorting and recycling 50 % of municipal waste by 2020, 65 % of municipal waste by 2035, and only 10 % of municipal waste in landfill in 2035 (Institute for Circular Economy, 2021).

However, the current situation in Slovakia with municipal waste is critical. The amount of waste produced is increasing every year. In 2021, up to 2,7 million tonnes of municipal waste will be generated in Slovakia, which represents 497 kilograms of waste per person per year. In Table 2 we can see how the municipal waste curve has progressed over the last 10 years. The amount of municipal waste produced is given in million tonnes.

Table 2. Development of the quantity of municipal waste in the Slovak Republic (million tonnes/year).

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Quan-												
tity of	1,77	1,81	1,75	1,74	1,83	1,89	1,95	2,14	2,33	2,37	2,61	2,70
waste												

Source: Own processing according to https://slovak.statistics.sk/wps/portal/

More than two million tonnes of municipal waste are generated in Slovakia every year. Mixed municipal waste accounts for a high proportion of municipal waste. There is a gradual reduction in landfilling, as Slovakia has set a target of 10 % landfilling of municipal waste in 2035. In Table 3, we forecast the development of municipal waste production and management so that only 10 % of municipal waste is landfilled in the target year.

 Table 3. Forecast of the development of municipal waste production and management (tonnes)

Municipal waste management	2020	2025	2030	2035
Municipal waste production	2 374 688	2 505 587	2 644 916	2 793 217
Recycling	1 187 344	1 378 073	1 586 950	1 815 591
Energy recovery in incineration plants	254 000	254 000	254 000	254 000
Energy recovery in cement plants	150 000	20 000	200 000	200 000
Landfilling of waste	783 344	673 514	603 966	279 322
Remaining municipal waste	0	0	0	244 304

Source: Own processing according to Waste management programme of the Slovak Republic for 2021-2025

In 2035, there will be 580 kg of municipal waste per capita in Slovakia. With an estimated population of 5,385 million inhabitants (according to the Eurostat forecast), the total waste production should be 3,123 million tonnes. The estimate of 580 kg of municipal waste production is based on the AIC estimate for 2035 and on the correlation between actual individual consumption and annual per capita municipal waste production in EU countries from Eurostat data for 2000-2018.

A total of 2 597 457 tonnes of municipal waste will be generated in Slovakia in 2022. This represents a decrease of 3,99% compared to the previous year, 2021, when municipal waste production reached 2 705 327 tonnes. However, municipal waste production is growing in the long term. The last time municipal waste generation decreased year-on-year was in 2013. The current decrease is thus the first decline in municipal waste production in eight years. In the following tables, we present the development of municipal waste production and recovery by individual regions in Slovakia over the period 2019-2021. The data for the above tables were drawn from analyses carried out by WOOD & Company and the Statistical Office of the Slovak Republic. For the sake of clarity, we present the data in retrospect (year 2021, 2020, 2019).

Table 4. Proportion of recovered, disposed, and collected municipal waste in 2021 in the Slovak Republic

Region of the SR, 2021	Percentage of municipal	Percentage of municipal	Percentage of municipal
Region of the 3K, 2021	waste	waste	waste
	recovered	disposal	stored
Bratislava region	75,06	20,65	4,29
Trnava region	53,87	43,78	2,35
Trencin Region	50,64	48,09	1,27
Nitra Region	50,62	48,25	1,13
Zilina region	52,19	47,08	0,73
Banska Bystrica region	49,86	49,47	0,67
Presov region	55,06	44,07	0,86
Kosice region	68,15	31,01	0,84
Slovak Republic	57,63	40,69	1,68

Source: Own processing according to Statistical Office of the Slovak Republic.

The production of municipal waste in Slovakia also increased in 2020, a year marked by a pandemic, which some expected to see a temporary slowdown in the growth of waste production. However, more de-waste was produced despite the lockdown, when people spent more time at home. In 2020, there was 2,5 % more municipal waste per capita in Slovakia than in the record year of 2019 so far, and 1/3 more than a decade ago.

Table 5. Production and management of municipal waste in 2020 in the regions of the Slovak Republic

Region of the SR, 2020	Municipal waste production (kg/person)	Rates of municipal waste recov- ered (%)	Rates recycling of municipal waste (%)	Landfill rates (%)
Bratislava region	531	73,45	43,71	25,51
Trnava region	584	47,25	47,22	52,73
Trencin Region	431	42,65	42,45	57,33
Nitra Region	521	44,71	44,69	55,25
Zilina region	452	45,73	45,53	54,27
Banska Bystrica region	392	43,46	43,45	56,54
Presov region	349	42,49	41,91	57,47
Kosice region	363	66,76	39,36	33,24
Slovak Republic	446	51,44	43,96	48,39

Source: WOOD & Company, Statistical Office of the Slovak Republic

In 2019, 435 kg of municipal waste per inhabitant. According to the analysis, municipal waste generation has increased by 35 % in comparison over the last 10 years.

Table 6. Production and management of municipal waste in 2019 in the regions of the Slovak Republic

Region of the SR, 2019	Municipal waste production (kg/person)	Rates of municipal waste recov- ered (%)	Rates recycling of municipal waste (%)	Landfill rates (%)
Bratislava region	507	46,4	36,0	26,7
Trnava region	573	45,0	45,0	55,0
Trencin region	420	43,1	38,9	56,9
Nitra region	520	42,1	42,1	<i>57,</i> 9
Žilina region	451	43.6	43,6	56,4
Banska Bystrica region	381	41,2	41,2	58,8
Presov region	343	40,2	39,7	59,8

Kosice region	340	64,3	35,2	35,7
Slovak Republic	435	45,6	40,3	50,6

Source: WOOD & Company, Statistical Office of the Slovak Republic

4. Discussion

The negative impacts of waste of all kinds, which are natural in the production or consumption activities of human society, have focused attention on ways to reduce or avoid its generation altogether. It is therefore desirable to introduce new zero-waste or low-waste technologies aimed at making the most rational use of scarce natural resources and energy for the needs of human society, while rigorously protecting the environment. Linear production is a system whereby any product produced goes to landfill. It is currently the most widespread system in Slovakia. The principle of the circular economy is the return of material back to production or further processing.

It should be mentioned that nowadays there are only two waste-to-energy facilities in Slovakia, one in Košice and the other in Bratislava. Compared to European standards, this is a very low figure, and this is one of the reasons why Slovakia is one of the countries that landfill the highest quantities of waste. There are more than 340 waste-to-energy facilities in operation in Europe.

The Environmental Policy Institute (2020) has assessed that municipal waste will continue to grow modestly in the coming years, estimating that municipal waste generation will grow by about 2.5 % per year between 2025 and 2045. This growth is projected to be due to a higher population in Bratislava and higher consumption by residents. However, as municipal waste production grows, so will the recycling rate, which is expected to be around 36 % in 2045.

Even assuming an optimistic scenario, which foresees the 65 % recycling target being met in 2035, the weight of non-recyclable municipal waste will exceed 1 million tonnes. At the same time, Slovakia will be able to landfill a maximum of 10 % of municipal waste.

The authors of the analysis of the waste management in the Slovak Republic indicate the following trends, which are desirable to focus on in the current conditions of waste management in Slovakia:

- striving for the highest possible recycling rate and energy recovery of non-recyclable waste,
- efficient management of biodegradable waste,
- the creation of a mechanism to ensure that cities and municipalities have sufficient financial resources to deal with municipal waste management tasks,
- the creation of a functioning information system capable of providing up-to-date data on waste production and management,
- prefer solutions that provide real-time results and do not represent a commitment to the future,
- monitoring waste producers,
- to build a standardised network of collection yards as local centres of sorted municipal waste collection in as many towns and municipalities in Slovakia as possible,
- using information and communication technologies to provide Slovak municipalities with online information on the capacity utilisation related to municipal waste collection,
- optimisation of means and technologies for the collection and export of sorted municipal waste components,
- to solve the system of management of used clothing, textiles, e.g. to ensure that waste textiles become an additional component of the mandatory separate collection.

However, it should be recalled that a functional system of separate collection in municipalities and towns is only possible with its effective support. Municipalities alone do not have sufficient resources (technological, financial, human) to implement it.

5. Conclusions

When examining the basis for the application of modern trends in waste management, we focused on the development of municipal waste production in the world and in Slovakia. There are several options to address the current situation. The implementation of circular economy principles can bring new sources of revenue, save costs and create competitive advantage for enterprises. However, the transition to a circular economy in Slovakia is preceded by tackling the high proportion of waste going to

landfill, reducing the volume of waste produced and increasing the rate of sorting of municipal waste. The use of alternative and renewable energy sources is also coming to the fore. Businesses and citizens alike need to be made aware of the importance and significance of responsible behaviour and business conduct. Integrating social, environmental and ecological aspects into corporate activities, as well as into everyday activities, is very important in order to develop a good relationship with the environment.

Funding: "This research was funded by VEGA, grant number 1/0465/23 Generic, convergence and model approaches of environmental production and logistics in business development in Slovakia."

References

- 1. Abubakar, F. H. (2018). *An investigation into the drivers, barriers and policy implications of circular economy using a mixed-mode research approach*. PhD thesis, University of Sheffield. https://etheses.whiterose.ac.uk/20947/
- 2. Bicket, M. et al. (2014). Scoping study to identify potential circular economy actions, priority sectors, material flows and value chains. https://westminsterresearch.westminster.ac.uk/item/9v45q/scoping-study-to-identify-potential-circular-economy-actions-priority-sectors-material-flows-and-value-chain
- 3. Geng, Y., & Doberstein, B. (2008). *Developing the circular economy in China: Challenges and opportunities for achieving 'leapfrog development'*. The International Journal of Sustainable Development & World Ecology, 15(3), 231-239. https://www.tandfonline.com/doi/abs/10.3843/SusDev.15.3:6
- 4. Govindan, K., Soleimani, H., & Kannan, D. (2015). *Reverse logistics and closedloop supply chain: A comprehensive review to explore the future*. European Journal of Operational Research, 240(3), 603-626. https://www.sciencedirect.com/science/article/pii/S0377221714005633
- 5. The Circular Economy Institute. (2021). *Waste management analysis* 2021. https://www.incien.sk/wp-content/uploads/2020/11/analyza-odpad-hosp-2020-final.pd
- 6. Ministry of the Environment of the Slovak Republic. (2021). Waste management programme of the Slovak Republic for 2021-2025. https://www.enviroportal.sk/odpady/program-odpadoveho-hospodarstva-slovenskej-republiky-2021-2025
- 7. Potočár, R. (2021). *Waste production in Slovakia is skyrocketing. The forecast for the future does not please anyone.* https://www.odpady-portal.sk/Dokument/105826/
- 8. Preston, F. (2012). A global redesign? Shaping the circular economy. https://rb.gy/dnb72
- 9. Richnák, P. (2022). *Current Trend of Industry 4.0 in Logistics and Transformation of Logistics Processes Using Digital Technologies:* An Empirical Study in the Slovak Republic. Logistics, 6(4), 1-21.
- 10. Richnák, P., & Fidlerová, H. (2022). *Impact and Potential of Sustainable Development Goals in Dimension of the Technological Revolution Industry 4.0 within the Analysis of Industrial Enterprises. Energies:* Journal of Related Scientific Research, Technology Development, Engineering, and the Studies in Policy and Management], 15(10), 1-20.
- 11. Rizos, V., et al. (2015). *The circular economy: Barriers and opportunities for SMEs. CEPS Working Documents.* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2664489
- 12. The World Bank. (2023). *Trends in solid waste management*. https://datatopics.worldbank.org/what-a-waste/trends_in_solid_waste_management.html
- 13. Statistical Office of the Slovak Republic. (2022). *Waste in the Slovak Republic for 2021*. https://slovak.statistics.sk/wps/portal/

Industrial Organization: An Assessment of Current Situation within Slovak Advertising Sector

Vladimír Hojdik 1, Miroslav Uhliar 2

- ¹ Faculty of Business Management, University of Economics in Bratislava, Slovakia, vladimir.hojdik@euba.sk
- ² Faculty of Business Management, University of Economics in Bratislava, Slovakia, miroslav.uhliar@euba.sk
- * Correspondence: vladimir.hojdik@euba.sk

Abstract: This study evaluates the concentration dynamics within the Slovak advertising industry, exploring its implications for business competitiveness within the sector. Utilizing critical indices such as market share, concentration ratios and the Herfindahl index, the research aims to dissect the financial performance of Slovak advertising firms, assessing the industry's overall concentration to comprehend its competitive edge in Slovakia's economic landscape. The methodology integrates mathematical and statistical analyses, data manipulation via MS Excel, and the application of specialized concentration metrics. These techniques are instrumental in quantifying key parameters that reflect the industry's competitive milieu, particularly within the advertising sector. The process involves examining enterprises' market shares, followed by calculating the concentration ratios based on the dominant firms' market presence. The Herfindahl index, a measure of market concentration, serves as the composite metric. In essence, this paper strives to enhance understanding of Slovakia's advertising sector, offering insights into its economic positioning. By delineating market concentration contours and competitive scenarios, the study presents valuable knowledge for stakeholders and policymakers, underscoring the sector's significance in the broader economic context. This condensed perspective aims to prompt further consideration regarding the industry's strategic role in Slovakia's comprehensive economic framework.

Keywords: advertising industry, industrial organization, market concentration, Herfindahl index

Introduction

The creative industry, often referred to as the "creative economy," comprises businesses and individuals responsible for producing cultural, artistic, and innovative products and services. These sectors include visual and performing arts, literature, music, film, design, architecture, advertising, software, and video games, among others. Here we'll discuss the creative industry's characteristics in a global context and specifically in Slovakia, along with important influencing factors.

1. Theoretical background

Industry concentration, synonymously known as market concentration, delineates the degree to which a significant segment of economic activity (e.g., sales, assets, or employment) is attributed to the leading firms within a specific market or industry (Kvalseth, 2018). As articulated by the OECD (2003) the impetus for gauging market or industry concentration derives from industrial organizational economics. This theory posits that heightened market concentration levels, ceteris paribus, potentially foster monopolistic behaviors, precipitating resource misallocation and suboptimal economic efficacy. Consequently, market concentration serves as a barometer for market power.

An escalation in market concentration typically inversely correlates with competitive intensity and operational efficiency, while simultaneously amplifying market dominance. Such a dynamics warrants vigilant scrutiny from both corporate entities and regulatory bodies. Governmental antitrust agencies are particularly instrumental in overseeing these trends, safeguarding market integrity, and preemptively addressing anti-competitive practices or monopolistic market distortions (U.S DOJ & FTC, 2010). In this paper, we examine concentration of Slovak advertising sector, which is the subsector of creative industry.

The creative industry, often referred to as the "creative economy," comprises businesses and individuals responsible for producing cultural, artistic, and innovative products and services. These sectors include visual and performing arts, literature, music, film, design, architecture, advertising, software, and video games, among others (Antonova, Pchelintsev, 2023).

Creative industry described from international standpoint is related to following characteristics (Rozentale, Lavanga, 2014):

- it has wide economic impact
- it is highly innovative sector of economy
- it contains cultural diversity
- it is continually developing.

Creative industry may be described as developing economy branch which is facing a multiple challenges, but also as a sector of rich cultural heritage (UNCTAD, 2022).

Despite the continual industry growth, the global challenges persist. Among the most influential hurdles we can mention lack of coherent policy strategies, insufficient financial mechanisms, and market fragmentation. However, the sector has strong potential, particularly thanks to digital innovation and traditional arts, which may stimulate economic growth and cultural promotion in countries worldwide. There is a growing recognition of creative industry economic potential, leading to increased government initiatives especially in digital media, arts, and cultural heritage projects (Deloitte, 2021).

Access to finance, market development, and intellectual property rights are among critical challenges as well. Badia et al. (2018) emphasized the need for more targeted investments within creative industry, with the objective of improving entrepreneurial ecosystem for creatives, and fostering policies that protect and incentivize creative work.

The creative industry is an umbrella term that encompasses various sectors where creativity and intellectual capital are the primary production inputs. While these sectors share common characteristics, they are distinct in terms of their products, services, and value creation. In Slovakia, as in many countries, the creative industry includes several partial branches, mainly following (Ministry of Culture & Ministry of Economy of Slovak Republic, 2014; Madudová, 2015):

- Visual Arts
- Performing Arts
- Music
- Film, Video, and Photography
- Design
- Publishing and Literature
- Advertising and Marketing
- Software, Video Games, and Digital Media
- Architecture and Interior Design
- Radio and Television Broadcasting

Each of these sectors contributes to the cultural and economic landscape of Slovakia. The advertising industry, a vital cog in economic machine, operates at the intersection of technology's cutting-edge, consumer behavioral trends, and regulatory frameworks. In the global arena, digital platforms reign supreme, commanding a substantial share of advertising revenue due to their expansive reach and precision targeting, made possible by sophisticated data-driven strategies. However, this reliance on consumer data presents its challenges, necessitating navigation through a labyrinth of regulations aimed at safeguarding consumer privacy (Ministry of Culture & Ministry of Economy of Slovak Republic, 2014).

The advertising industry in the Slovak Republic consists of two fundamental components of the market cycle - the communication market and the media market. The former includes traditional communication agencies primarily engaged in the creation of creative advertising ideas and their implementation, PR agencies, agencies focused on promotion and marketing through events, and production companies. The latter is composed of media agencies whose main activity is the purchase of media space. The majority of the sector is made up of self-employed individuals or small businesses, although there are also joint-stock companies among the larger players. The advertising field is characterized by a fluid workforce - professionals from various creative industries (film, theater, literature, visual arts, photography, etc.) supply goods and services to various segments of the advertising industry, with

these activities constituting only a part of their work portfolio (Ministry of Culture & Ministry of Economy of Slovak Republic, 2014).

Based on Slovak legislation, advertising industry consists of smaller segments of business activities, which are recognized by specific codes known as SK NACE. Advertising industry therefore covers following activities (Statistical Office of Slovak republic, 2007):

- advertising agencies,
- market survey and public opinion survey,
- photographic activities,
- sale of broadcast time,
- services in the field of contact and communication with the public.

Both globally and in Slovakia, the advertising sector remains in a state of flux, continuously evolving in response to technological advancements, shifting consumer preferences, and the ever-changing regulatory terrain. Success hinges on adaptability, innovative strategy, and an unerring pulse on both local and global consumer currents.

2. Methods and methodology

The objective of this paper is to evaluate the current condition of the Slovak advertising sector, with a focus on elucidating aspects of market concentration. The research methodology is bifurcated into general and specific research techniques to ensure a comprehensive analysis.

The initial part of the research predominantly utilized general methodologies, including systematic analysis, comparative evaluation, and synthesis, to articulate fundamental concepts. This segment, inherently descriptive, delineates the contemporary landscape of the advertising sector within Slovakia, providing a foundational understanding for subsequent investigative processes.

In contrast, the fulfillment of the research's primary objectives necessitated the deployment of mathematical and statistical analyses. Then, the data processing was executed utilizing the computational framework provided by MS Excel. The final step of the study was quantification and subsequent implementation of critical indicators germane to this research, namely market share, concentration ratios, and the Herfindahl index.

These precise mathematical and statistical approaches facilitated the derivation of essential metrics indicative of the concentration levels within the advertising sector. The initial phase involved the computation of the market shares (denominated in percentages) of enterprises active within the advertising domain, predicated on the aggregate revenues of the entities under scrutiny. Subsequent stages involved the determination of an additional pivotal metric — the concentration ratio. The culmination of the analysis was the calculation of the Herfindahl index, a complex indicator for assessing the absolute concentration within an industry. Both the concentration ratio and the Herfindahl index are quintessential tools, frequently utilized for their efficacy in evaluating competitive intensity within various sectors (Bikker & Haaf, 2002).

The empirical findings derived from the quantification of mentioned indicators constituted the foundational basis for the interpretative assessment of market concentration phenomena among the entities within the Slovak Republic's advertising sector. This comprehensive approach ensures a nuanced understanding of market dynamics and competitive forces shaping the industry's landscape.

3. Results

This section encapsulates the empirical research conducted, delineating the methodologies employed in calculating market share, concentration ratios, and, ultimately, the Herfindahl index. The research cohort comprises enterprises formally registered within the advertising sector in the Slovak Republic. All quantitative evaluations have been executed utilizing data from the fiscal year 2021, owing to the unavailability of comprehensive data sets for all industry participants for the subsequent year, 2022. This temporal parameterization ensures the analytical consistency and data integrity necessary for the robust assessment of sectoral dynamics and competitive paradigms.

3.1. Indicators definition

Indicators assessing industry concentration are pivotal in evaluating the caliber of competition within an economy, enabling pertinent institutions to surveil the competitiveness of entities within

distinct economic sectors (MacKay & Phillips, 2005). The scholarly literature posits various methodologies for gauging industry concentration. This study focused on absolute concentration metrics, encompassing the concentration ratio and the Herfindahl index predicated on market share computations. These indices, derived from the aggregate revenues of individual enterprises, facilitate the determination of market share, subsequently informing the calculation of both the concentration ratio and the Herfindahl index (Kvalseth, 2018).

Market Share

Market share stands as a foundational parameter of market concentration, signifying an enterprise's proportion of total sector revenues, thereby offering comparative performance insights vis-à-vis other market entities. This metric is analytically articulated through a specific formula (Fendek & Fendeková, 2008):

$$r_k = \frac{q_k}{q} = \frac{q_k}{\sum_{j=1}^n q_j}$$

n denotes the number of companies within the sector,

 q_k represents the revenue of the k company (where k ranges from 1 to n),

q signifies the aggregate sector revenue, and

rk corresponds to the market share of the k company.

Market share manifests in two forms: a relative expression (ranging between 0 and 1) and a percentage (spanning from 0 to 100). These values demarcate the spectrum from a monopolistic scenario (rk=1) indicating total market concentration, to a void scenario (rk=0) suggesting no active market participants (Fendek & Fendeková, 2008). This study utilizes the percentage formulation of market share for analytical clarity and precision.

Concentration ratio

The concentration ratio epitomizes the cumulative market share appropriated by a subset of leading enterprises within an industry. The analytical formulation for computing the concentration ratio is delineated as follows (Fendek & Fendeková, 2008):

$$CR_{\psi} = \frac{1}{q} * \sum_{k=1}^{\psi} q_k$$

In this context, ψ resides within the interval <1;n>, and CR ψ assumes values within <0;1> for relative calculations, or <0;100> for percentage-based outcomes. Customarily, the concentration ratio is computed for the upper echelons of industry competitors, typically the three, five, or ten most formidable entities (manifested as indicators CR3, CR5, and CR10). However, certain scholarly inquiries advocate for the CR4 and CR8 indices, representing the four and eight most dominant market participants, respectively (Herfindahl, 1950; Hirschmann, 1964; Rhoades, 1993; Nauenberg et al., 1997). For the purposes of this investigation, the concentration ratio is articulated in terms of its percentage composition, enhancing interpretative lucidity and metric consistency.

Herfindahl index

The Herfindahl index, a nuanced metric, gauges absolute industry concentration and is interchangeably referred to as the Herfindahl-Hirschman Index in scholarly discourse (Grullon et al., 2017). Esteemed for its analytical precision, this index elucidates the influence of individual enterprises' revenues on overall industry concentration, operating by squaring each entity's market share and aggregating these figures (Cavalleri et al., 2019).

The index's mathematical formulation is articulated as follows (Fendek & Fendeková, 2008):

$$H = \sum_{k=1}^{n} \left(\frac{q_k}{q}\right)^2$$

The index H oscillates between <1/n, 1>, with the nadir H = 1/n indicating uniform market share distribution across firms, and the zenith H = 1 denoting a monopolistic market structure. To accommodate industries' broad spectra of firm quantities, H often undergoes normalization via multiplication by a factor, typically 10,000, to yield pragmatic, interpretable figures.

This recalibrated H informs industry concentration assessments, guided by benchmarks established by the US Federal Trade Commission (2010):

- H < 1500: non-concentrated industry,
- $1500 \le H < 2500$: moderately concentrated industry,
- $H \ge 2500$: highly concentrated industry.

These thresholds significantly influence governmental competition regulatory frameworks (Mac-Kay & Phillips, 2005).

Initially conceptualized by O. C. Herfindahl in the mid-20th century, the index's foundational principles echo earlier work by A. O. Hirschman, leading to occasional terminological variations in literature—though the underlying analytical construct remains consistent. The Herfindahl index's versatility is evidenced in its recurrent application across diverse sectors, as banking (Aijde & Ajileye, 2015; Williams et al., 1994; Rianto & Awwaliyah, 2019) automotive (Hojdik, 2020; Rolim et al., 2019), biomass (Busu, 2020), tour operator (Derco, 2022), power energy (Kaszynski et al., 2023), manufacturing (Fedderke & Naumann, 2011) industries. However, its applicability is confined to geographically delineated markets, precluding its use in broader international contexts due to potential analytical distortions (Aghion et al., 2005).

3.2. Indicators quantification

Market share, a key indicator of business performance within an industry, is derived from company revenues, as detailed below in Table 1. This table presents the market shares of the ten most formidable players in Slovakia's advertising sector, expressed in percentages. These figures not only depict the individual company's economic footprint within the industry but also provide insights into the competition intensity of the sector.

Table 1 Market share of TOP 10 companies in advertising sector in 2021

Rank	Company	Total Revenues	Market Share (%)
1	Unimedia, s.r.o.	57 067 963	4.14
2	Merck Sharp & Dohme, s.r.o.	45 036 238	3.27
3	JandL, marketing a reklama, s.r.o.	40 485 869	2.94
4	Dual Production, s.r.o.	31 702 457	2.30
5	Novo Nordisk Slovakia, s.r.o.	29 683 965	2.15
6	ZenithMedia, s.r.o.	28 633 419	2.08
7	VivaKi Exchange, s.r.o.	26 823 356	1.94
8	K-TOM FOOD, s.r.o.	26 189 982	1.90
9	Wavemaker, s.r.o.	26 036 572	1.89
10	MediaCom Bratislava, s.r.o.	24 744 881	1.79

Source: finstat.sk

The concentration ratio within any industry is reflective of the market shares held by the top entities. In the case of Slovakia's advertising industry, Table 2 elucidates the concentration ratios for 2021, derived from the revenues of the firms during the stipulated period.

Table 2 Concentration ratio for Slovak advertising industry in 2021

Concentration ratio	Value (%)
CR3	10.34
CR5	14.79
CR10	24.39

Source: own calculations

The final phase of the analysis involves computing the Herfindahl index, a crucial measure for assessing industry concentration. Initially, the total count of enterprises within the sector was established at 5,726 (n = 5,726), indicating a substantial number of market participants. This high count underscores the relevance of applying the Herfindahl index as a meaningful metric. In situations with fewer businesses, the index's applicability diminishes, often signaling an oligopolistic market structure. The calculated Herfindahl index for the Slovak advertising sector, derived from prior steps, is documented in Table 3.

Table 3 Herfindahl index for Slovak advertising industry in 2021

Herfindahl index	Value
H (index)	0.00921
H (multiplied)	92.19

Source: own calculations

4. Discussion

The advertising sector in Slovakia presents a landscape of balanced competition rather than dominance by any single entity. Revenues appear to be distributed evenly among various players, preventing market polarization. In 2021, Unimedia, s.r.o. led the industry, securing a 4.14% market share, yet without asserting overwhelming control. Following closely, Merck Sharp & Dohme, s.r.o. commanded 3.27% of the market, with JandL, marketing a reklama, s.r.o. in third at 2.94%. Interestingly, MediaCom Bratislava, s.r.o., despite a modest 1.79% market presence, ranked within the top ten, underscoring the intense competitiveness in the sector. A more granular examination reveals a total of 5,726 enterprises operating within Slovakia's advertising sector in 2021, of which 4,475 reported positive revenues, further emphasizing the sector's competitive vitality.

The CR3 ratio, indicative of the market percentage held by the top three enterprises, stands at 10.34% for the local advertising realm. Expanding the analysis, the CR5 ratio is calculated at 14.79%, while the CR10 reveals that the ten preeminent companies command 24.39% of the market. This scenario translates into a quarter of the entire Slovak advertising sector being governed by ten firms, highlighting a moderate level of market concentration without tipping the scale towards oligopolistic dominance.

The Herfindahl index provides a comprehensive evaluation of industry concentration levels. For the period under scrutiny, specifically the year 2021, the Herfindahl index registered at 92.19 (post-adjustment with a 10,000 multiplier). Adhering to the established guidelines from the U.S. Department of Justice and Federal Trade Commision (2010), the industry unequivocally falls into the 'non-concentrated' category, as the index values substantially fall below the 1500 threshold. This categorization is further bolstered by additional criteria suggesting that a Herfindahl index below 1800 typifies a non-concentrated industry.

The values deduced for the Slovak advertising sector consequently designate it as a non-concentrated, or rather, a low-concentration industry. Currently, the sector is characterized by the presence of almost six thousand enterprises, none wielding overriding market dominance. Specifically, no single entity or conglomerate holds sufficient clout to restrict market expansion activities of other players. Ultimately, the Slovak advertising sector enjoys a high degree of competition, creating an environment conducive to business for all entities involved.

5. Conclusions

The study confirms that the Slovak advertising sector thrives on heightened competition, not swayed by a minority of dominant entities. Analysis and substantiation of relevant indicators affirm that this sector exemplifies a non-concentrated industry. This conclusion, beyond the calculated indicators, is underpinned primarily by two observations: (1) the sector's bustling activity, with business numbers soaring past 5,000, and (2) a balanced distribution of market influence among competitors.

Aligning with the Herfindahl index's interpretative framework, the sector categorically fits into the segment of non-concentrated industries, indicative of vibrant competitive dynamics and a favorable business environment. Although the sector has demonstrated consistent growth trajectories in recent

years, forecasting the future remains a complex endeavor. The advertising industry faces several impending challenges that could significantly reshape its landscape, especially considering the rapid technological advancements and shifting consumer behaviors globally (digital transformation, data privacy regulations, consumer preferences changes, pressures for sustainable advertising, economic uncertainty).

In the fast-paced advertising industry, maintaining competitive edge hinges on several core strategies. Embracing technological advancements, particularly in AI and immersive technologies, is essential for personalized, effective campaigns. Equally crucial is the stringent observance of data privacy norms to safeguard consumer trust and compliance. Today, companies must resonate with consumers' ethical and social sensibilities, necessitating authentically value-driven content that aligns with environmental and social consciousness.

Operational flexibility, a willingness to adapt swiftly to market changes, and a diversified approach to media channels are fundamental to staying relevant for advertising businesses. Continuous learning within the organization and strategic external collaborations amplify a company's reach and adaptability. Ultimately, firms that integrate these principles—adaptability, technological adeptness, and ethical business practices—will be best equipped to succeed in turbulent advertising landscape.

Funding: This research was funded by research grant VEGA 1/0582/22, entitled "Dimensions of cross-sectoral entrepreneurship of cultural and creative industry entities in the context of sustainable development".

References

- 1. Antonova, I. S., & Pchelintsev, E. A. (2023). Econometric Modeling of Creative Industries Concentration Process in the Siberian and the Urals Single-Industry Towns. *Mathematics*, 11(17), 3704. DOI: http://dx.doi.org/10.3390/math11173704
- 2. Aijde, F. M. & Ajileye, J. O. (2015) Market concentration and Profitability in Nigerian Banking Industry: Evidence from Error Correction Modeling. *International Journal of Economics, Commerce and Management* 3, 1-12.
- 3. Aghion, P., Bloom, N, R. Blundell, R. (2005), Competition and Innovation: An Inverted-U Relationship. *Quarterly Journal of Economics* 120 (2),701-728 DOI: 10.1093/qje/120.2.701
- 4. Badia, F., Landi, T., Bartolucci, E. (2018). Challenges for cultural and creative industries: Sustainability, business model innovation and policy changes. August 2018. *Conference: 10th International Conference on Cultural Policy Research (ICCPR 2018)* Tallinn.
- 5. Bikker, J. A. & Haaf, K. (2002). Competition, concentration and their relationship: an empirical analysis of the banking industry. *Journal of Banking and Finance* 26, 2191-2214 DOI:10.1016/S0378-4266(02)00205-4
- 6. Brezina, I., Oršulová, A., Pekár, J. (2009). Analýza absolútnej koncentrácie vybraného odvetvia pomocou Herfindahlovho-Hirschmannovhio indexu, *Ekonomický časopis*, 57 (1), pp. 77-94.
- 7. Brezina, I., Pekár, J., Čičková, Z., Reiff, M. (2016). Herfindahl-Hirschmann index level of concentration values modification and analysis of their change, *Central European Journal of Operations Research* 24, 49-72 DOI: 10.1007/s10100-014-0350-y
- 8. Busu, M. (2020). A Market Concentration Analysis of the Biomass Sector in Romania. *Resources*, 9 (6) 64 DOI: https://doi.org/10.3390/resources9060064
- 9. Cavalleri, M. C., Eliet, A., McAdam, P. (2019). Concentration, market power and dynamism in the euro area. *ECB Working Paper Series, Discussion Paper No.* 2253, European Central Bank DOI:10.2866/379250
- 10. Derco, J. (2022). The Impacts of the COVID-19 Pandemic on the Tour Operator Market—The Case of Slovakia. *Journal of Risk and Financial Management, 15*(10), 446. MDPI AG. Retrieved from http://dx.doi.org/10.3390/jrfm15100446
- 11. Deloitte (2021). The Future of the Creative Economy., Deloitte LLP, United Kingdom.
- 12. Fedderke, J. & Naumann, D. (2011). An Analysis of Industry Concentration in South African Manufacturing 1972-2001, *Applied Economics* 43, 2919-2939 DOI: 10.1080/00036840802631835
- 13. Fendek, M. & Fendeková, M. (2008). Mikroekonomická analýza. Iura Edition, Bratislava, 2008.

- 14. Finstat.sk (2023). Database of Slovak Businesses and Organizations. Available at https://www.finstat.sk>
- 15. Grullon, G., Larkin, Y., Michaely, R. (2017). Are US industries becoming more concentrated? Forthcoming, Review of Finance.
- 16. Herfindahl, O. C. (1950). Concentration in Steel Industry: Unpublished Ph.D. dissertation, Columbia University, USA.
- 17. Herfindahl, O. C. (1964). Copper Costs and Prices: 1870-1957. Baltimore, The John Hopkins Press, 1964.
- 18. Hirschmann, A. O. (1964). The Paternity of an Index, American Economic Review 54, 761-762.
- Hojdik, V. (2020). Evaluation of Slovak Automotive Industry Competitiveness Based on Market Concentration Indicators. SHS Conferences 83: Current Problems of the Corporate Sector 2020: 17th Scientific Conference. – Paris: Edition Difussion Presse Sciences. DOI: 10.1051/shfconf/20208301022
- 20. Kaszyński, P., Komorowska, A., & Kamiński, J. (2023). Revisiting Market Power in the Polish Power System. *Energies*, *16*(13), 4856. DOI: http://dx.doi.org/10.3390/en16134856
- 21. Kvalseth, T. O. (2018). Relationship between concentration ratio and Herfindahl-Hirschman index: A re-examination based on majorization theory. *Heliyon*, 4 (2018) e00846. DOI: 10.1016/j.heliyon.2018.e00846
- 22. MacKay, P., Phillips, G.M. (2005). How Does Industry Affect Firm Financial Structure? *The Review of Financial Studies*, *18*, (4) DOI: 10.1093/rfs/hhi032
- 23. Madudová, E. (2015). Teoretické východiská vymedzenia kultúrneho a kreatívneho priemyslu v Slovenskej republike. *Pošta, Telekomunikácie a Elektronický obchod.* DOI: 10.26552/pte.C.2015.1.4
- 24. Ministry of Culture & Ministry of Economy of Slovak Republic (2014). Stratégia rozvoja kreatívneho priemyslu v SLovenskej republike. Bratislava, Slovakia.
- 25. Nauenberg, E., Basu, K., Chand, H. (1997). Hirshmann-Herfindahl Index Determination under Incomplete Information, *Applied Economics Letters*, 4 (10), 639-642 DOI: 10.1080/758533291
- 26. OECD. (2018). Infrastructure Investment (Indicator). DOI: 10.1787/b06ce3ad-en
- 27. Rhoades, S. (1993). The Herfindahl-Hirshmann index, Federal Reserve Bank of St. Louis, 52 (3), pp. 188-189.
- 28. Rolim, Z. E. L., Oliveira, R. R., Oliveira, H. M. (2019). Industrial Concentration of the Brazilian Automobile Market and Positioning in the World Market, Working Paper DOI:10.13140/RG.2.2.11210.11207
- 29. Rozentale, I., Lavanga, M. (2014). The "universal" characteristics of creative industries revisited: The case of Riga. City, Culture and Society, DOI: http://dx.doi.org/10.1016/j.ccs.2014.05.006
- 30. Rianto Al Arif, M. N., Awwaliyah, T. B. (2019). Market share, concentration ratio and profitability: Evidence from Indonesian Islamic Banking Industry. *Journal of Central Banking Theory and Practice*, 2, 189-201 DOI: 10.2478/jcbtp-2019-0020
- 31. Statistical Office of Slovak Republic (2007). Statictical Classification of Economic Activities SK NACE Rev. 2. Bratislava, Slovakia.
- 32. U.S. Department of Justice and Federal Trade Commision. (2010). Horizontal Merger Guidelines.
- 33. Wengle, M., Petry, Ch., Schwegler, R. (2019). Inrate Sector Analysis: Transportation. Zurich, Switzerland, 2019.
- 34. Williams, D. M. L., Molyneux, P., Thornton, J. (1994). Market Structure and Performance in Spanish Banking. *Journal of Banking and Finance*, 18, 433-443 DOI:10.1016/0378-4266(94)90002-7

Interest rate development and their impact on business decision-making

Anna Polednáková 1

Affiliation 1 (Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia); anna.polednakova@euba.sk

Abstract: The aim of the contribution is to analyse the impact of low interest rates on the use of credit resources in companies in the automotive industry and to demonstrate a possible correlation between interest rates and corporate indebtedness, which affects the quantitative results of companies. The paper points to the development of bank loan interest rates and defines the causes of the persistent period of low interest rates. Such an environment in the financial markets led companies to take on more debt through bank loans, which subsequently had a positive or negative effect on their financial results. The stated assumption, which we expressed through hypotheses, was subsequently investigated using statistical methods. The intention was to examine the relationship between bank loans and long-term assets, as well as to find out what effect the use of credit resources at low interest rates has on the return on equity (ROE) of companies in the selected industry /automotive industry. /

Keywords: interest rates; bank loans; indebtedness; profitableness, ROE.

Introduction

One of the most important strategic decisions made by every company is the choice of funding sources for its business activities. Effective management of resources by companies leads to the achievement of their set short-term or long-term goals, which is to increase the value of the company. Finally, it also ensures sufficient liquidity. The most used debt source of business financing in Slovakia is a loan. Loans are mainly used by small and medium-sized enterprises, for which it is a relatively quick and easy way of financing.

The interest rate is one of the factors that affects companies when deciding on drawing debt resources. Currently, banks are in a situation where they must fight in a competitive battle for their customers, they are willing to reduce the conditions for granting loans. They often provide loans to less creditworthy clients. In addition, we have been dealing with the low interest rate environment prevailing in the financial markets for several years. It is the result of the policy of the European Central Bank (ECB), which in this way tries to support and stimulate the economy. This creates an opportunity for companies to obtain relatively cheap foreign capital. At the same time, one should not forget that low to zero interest rates have a significantly negative impact on financial stability.

The aim of the presented contribution is to analyse the impact of low interest rates on the use of credit sources for financing companies from the automotive industry. Finally, it focuses on the relationship between loans and long-term assets as well as between financial leverage and return on equity-ROE. The intention is to identify suitable periods of development in the financial markets, which will allow companies to appreciate their own capital.

1. Theoretical background

The last financial crisis, which started in 2008 in the USA, was initially resisted by Europe, but later its impact began to be felt in the eurozone. In Europe, a crisis plan was launched, based on which banks had to maintain larger capital reserves. Slovakia has joined several member states that have announced

that the state will guarantee all bank deposits in full. In parallel, six central banks of the world, including the ECB, coordinated a reduction of the base interest rate by half a percentage point (Euractiv, 2016).

However, these problems started much earlier. Most analysts state that, in the long term, this financial crisis was caused by the wrong policy of low interest rates, which the FED led by Alan Greenspan chose after 2000 (Lawson, Zimková, 2008). Banks lowered interest rates at the initiative of the government, which was trying to prevent a global economic recession, and loosened the criteria for granting loans. The criteria were gradually reduced until interest rates were reduced to one percent, which caused a money-lending frenzy. Investors made risky investments and banks had a liberal attitude towards lending.

Interest rates have a significant impact on financial stability. Currently, interest rates are being reduced again not only by the American but also by the European central bank. The ECB keeps interest rates at zero to negative levels to stimulate and support the economy. And it will do so until inflation in the Eurozone reaches two percent, which will take several more years. Long-term maintenance of low interest rates has a very negative effect on financial stability. It is also for this reason that there are threats of another financial crisis, which should appear in the next few years.

In the Slovak banking sector, the prevailing business model is based on accepting deposits and granting loans. Trading thus forms only a small part of the activities. Because of this, banks are dependent on interest income and therefore interest rates have a direct impact on their interest margins. In addition to the competitive struggle of banks, the ECB also has an influence on the level of interest rates in Slovakia. Currently, the competition between banks is fierce. If any of the banks tried to increase interest rates and thus also their interest margins, the competing bank would take the opposite step, i.e. lower interest rates in order to gain or keep a client. The ECB, in turn, makes decisions on base rates that influence the decisions of commercial banks. The base interest rate is the rate called Main refinancing operations. The change in official interest rates affects the interest rates on loans and deposits that banks set for their customers. The year 2018 saw a stable growth rate of business loans due to strong demand, which reflected the favourable economic situation, and due to low interest rates. In 2018, interest rates were increased by one percentage point. Most of them were loans to large companies, but interest rates for small and medium-sized companies also increased to a lesser extent.

The beginning of 2019 brought a slowdown in loan growth due to concerns about further economic developments. Národná banka Slovenska (2019) reports that interest rates on corporate loans did not change significantly during the first half of 2019, with a level of 2.45% as of June 2019. Excluding peripheral countries (Ireland, Greece, Malta, Cyprus), interest rates are on loans from domestic banks, the second highest, but comparable to the Baltic countries. In the monitored period of 2019, the average interest rate was 1.8% p.a. a., which represents its decrease by 0.3 percentage points. In the monitored years, the lowest interest rate for loans over one million euros was recorded in the first quarter of 2019 with an average value of 1.5% p. a. (National Bank of Slovakia, 2019). and interest rates saw an increase only within historical volatility. From 2021, the growth of interest rates is already evident, even though the value of loans grew slightly. Currently, interest rates are above 2.60%. As for companies in the automotive industry compared to other industries/ for example, the electrical engineering and information and communication industry/ the interest rate at which these companies borrowed was at the level of 1.82%. As part of the research, we also compared compliance with the desired relationship, i.e., the profitability of equity capital should be higher than the profitability of total capital, and it should be higher than the interest rate at which the company obtained debt resources (RVK > RCK > i).

In individual years /2016-2022/, there were always a maximum of 2 companies that achieved that the cost of foreign capital was higher than the profitability of the total capital. We can state that it paid off

to increase the share of foreign capital, and thus indebtedness at low interest rates, as the effect of financial leverage increased the profitability of equity capital.

Table no. 1 Development of the value of loans and the average interest rate in the years 2013-2023
--

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Total loan value (v mil. €)	15,56	15,44	16,38	16,75	18,02	19,30	19,97	19,52	21,30	20,87	21,98
Average interest rate (v % p.a.)	3,41	3,26	2,83	2,60	2,41	2,45	2,38	2,29	2,27	2,54	-

Source: own processing according to Národná banka Slovenska. Statistical data of monetary financial institutions - Loans. [electronic resource]. [cit. 2021-02-17]. 2021. Available at: https://www.nbs.sk/sk/statisticke-udaje/financne-institucie/banky/statisticke-udaje-penazných-financnych-institucii for the period 2013-2023

2. Methods and methodology

The aim of the submitted contribution is to define the influence of interest rates on the decision-making of companies in the automotive industry and to demonstrate a possible relationship between the current situation of low interest rates and higher indebtedness of companies, which has a direct impact on their profitability.

In the contribution, we deal with the following question: Has the growth of corporate indebtedness affected the profitability of their own capital? During its activity, every company strives for the most effective evaluation of its own capital, which can be monitored through the ROE indicator. This indicator is especially important for the companies themselves. It is influenced by the amount of foreign capital and partly also by the decision of the management of the company itself on the distribution of equity. The financial leverage indicator, which expresses the ratio of the company's own and foreign resources, tells us about the company's indebtedness. We assume that increasing the indebtedness of companies that used debt resources at given interest rates will have an impact on the growth or decline of the ROE indicator, depending on the financial situation of the company (prosperous/non-prosperous company). In the research question, we focused on whether financial leverage positively/negatively. The object of investigation is a sample of companies from the automotive industry, in which we analysed a period of five years (2016, 2017, 2018, 2019, 2020). The sample of companies was selected based on precisely defined criteria, so that it was possible to compare different industries/ electrotechnical and information-technical indus-

tries/.

Data processing was performed using Microsoft Excel and PSPP statistical software, which is used to analyse the input data and the relationships between them using statistical methods. Correlation analysis was used to examine the relationship between two variables. By using this analysis, we can find out if there is a relationship between

the relationship between two variables. By using this analysis, we can find out if there is a relationship between the determined variables, i.e., if one variable affects another variable. Regression analysis examined the causal relationship, which we can also calculate mathematically.

We can calculate the relationship between the investigated variables using the following equation:

¹ From to 1 to 8 month of 2023

 $Y = b_0 + b_1 * X + e$

where: Y – dependent variable; X – independent variable; b0 – the point where the regression line intersects the y axis (expresses the value of variable Y if variable X is equal to zero); b1 – the direction of the regression line (expresses how the variable Y will change if the variable X increases by one unit), e – the estimation error. In the case if b1 < 0, we speak of negative dependence. In the opposite case, i.e., if b1 > 0, it is a positive dependence. We estimate the statistical significance of the linear regression model using the F-test of statistical significance of the model ($\alpha = 0.05$) (Andrejiová, 2016). We compare the F-test value calculated during the regression analysis with the table value according to the level of significance and degree.

We estimate the statistical significance of the linear regression model using the F-test of statistical significance of the model (α = 0.05) (Andrejiová, 2016). We compare the F-test value calculated during the regression analysis with the table value according to the level of significance and degrees of freedom.

3. Results

In the correlation analysis, we worked with two variables, namely the financial leverage and ROE indicators. Financial leverage expresses what part of total assets is made up of equity capital, and thus tells about the ratio of equity and foreign capital. The ROE indicator represents the appreciation of equity capital. We calculated both indicators using the method of financial ratio indicators. We applied the following relationships to calculate the indicators:

Leverage = assets/(equity)

ROE= (profit for the accounting period after tax)/(equity) * 100

We drew information on individual items in the formulas from the financial statements of companies for the analysed period of four years. We calculated the values of correlation coefficients for individual years and then averaged these values.

In the case of regression analysis, it was necessary to determine which of the variables is dependent and which is independent. In the scientific question, we examine the relationship between financial leverage and ROE. We assume that the growth of the financial leverage indicator, which represents an increase in the share of foreign resources drawn at low interest rates, will have a positive/negative impact on ROE. Based on this, financial leverage is the independent variable and ROE is the dependent variable.

Table 2 Results of correlation analysis of financial leverage and ROE

	(r)	R Square (r ²)	Sigma 2-tailed (p)	N
2016	0,62	38,44 %	0,017	14
2017	0.66	43.56 %	0.011	14
2018	0,54	29,16 %	0,049	14
2019	0.51	26.01 %	0.060	14
2020	0,52	27,13 %	0,054	14
Mean	0,57	34,57 %		

Source: Own construction.

Comment: r - Correlation Coefficient; $r^2 - Coefficient$ of Determination; p - Sigma 2-Tailed; N - Quantity.

In the automotive industry, a strong correlation was achieved between the investigated variables. In all years, the value of the coefficient was positive, which indicates direct dependence, and thus the growth of financial leverage caused the growth of ROE. The strongest dependence was in 2017 (r = 0.66). In 2019, on the contrary, the relationship between the variables was the weakest (r = 0.51), but the level of significance (sigma) was slightly above the recommended value. The probability of randomness of the results was six percent, and therefore we consider the result in 2019 to be statistically insignificant and did not include it in the calculation of the average value. The average correlation coefficient was 0.57, which represents a strong correlation dependence between financial leverage and ROE.

Overall, we can conclude that the increase in corporate indebtedness at lower interest rates, which was reflected in the growth of the financial leverage indicator, had an impact on increasing the ROE of companies in the automotive industry. Financial leverage in 2019 had no impact on ROE.

	\mathbf{b}_0	b ₁	Regresná funkcia	Typ závislosti
2016	13,28	2,87	Y = 13,28 + 2,87 * 1,60	$b_1 > 0$ positiv
2017	14,94	2,07	Y = 14,94 + 2,07 * 5,39	b ₁ > 0 positiv
2018	10,66	2,68	Y = 10,66 + 2,68 * 3,69	$b_1 > 0$ positiv
2019			-	
2020	12,56	2,73	Y = 12.56 + 2.73 * 4.23	$b_1 > 0$ positiv

Table 3 Results of regression analysis of financial leverage and ROE

Source: own processing based on the results of regression analysis, regression analysis in the automotive industry

A positive dependence was demonstrated in all the investigated years. The strongest dependence and tightness were achieved in 2017, when the correlation coefficient pointed to a strong dependence between variables. In this year, the regression function had the form Y = 14.94 + 2.07 * 5.39 = 26.10 and indicates that if the financial leverage were zero, the ROE would have a value of 14.94%. But if financial leverage were to increase by one unit, ROE would increase by 2.07 * 5.39 = 11.16%. The smallest tightness and dependence were in 2018, when the regression function had the form Y = 10.66 + 2.68 * 3.69 = 20.55. It means that if the financial leverage were zero, then the ROE would be at the level of 10.66%, but if the financial leverage increased by one unit, then the ROE would increase by 2.68 * 3.69 = 9.89%.

Based on the results of the regression analysis, we can claim that the increase in financial leverage, which represents the growth of the share of foreign resources drawn at lower interest rates, positively affects the ROE of companies in the automotive industry.

From the results of the correlation and regression analysis, we can conclude that there was a dependency between the investigated variables in the automotive industry. We therefore decided to investigate in more detail the reason for the difference in these results. In the hypothesis, we focused on ROE. It is an indicator that can be transformed and thus expressed through separate indicators. This indicator decomposition is called the second Du Pont equation.

In individual industries and in the group of loss-making companies, we calculated these five indicators for the period we analysed, and then we calculated the coefficient of determination, which told us how many percent of ROE variability these indicators explained. ROE represented the dependent variable and the other indicators, i.e., operating profitability of sales, asset turnover, interest reduction of profit, financial leverage, tax reduction of profit represented independent variables. The indicators with the highest value of the coefficient of determination explained the most variability of the ROE examined by us.

Correlation and regression analysis in the automotive industry demonstrated the dependence between financial leverage and ROE, which was also confirmed by the results of the coefficient of determination. We can conclude that financial leverage was the indicator that explained the most variability of ROE in 2017 and 2019. In the remaining years, operating profitability of sales prevailed, but financial leverage also had a significant share in variability.

		Automotive industry								
	2016	2017	2018	2019	2020					
EBIT/S	0.48	0.12	0.33	0.16	0,38					
TR/CA	0.39	0.37	0.02	0.00	0,17					
EBT/EBIT	0.03	0.03	0.01	0.02	0,02					
CA/VI	0.39	0.43	0.27	0.26	0,27					
EAT/EBT	0.43	0.02	0.05	0.03	0,14					

Table 4. Coefficient of determination of indicators in the automotive industry

Source: own processing based on the results of regression analysis, regression analysis in the automotive industry

Explanations: EBIT/TR – operating profitability of sales, TR/CA – turnover of total assets, EBT/EBIT – interest reduction of profit, CA/VI – financial leverage, EAT/EBT – tax reduction of profit.

4. Discussion

Based on a scientific assumption, we analyzed the relationship between the financial leverage indicator and the ROE indicator. In the automotive industry, the hypothesis was confirmed in three of the five years examined, and thus the increase in indebtedness at low interest rates, which was reflected in the growth of financial leverage, had a positive effect on ROE. The reason is mainly the sample size, where even a small change between the data will be significantly reflected in the correlation. By decomposing the ROE indicator, we concluded that, compared to other industries / for example, electrotechnical and information technology, another indicator most determined the creation of profitability, and that was the interest reduction of profit. The relationship to financial leverage was negligible and the external factor had a greater influence.

5. Conclusions

Strategic use of financial resources is the key to the success of any business. Bank loans are among the most used debt sources of business financing. Interest in loans between businesses is growing every year. The reason is the state of the banking sector, where high competition between banks and low

interest rates prevails. Interest rates are at historically low levels. Currently, interest rates are rising, but their significant increase is not expected. The ECB's intention is to encourage banks not to create excess reserves, but to provide funds to clients to support the economy. Interest rates that drive investment decisions and therefore have a greater impact on the economy tend to have longer maturities. Therefore, to affect the economy, monetary impulses must first be transferred from the money market to the capital market.

By evaluating the impact of indebtedness expressed through financial leverage on the ROE indicator of companies, we concluded that increasing indebtedness at low interest rates has a positive effect on the ROE indicator in the case of profitable companies from the automotive industry.

Overall, we have concluded that the environment of low interest rates in the financial markets creates suitable conditions for obtaining cheap foreign capital, which contributes to making investments and is profitable for companies at the same time. However, this only applies to those businesses that are financially sound and follow the established rules between debt and profitability.

References

- 1. Andrejiová, M. (2016). Štatistické metódy v praxi. Košice: Equlibria. ISBN 978-80-553-3078-5.
- 2. EURACTIV (2016). *Finančná kríza*. Bratislava: EURACTIV. https://euractiv.sk/section/ekonomika-a-euro/linksdossier/financna-kriza-000227/
- 3. Rimarčík, M. (2007). Štatistika pre prax. Košice: Marián Rimarčík. ISBN 978-80-969813-1-1.
- 4. EUROPEAN CENTRAL BANK. ECB Staff Macroeconomic Projections for the Euro Area September 2019. [online]. Frankfurt am Main: European Central Bank, 2019. [cit. 29.11.2019].https://www.ecb.europa.eu/pub/projections/html/ecb.projections201909_ecbstaff-0ac7cbcf7a.sk.html#toc3>.
- 5. RYCHTÁRIK, Š. *Vplyv nízkych úrokových sadzieb na finančnú stabilita na Slovensku.* [online]. Bratislava: National Bank of Slovakia, 2017. [cit. 25.11.2019]. https://www.nbs.sk/_img/Documents/_PUB-LIK_NBS_FSR/Biatec/Rok2017/032017 /Biatec_17_03_01rychtarik.pdf>.
- 6. FINSTAT. *Firmy s finančnými údajmi databáza hospodárskych výsledkov slovenských firiem.* [online]. Bratislava: FinStat, 2021. https://finstat.sk/databaza-financnych- udajov>.
- 7. Lawson, C., Zimková, E. (2008). *Medzinárodná finančná kríza a jej potenciálny vplyv na slovenský bankový sektor.* BIATEC odborný bankový časopis, 16, s. 21–27.
- 8. Národná banka Slovenska. (2016). Štatistický bulletin rok 2015. Bratislava: Národná banka Slovenska. https://www.nbs.sk/_img/Documents/_Publikacie/BulletinMFS/2015/BulletinMFS_122015.pdf
- 9. Národná banka Slovenska. (2019). *Správa o stave a vývoji finančného trhu. 1. polrok 2019.* Bratislava: Národná banka Slovenska. Dostupné z: https://www.nbs.sk/_img/Documents/_
- 10. Dohlad/Makropolitika/Sprava_o_stave_a_vyvoji_FT_za_1.polrok_2019.pdf
- 11. Národná banka Slovenska (2016) *Štatistický bulletin rok* 2016. Bratislava: Národná banka Slovenska. Dostupné z: http://www.nbs.sk/_img/Documents/_Publikacie/BulletinMFS
- 12. /2017/BulletinMFS_032016.pdf
- 13. Národná banka Slovenska (2017) *Štatistický bulletin rok 2017.* Bratislava: Národná banka Slovenska. Dostupné z: http://www.nbs.sk/_img/Documents/_Publikacie/BulletinMFS
- 14. /2017/BulletinMFS_032017.pdf
- 15. Národná banka Slovenska. (2019). *Štatistický bulletinrok* 2019. Bratislava: Národná banka Slovenska. Dostupné z: http://www.nbs.sk/_img/Documents/_Publikacie/BulletinMFS
- 16. /2019/BulletinMFS_062019.pdf
- 17. Národná banka Slovenska. (2020). *Štatistický bulletinrok* 2020. Bratislava: Národná banka Slovenska. Dostupné z: http://www.nbs.sk/_img/Documents/_Publikacie/BulletinMFS
- 18. /2019/BulletinMFS_062020.pdf
- 19. Národná banka Slovenska. (2021). *Štatistický bulletin 2021* Bratislava: Národná banka Slovenska. Dostupné z: http://www.nbs.sk/_img/Documents/_Publikacie/BulletinMFS
- 20. /2021/BulletinMFS_062021.pdf
- 21. Národná banka Slovenska. (2018). *Štatistický bulletin* 2018. Bratislava: Národná banka Slovenska. Dostupné z: http://www.nbs.sk/_img/Documents/_Publikacie/BulletinMFS
- 22. /2018/BulletinMFS_122018.pdf
- 23. Rimarčík, M. (2007). Štatistika pre prax. Košice: Marián Rimarčík. ISBN 978-80-969813-1-1.

Does Green Public Procurement impact sustainability?

Brigita Boorová 1

¹ Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia, brigita,boorova@euba.sk

Abstract: Environmental problems affect the economy, employment, but also the comfort of the life of the population. The economic, social, and environmental dimensions are linked by sustainable development across all sectors of economic, cultural, and social life. The Europe 2020 strategy has identified green public procurement as one of the key tools for achieving smart and sustainable growth, including in the business environment.

Keywords: Green Public Procurement, sustainable development, circular economy

Introduction

Effective use of natural resources, energy efficiency and ecosystem protection are an integral part of economic growth. Economic, social and environmental dimensions link sustainable development across all sectors of economic, cultural and social life. In recent years, considerable progress has been made in mainstreaming environmental policy, for example in the area of energy policy, as reflected in the parallel development of the EU's climate and energy package or the transition plan to a competitive low-carbon economy in 2050. At the same time, environmental problems have an increasing impact on the economy, employment, and the comfort of life of the inhabitants. In addition, like all over the world, our country is already affected by climate change with visible impacts, which will be seriously manifested in the form of environmental, economic and health problems in the future. There are problems with air quality, the low rate of waste recycling, but also with the protection of ecosystems. The concept of sustainable production and consumption and scientific research on sustainable development appear to be essential, and sustainability models across sectors are addressed by authors from all continents (e.g. Brklacich, et al., 1991; Antelava, et al., 2019; Wang, et al., 2019; Tripathy, et al., 2018; Solomon, 2015; Broman et al., 2017; and others). Sustainable development forms the basis for the circular economy, which represents a regenerative design of the economic model, which means the constant maintenance of raw materials, materials and products in their useful position, within the life cycle. The circular economy concept expands the possibilities of reuse and recycling of conventional wastes and by-products, emphasizing the use of the value embedded in waste materials (see e.g. Srisruthi, 2017; Barman, 2017; Asif et al., 2016; Gusmerotti et al., 2019; Bocken et al. al., 2016).

1. Theoretical background

In 1987, the United Nations Brundtland Commission defined sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs. According to Act no. 17/1992 of the Slovak Republic, sustainable development is such development that preserves the opportunity for current and future generations to satisfy their basic life needs while not reducing the diversity of nature and preserving the natural functions of ecosystems. Progress in the field of sustainable development is covered by the United Nations from a global perspective, mainly through the activities of its Commission for Sustainable Development and through the organization of world summits and conferences on sustainable development. (MŽP SR, 2021)

KEY TAKEAWAYS

• Sustainability is the ability to maintain or support a process over time.

- Sustainability is often broken into three core concepts: economic, environmental, and social.
- Many businesses and governments have committed to sustainable goals, such as reducing their environmental footprints and conserving resources.
- Some investors are actively embracing sustainability investments, known as "green investments."
- Skeptics have accused some companies of "greenwashing," the practice of misleading the public to make a business seem more environmentally friendly than it is.(Mollenkamp, 2023)

In September 2015, world leaders adopted an OSN program called "Transforming our world: the 2030 Agenda for Sustainable Development", which sets out a set of sustainable development goals to end poverty, protect the planet, ensure the protection of human rights and guarantee prosperity for all. The adoption of this program is a historic milestone on the way to a new model, as it addresses economic, social, and environmental disparities in a global and integrated way. European values of social justice, democratic governance, and social market economy, as well as environmental protection, are fully reflected in this process. Through the "Sustainable Development Monitoring Center" it advocates for a Europe that sets an example to the whole world by fully complying with and implementing the UN 2030 Agenda. Specifically, the following key policy areas have been identified as the basis for the transition to sustainable development in the EU:

- a fair transition to a low-carbon and circular economy and an economy that uses resources efficiently,
- transition to a socially inclusive society and economy decent work and human rights,
- transition to sustainable food production and consumption,
- investing in innovation and long-term infrastructure modernization and supporting sustainable business,
- the use of trade in favor of global sustainable development.

Sustainable Development Monitoring Center strives to ensure that all these transformations take place in a coherent and integrated manner, thus optimizing their contribution to society. (European Economic and Social Committee, 2020)

Green public procurement (GPP) is one of the voluntary instruments of environmental policy. Voluntary instruments of environmental policy operate within the frameworks that the state creates for their functioning on the market through legislative regulations (law, decree) or non-legislative regulations (government resolution). By their nature, they follow on from the use of the market and subsequent self-regulation. They influence the operation of companies without significantly restricting their free decision-making. They enable companies to evaluate and improve their environmental behavior and achieve a competitive advantage in the global market without significant restrictions. Voluntary environmental policy instruments are an important part of the transition to a circular economy.

GPP (MŽP SR, 2016) is defined by the European Commission as "a process by which public authorities seek to acquire goods, services and works with a reduced environmental impact throughout their life cycle compared to goods, services and works with the same primary a function that they would have obtained otherwise."

GPP can also be characterized as a procedure in which environmental aspects are considered in the framework of public procurement, by entering environmental characteristics into the tender documents and other documents required by the rules and procedures of public procurement. Green public

procurement is a voluntary tool for the support of environmental protection, which means that individual public procurers and procurers can choose the extent to which they will use this tool in practice. The advantages of Green public procurement can be observed mainly in the following areas:

- in the field of the environment (e.g. energy efficiency, conservation of natural resources, reduction of CO2 emissions, climate change, wasteful use of primary resources, deforestation, pollution of air, water, soil, generation of waste and packaging waste, etc.),
- in the economic field (energy saving, reduction of operating costs, longer use of the product, etc.),
- in the area of social and health conditions (e.g. increasing the quality of life, health protection),
- in the political area (increasing the trust of citizens, businesses and society towards public administration),
- in the area of promoting innovations and developing competitive environmental products.

The basic concept of GPP relies on having clear, verifiable, justifiable and environmental characteristics for products, services and works, based on a life cycle approach and a scientific knowledge base.

How to apply GPP in public procurement? Applying GPP needs to be perceived from several levels:

- 1) Public procurement planning.
- 2) Preparation of public procurement.
- 3) Implementation of the order.

In the public procurement planning phase, the recipient performs the following activities:

- familiarization with the scope and potential benefits of green public procurement, as well as the resources that are available,
- assessment of how ecological requirements will affect the public procurement procedure and how they will be applied in accordance with other legal obligations,
- creation of an overview of products and services available on the market,
- creating an idea of life cycle cost assessment (if relevant).

In the stage of public procurement preparation, the recipient performs the following activities:

- defining the subject of the contract and technical specifications in the tender documents in such a way that environmental impacts are taken into account during the entire life cycle of goods, services or construction works,
- if appropriate, applying the conditions of participation within the framework of technical competence in the field of environmental protection or measures of environmental management,
- defining transparent and non-discriminatory criteria for evaluating bids, aimed at supporting higher levels of the environmental profile than is determined by standard,
- defining the terms of performance of the contract, in which the environmental obligations of the suppliers are emphasized with the indication of the relevant corrective measures and the determination of the system for monitoring these obligations.

In the contract implementation phase, the recipient performs the following activities:

- monitoring the fulfillment of environmental conditions/characteristics determined in the framework of public procurement,
- application of sanctions for non-fulfillment of these environmental conditions/characteristics.

Therefore, the phase of preparation and implementation of public procurement is decisive for the very definition of the requirements of Green Public Procurement. It is therefore appropriate to focus attention in particular on the following areas of application of Green Public Procurement:

- determination of "green" requirements for the subject of the order,
- determining the "green" conditions of participation,
- determination of "green" criteria for evaluating bids,
- determination of "green" contractual requirements for contract performance.

The benefits of applying green public procurement are not only about reducing the direct impact of the activities of public institutions on the environment, but at the same time they can also bring social and health, or economic and political benefits. Environmental characteristics, which can be used during the entire process of public procurement or purchase, are aimed at reducing the negative effects of products (goods, services and construction works) procured and purchased by public contracting authorities and contracting authorities on the environment during the entire life cycle of the products. (MŽP SR, 2016)

The main goal of the contribution is to clarify the relationship, or the link between GPP and sustainable development.

2. Methods and methodology

In the introductory part of the paper, we described the basic definitions of terms that are related to the issue and related to sustainable development and GPP. The results of the work and the discussion resulted in findings regarding the impact of GPP on sustainability. We used the methods of analysis, synthesis, induction, and deduction to process the information and knowledge in the paper.

3. Results

Substantial public financial resources are spent on purchasing through public procurement every year. According to data from the European Commission, EU member states annually procure goods and services worth more than EUR 2 trillion, which represents approximately 14% of EU GDP. In Slovakia in 2017, it was more than EUR 4 billion (4.7% of GDP).

In the case of green public procurement, the state contributes to the fulfillment of its goals in the field of mitigating and preventing climate change, protecting the environment and the health of the population by spending financial resources for the procurement of goods, services and construction works taking into account their environmental impact. The procurement results in goods, services or construction works with a lower negative impact on the environment compared to goods, services or construction works that are the same or comparable in terms of their functionality or performance, but do not take environmental impacts into account.

Despite this, the level of application of green public procurement in Slovakia has been low for a long time. The first action plan of the Slovak Republic for green public procurement was adopted in November 2007. According to data from the last monitoring in 2019, the share of green public procurement in the total public procurement in 2018 was at the level of 7.58%, in terms of the number of completed orders and level of 3.83%, as regards their value in euros without VAT.

The legal framework for public procurement is defined by the provisions of the Treaty on the Functioning of the European Union (hereafter the Treaty) and by the EU Procurement Directives, as interpreted by the European Court of Justice. From an international perspective, the EU is bound by the conditions of the Government Procurement Agreement (GPA) of the World Trade Organisation (WTO), and by bilateral trade agreements. In practice, compliance with these instruments is generally achieved by extending the same rights to operators established in third countries as apply to EU economic operators. (EU, 2016)²

² European Union. 2016. Bying green. A handbook of green public procurement. https://sustainable-procurement.org/fileadmin/user_upload/layout/Documents/Buying-Green-Handbook-3rd-Edition.pdf

The potential environmental benefits, that could be obtained if green criteria were systematically included in public tenders, are self-evident (Parikka-Alhola, 2008), as indicated in the study of PricewaterhouseCoopers (2009) which estimated an average 25% reduction of CO2 emission related to the adoption of GPP practices in 2006–2007 in seven European countries (Austria, Denmark, Finland, Germany, Great Britain, the Netherlands and Sweden) for ten product groups analyzed. (Testa et all, 2016)

Inclusion of GPP would also stimulate the innovation capabilities of firms. According to Porter's theory, GPP could represent a "properly designed" environmental policy instrument able to conjugate environmental benefits and competitive improvement in the firm's performance. Indeed, the high impact of GPP on production activities positively influences the probability that firms invest (at both technological and organizational levels) in innovative solutions, as demonstrated by Testa et al. (2011).

There are several plausible reasons for the increasing focus on GPP. First, the sheer magnitude of public procurement makes it important for the economy. In OECD member countries governmental consumption ranges from 8 to 25% of GDP, with an average on 15% (OECD, 2000).

4. Discussion

Green public procurement gives state contracts a new dimension and reduces their impact on the environment. The Europe 2020 strategy has identified green public procurement as one of the key tools for achieving smart and sustainable growth, including in the business environment. The reason is the higher competitiveness of innovative companies with an environmental approach, as the EU tries to support and prioritize such companies in order to gradually move to the so-called circular economy model with sustainable production and consumption. In other words, the application of GPP should support, for example, the sustainable use of natural resources by suppliers, and support the change to sustainable production as well as innovation.

This not only changes the rules for orders from the state, but also for companies that do business with it. The fact that the new GPP rules are being taken seriously indicates the obligation to apply green public procurement tools in state contracts related to construction works and contracts over 30,000 euros from October 1, 2022. Minor construction works up to 30,000 euros will be an exception. These are less important for the state and often need to be carried out quickly, since most of them are adjustments or repairs of damages. (GreenTalk, 2022)

Green Public Procurement is the way in which public administration bodies integrate environmental requirements into the procurement process, within the framework of technical requirements or selection criteria. The advantage and contribution of GPP is the creation of a demand for an environmentally suitable product or service on the market and at the same time the support of the supply of these products. The disadvantage and risk from the point of view of the company are the higher costs associated with the preparation of the offer, which is not guaranteed to be successful in the tendering process, despite the fact that it will offer environmentally friendly products. GPP supports sustainability and plays an important role in the circular economy, as it creates space for orders for sustainable products and services.

Acknowledgment

This article is a partial output of the solution of the project VEGA 1/0465/23 Generic, convergence and model approaches of environmental production and logistics in business development in Slovakia in the range of 100%.

References

1. Antelava, A. et al. (2019). Plastic Solid Waste (PSW) in the Context of Life Cycle Assessment (LCA) and Sustainable Management. Environmental Management 64, 230–244 (2019). https://doi.org/10.1007/s00267-019-01178-3.

- 2. Asif, F. M. et al. (2016). Multi-method simulation based tool to evaluate economic and environmental performance of circular product systems. Journal of Cleaner Production, 139, 1261-1281. doi:10.1016/j.jcle-pro.2016.08.122.
- 3. Barman, B. CH. (2017). *Role of Green Economy in the Context of Indian Economy*. Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-2 | Issue-1, December 2017, Article URL: http://www.ijtsrd.com/economics/development-economics/7184/role-of-green-economy-in-the-context-of-indian-economy/bhajan-chandra-barman, [accessed 08.09.2023].
- 4. Bocken, N. et al. (2016). *Product design and business model strategies for a circular economy*. Journal of Industrial and Production Engineering, 33:5, 308-320, doi: 10.1080/21681015.2016.1172124.
- 5. Brklacich, M. et al. (1991). Review and appraisal of concept of sustainable food production systems. Environmental Management 15, 1–14 (1991). https://doi.org/10.1007/BF02393834.
- 6. Broman, G. et al. (2017). *Science in support of systematic leadership towards sustainability*. Journal of Cleaner Production, 140, 1-9. doi:10.1016/j.jclepro.2016.09.085.
- 7. European Economic and Social Committee. (2020). https://www.europarl.europa.eu/fact-sheets/sk/sheet/15/europsky-hospodarsky-a-socialny-vybor, [accessed 09.09.2023].
- 8. European Union. 2016. Bying green. A handbook of green public procurement. https://sustainable-procurement.org/fileadmin/user_upload/layout/Documents/Buying-Green-Handbook-3rd-Edition.pdf, [accessed 09.09.2023]
- 9. GreenTalk. (2023). https://greentalk.sk, [accessed 09.09.2023].
- 10. Gusmerotti, N. et al. (2019). *Drivers and approaches to the circular economy in manufacturing firms.* Journal of Cleaner Production, Volume 230,2019, Pages 314-327, ISSN 0959-6526, https://doi.org/10.1016/j.jcle-pro.2019.05.044.
- 11. Ministerstvo životného prostredia Slovenskej republiky. *Strategické dokumenty Národná stratégia trvalo udržateľného rozvoja Slovenskej republiky*. https://www.minzp.sk/dokumenty/strategicke-dokumenty/, [accessed 09.09.2023].
- 12. Ministerstvo životného prostredia Slovenskej republiky. (2016). Metodická pomôcka k aplikácii aspektov "zeleného verejného obstarávania" v rámci zákaziek spolufinancovaných zo zdrojov Operačného programu Kvalita životného prostredia. [cit. 2023-20-08] Str. 4 8. Dostupné na: https://www.op-kzp.sk/wp-content/up-loads/2016/04/Metodick---pom--cka-k-aplik--cii-aspektov----zelen--ho-VO----v-r--mci-OP-K--P-verzia-1.0.pdf
- 13. Mollenkamp, D. (2023). What is Sustainability? How Sustainability's Work, Benefits and Example. https://www.investopedia.com/terms/s/sustainability.asp, [accessed 09.09.2023].
- 14. Solomon, B.D. et al. (2015). Policies for the Sustainable Development of Biofuels in the Pan American Region: A Review and Synthesis of Five Countries. Environmental Management 56, 1276–1294 (2015). https://doi.org/10.1007/s00267-014-0424-6.
- 15. Parikka-Alhola, K. (2008). Promoting environmentallys sound furniture by green public procurement. Elsevier. Ecological economics, Volume 68. https://doi.org/10.1016/j.ecolecon.2008.05.004
- 16. Testa, F. et al. (2016). Drawbacks and opportunities of green public procurement: an effective tool for sustainable production. Elsevier, Journal of Cleaner Production, Volume 112. https://doi.org/10.1016/j.jcle-pro.2014.09.092.
- 17. Testa, F. et al. (2011). The effect of environmental regulation on firms' competitive performance: the case of the building & construction sector in some EU regions. (2011). Elsevier, Journal of Environmental Management. Volume 92. https://doi.org/10.1016/j.jenvman.2011.03.039
- 18. Tripathy, B.R. et al. (2018). Modeling of Electric Demand for Sustainable Energy and Management in India Using Spatio-Temporal DMSP-OLS Night-Time Data. Environmental Management 61, 615–623 (2018). https://doi.org/10.1007/s00267-017-0978-1.
- 19. Wang, Y. et al. (2019). Energy Consumption, Carbon Emissions and Global Warming Potential of Wolfberry Production in Jingtai Oasis, Gansu Province, China. Environmental Management 64, 772–782 (2019). https://doi.org/10.1007/s00267-019-01225-z.
- Srisruthi, K. M. (2017). Circular Economy. In International Journal of Trend in Scientific Research and Development (ijtsrd), Volume-1 | Issue-6, 2017. ISSN: 2456-6470. http://www.ijtsrd.com/papers/ijtsrd4610.pdf, [accessed 09.09.2023].

Trends in waste management as part of the circular economy of the Slovak Republic

Slavka Šagátová 1, *

- ¹ Faculty of Business Management, University of Economic in Bratislava, Bratislava, Slovak Republic; slavka.sagatova@euba.sk
- * Correspondence: slavka.sagatova@euba.sk

Abstract: The article focuses on the management of municipal waste in the Slovak Republic, with a primary emphasis on regional disparities, recycling efficacy, and waste-to-energy processes. The contextual framework evaluates alignment with the European Commission's objectives in the domain of waste management and the circular economy. The methodologies employed include quantitative analysis of trends in landfilling and waste valorization. The article also explores various determinants affecting waste management across different Slovak regions. And explores their mutual correlations with municipal waste. Findings reveal an incessant increase in waste production, which correlates with the rise in GDP and household income. Despite this, there is a positive trend in waste valorization, notably in the Bratislava and Kosice regions. However, the rate of improvement is not aligned with European goals, categorizing Slovakia among the EU's risk-prone member states. The study concludes that while there are some positive developments in municipal waste management, more rigorous implementation of measures and practices aligned with EU objectives is essential. For future research, a more detailed mapping of capacities and an analysis of influencing determinants are suggested, which could lead to more effective waste management and a transition to a circular economy.

Keywords: circular economy; waste management; municipal waste; structure of waste; methods of handling municipal waste;

Introduction

The protection of the environment and ecological balance is gaining prominence at a global level. Through the adoption of recommendations and policies, pressure is also being exerted on individual countries to improve their environmental orientation. Among the fundamental issues that necessitate attention is waste management. This issue falls under the broader umbrella of the circular economy, whose objective is to sustain the longevity of raw materials and resources within the economy, conserve natural assets, and thereby mitigate human impact on the planet through alterations in production, consumption, and waste management practices (Kureková, 2019; Yang, 2023). Generally, waste is perceived negatively as something to be eliminated. According to the European Commission's Directive on Waste, "waste" is defined as any substance or object that the holder discards, intends to discard, or is required to discard (EC, 2018a). The focus on waste stems from the realization that it contains valuable resources that could be utilized more efficiently (Gharfalkar, 2015). As such, waste is increasingly being comprehensively regarded as a resource. This conceptual shift aligns with closed-loop economies or circular material flows that reinforce the idea of a "resource" paradigm rather than a "waste" paradigm (Park & Chertow, 2014). It, thus, shifts the linear economic model towards a circular economic framework.

1. Theoretical background

Waste can be considered from two basic intentions concerning its genesis. In the case of recyclable waste, it becomes a resource for further utilization and enters into the circular economy. The reutilization of waste is crucial for the transformation from a linear to a circular economic model. For monitoring the circular economy, the European Commission has proposed several indicators, grouped into four main areas: production and consumption, secondary raw materials, waste management, and competitiveness and innovation (EU, 2018c). Among the ten indicators for the circular economy, particular

attention is given to municipal waste, as many of these indicators are directly related to the generation of municipal waste and its subsequent management (EC, 2018b; Moraga, 2019; Smol, 2020). As part of the implementation strategy for the circular economy within the EU, the European Commission has also developed the Waste Framework Directive (EC, 2008a), which sets specific objectives in the area of municipal waste management. The Directive includes recommendations related not only to waste at the end-of-life but also outlines a waste hierarchy applicable in all 28 member states of the European Union. The "waste hierarchy" as captured in WFD 2008 delineates various measures that could be applied to substances, materials, and objects before they become waste or after they have turned into waste (Gharfalkar, 2015).

Waste management approaches, in line with the principles of the circular economy, can be classified from various perspectives. The fundamental hierarchy of waste management includes:

- Waste Prevention: This encompasses the reduction in the amount of waste and hazardous substances in products. It is a critical factor in any waste management strategy and is closely linked to improving product design and production methods, as well as influencing consumers to demand more eco-friendly products and less packaging (EP EU Directive, 2018; Mensah, 2020).
- Recycling and Reuse: These represent steps that need to be taken when waste prevention is not possible. Recycling is any waste valorization activity in which waste is reprocessed into products, materials, or substances for original or other purposes (Act No. 79/2015). The recycling of raw materials mitigates risks associated with raw material supply, such as price volatility, availability, and import dependency (European Parliament, 2023).
- Improvement in Final Disposal and Monitoring: Disposal is the last permissible waste management solution when neither recycling nor reuse is possible. The prioritized approach is safe incineration; if that is not feasible, the last resort is landfilling. Both of these methods, however, require meticulous monitoring of the entire process, as they may cause serious environmental damage (Eurostat, 2023).

A salient issue in the realm of waste in modern societies is the burgeoning increase in municipal waste (Cheng, 2020; Ríos & Picazo-Tadeo, 2021). This phenomenon poses a threat not only to environmental sustainability but also specifically to public health (Knickmeyer, 2020). In 2020, municipal waste production reached 732,106,000 tons (OECD, 2023), with an alarming 33% of this volume being improperly managed (Shah et al., 2021). Projections suggest that municipal waste production will escalate to 2.2 billion tons by 2025 and further soar to 4.2 billion tons by 2050 (Kumar & Samadder, 2017; Rajca, 2022). Key factors in addressing the challenges of solid municipal waste include reducing its production and enhancing recycling measures (Soukiazis & Proença, 2020). The significance of the topic of municipal waste is underscored by objectives set by the European Union through the European Environment Agency specific to this area of waste (EEA, 2013). According to the European Parliament and Council Directive (2018), there are substantial disparities among member states in waste management performance, particularly concerning the recycling and landfilling of municipal waste (Scarlat, 2019). Despite heightened attention to waste issues, most research is conducted at the country level, with limited studies focusing on smaller units at lower levels (Soukiazis & Proença, 2020). For the effective governance of waste management and the transition to a circular economy, it is imperative to understand developmental trends in waste as well as to analyze potential determinants of such trends. Fundamental parameters influencing waste development include economic growth, demographic and climatic factors including urbanization, legislative and policy measures, socio-cultural norms including lifestyle and ecological awareness, and scientific-technological advancements (Zambrano-Monserrate, 2021; Ryborá, 2018).

The objective of this article is to analyze trends in the development of municipal waste and its recycling at the level of autonomous regions in Slovakia, thereby mapping the groundwork for further advancements of the country in this domain.

2. Methods and methodology

For the analysis of data, we utilized panel data from the Statistical Office of the Slovak Republic, sourced from DATAcube (ŠÚ SR, 2023a) and STATdata (ŠÚ SR, 2023b) databases. The data comprised demographic statistics, such as population size; macroeconomic indicators like GDP, total household income, and expenditure; as well as environmental statistics including domestic material consumption, and the quantity of municipal waste categorized by waste type, waste subgroups, and waste management methods. The collected data represented aggregate figures for the entire Slovak Republic and also data at the level of individual regions.

The investigation was conducted in two phases. In the first phase, we analyzed quantitative indicators of the structure and volume of municipal waste and their development over time. We also scrutinized the influence of selected determinants on its evolution. Guided by theoretical presuppositions, we examined the relationship between municipal waste and variables such as material consumption, GDP, and household income and expenditure (Zambrano-Monserrate, 2021). A constraining factor affecting the final selection of determinants was the availability of data. Information on the "Quantity of Municipal Waste by Type" was available only for the years 2019 to 2021, while other data spanned from 2002 to 2021. Using correlational analysis, we explored the mutual relationships between the chosen variables and the volume of municipal waste for the period with available data (mostly 2002 to 2021). To maintain data homogeneity, we standardized all data per capita. For calculating correlation coefficients and determining the coefficient of determination, we employed Microsoft Excel software.

In the second phase, we analyzed waste management practices in Slovakia based on available data for the years 2017 and 2021. Due to a change in methodology in 2020, which expanded the list of monitored waste types, we limited our examination of the structural development of municipal waste to its characteristics for only the years 2020 and 2021.

3. Results

The volume of municipal waste in Slovak Republic has been annually increasing from 2014 to 2021, with an average growth rate of 5,7 %. In 2021, the total volume reached 2 705 327 tons, equating to 496 kg per capita. Over the last decade, the per capita production of municipal waste increased by 54 %. A concerning aspect is that mixed municipal waste constitutes up to 40 % of this total waste. On a positive note, the volume of mixed municipal waste slightly declined in the last three observed years (2019-2021), with an average annual decrease of 4 %-tage points. More than 5% of the total structure of municipal waste contributes metals (16 %), biodegradable waste (13 %) and bulky waste (7 %). These specific types of waste have experienced a slight year-over-year decline in the last three observed years. Other types of waste comprise less than 5 % of the overall structure (Figure 1.).

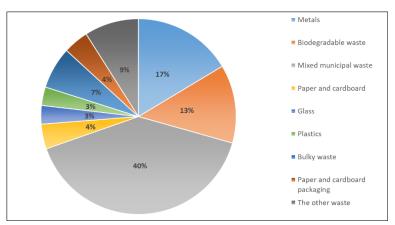


Figure 1. Structure of municipal waste in 2021 - by types of waste

Source: own processing according to the data of the ŠÚ SR

Of the total municipal waste generated, the largest amount comes from the Bratislava Region, while the smallest amount is produced in the Banska Bystrica Region. However, when adjusted for per capita

figures, the situation varies: the Trnava Region produces 32 % more municipal waste than the national average of Slovakia, while the Kosice Region generates 24 % less than the national average. Comparing the developments over the last decade, the most significant increase in per capita municipal waste was observed in the Bratislava Region, with a rise of 62 %, and the smallest increase occurred in the Kosice region, at 40 % (Figure 2.).

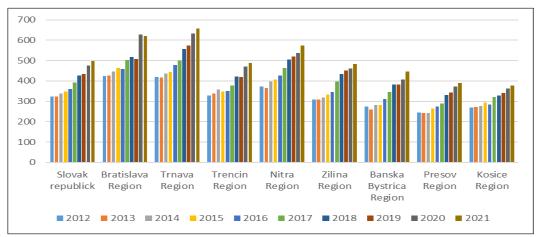


Figure 2. Development of the volume of waste in kg per capita by region of the Slovak Republic

Source: own processing according to the data of the $\check{S}\check{U}$ SR

In the most recently observed year, municipal waste accounted for 4 % of domestic material consumption. Given the decline in domestic material consumption and the increase in municipal waste, this parameter has shown a slightly negative developmental trend since 2014, deteriorating by 0,2 percentage points on an annual basis. The strongest positive correlation can be observed between municipal waste and the material consumption of other products (r = 0.75), where a moderately strong correlation is evident, although the degree of variability is not particularly high. A negative correlation can be observed between municipal waste and fossil fuel materials, with a correlation coefficient of r = -0.84 and a variability degree of 0,7 (Table 1.).

Table 1. Correlation of municipal waste development and domestic material consumption in SR

Character of domestic material consumption	r	\mathbb{R}^2
Total domestic material consumption in the Slovak Republic	-0,07	0,01
Biomass	-0,22	0,05
Metal ores	-0,18	0,03
Non-mineral raw materials	0,37	0,14
Fossil energy materials/carriers	-0,84	0,70
Other products	0,75	0,56
Waste imported for final processing and disposal	0,54	0,30

Source: own processing

In tracking the changes in the production of municipal waste and GDP (Gross Domestic Product) (Table 2.), a strong dependency between these factors at the national level in Slovakia was confirmed. The strongest dependency can be observed in the Kosice Region, with a high correlation coefficient of r = 0.97 and a high degree of variability. In other regions, the situation is only slightly less favorable, but the development of municipal waste can be considered strongly dependent on GDP growth, with the exception of the Bratislava and Zilina regions. In these latter cases, the dependency of waste on GDP can be considered moderately strong, but with a lower degree of variability.

Household Household **GDP** Territory incomes expenses \mathbb{R}^2 \mathbb{R}^2 \mathbb{R}^2 r 0,88 0,92 0,85 Slovak republic 0,78 0,94 0,89 0,72 0,52 0,86 0,73 -0,21Bratislava Region 0,04 0,94 0,89 0,77 Trnava Region 0,84 0,71 0,59 0,93 0,73 Trencin Region 0,86 0,85 0,90 0,82 0,92 0,94 0,97 0,85 0,88 0,94 Nitra Region 0,72 0,53 0,82 0,91 Zilina Region 0,67 0,83 0,84 0,71 0,85 0,73 0,95 0,90 Banska Bystrica Region Presov Region 0,90 0,81 0,91 0,82 0,95 0,89 0,97 0,93 0,88 0,78 0,91 0,82 Kosice Region

Table 2. Correlation of municipal waste development and GDP, household incomes and expenses

Source: own processing

In examining the relationship between household income and expenditures and the volume of municipal waste, strong linear dependencies are predominantly observed, both at the national level in Slovakia and in the majority of individual regions. An exception is the Trnava Region, where there is a greater dependency of municipal waste production on income rather than on expenditures. A noteworthy situation arises in the Bratislava Region, where there is a strong positive correlation between municipal waste and household income, but no correlation with expenditures (Table 2.). This signals that the production of municipal waste in the Bratislava Region is linked to household income but not to their expenditures. This phenomenon is primarily driven by the development of expenditures in this region in the year 2020. This was a period during which, despite rising incomes, there was a sharp decline in expenditures; however, the production of municipal waste also increased.

Regarding the underlying causes, it can only be speculated, given the current state of knowledge, that this development was influenced by the pandemic period, during which residents spent much time at home (including working from home). This led to reduced consumption of services and thus lower expenditures, but the stay-at-home situation manifested in an increase in waste. Alternatively, individuals could have dedicated more time to decluttering, which could also have led to an increase in waste volume without a corresponding increase in expenditures.

The most prevalent method of municipal waste management in Slovakia in 2021 was landfilling, accounting for as much as 41% of total waste treatment. Twenty-seven percent of municipal waste was valorized through the recovery of organic substances (of which 57 % was composted), 23 % was recycled, and 8% was converted to energy. The trend indicates that landfilling is decreasing on a year-over-year basis, while waste valorization is increasing (Figure 3).

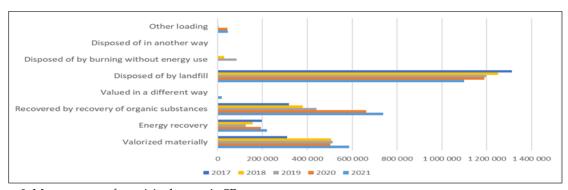


Figure 3. Management of municipal waste in SR

Source: own processing according to the data of the SÚ SR

The structure of waste management methods is similar in all regions with the exception of Bratislava and Kosice (Table 3.). Landfilling is the dominant method at the level of 44 % to 49 %. This approach prevails in all regions except Bratislava. It is positively noteworthy that this least desirable method of waste management has been on a declining trend in all regions from the year 2017 to 2021.

Table 3. The most common methods of waste management in individual regions of the SR in 2021

			Region							
Waste management Unit		Units	Bratislava	Trnava	Trencin	Nitra	Zilina	Banska Bystrica	Presov	Kosice
		tons	73 811,03	71 103,83	62 201,70	82 635,66	86 930,23	68 960,51	72 038,80	67 896,35
	materially	kg per capita	102,34	125,80	108,13	122,47	125,89	110,68	89,13	86,95
		change index	1,01	1,15	1,26	1,22	1,18	1,31	1,19	1,06
u.		tons	111 737,96	35,31	119,78	413,51	737,48	251,91	22 975,03	83 097,79
Valuation	energetically	kg per capita	154,93	0,06	0,21	0,61	1,07	0,40	28,43	106,42
Na		change index	0,95	0,08	1,27	2,74	1,37	20,89	15,92	1,06
	, .	tons	139 112,94	128 155,66	79 171,03	112 255,41	84 194,69	68 740,08	77 633,45	48 183,28
	recovery of organic	kg per capita	192,89	226,74	137,62	166,36	121,93	110,32	96,05	61,71
	substances	change index	1,03	1,12	1,09	1,18	1,18	1,13	1,07	1,10
	landfilling	tons	91 951,06	162 580,96	134 769,22	186 534,18	156 676,60	137 573,49	138 497,05	90 705,60
		kg per capita	127,49	287,65	234,27	276,44	226,89	220,80	171,36	116,17
Disposal		change index	0,99	0,92	0,93	0,95	0,92	0,99	0,85	0,97
Disp	burning without	tons	162,97	36,76	7,07	9,14	17,65	6,2	12,54	17,08
	energy recovery	kg per capita	0,23	0,07	0,01	0,01	0,03	0,01	0,02	0,02
		change index	1,16	2,60	1,66	1,24	3,78	0,53	2,90	1,38

Notes: The change index is calculated from the value of waste per inhabitant for the years 2021/2020

The table does not include municipal waste management methods that do not process even 5% of the total waste.

Source: own processing according to the data of the ŠÚ SR

In the Bratislava Region, 21 % of waste is managed through landfilling, while in the Kosice region, this figure is 31 %. The second most common method in Bratislava is the recovery of organic substances, utilized for 31 % of waste; however, in Kosice, this method ranks third, applied to 16 % of waste. Another method employed in these regions is energy valorization, used for 25 % of waste in Bratislava and 28 % in Kosice. The last significantly employed method in waste management is material valorization, applied to 17 % of municipal waste in Bratislava and 23 % in Kosice. In the other regions, the second most common method is the recovery of organic substances, accounting for 25 % to 31 % of waste. It is positive to note that this trend is increasing annually. The third most frequently used waste management method is material valorization, deployed for 19 % to 26 % of processed municipal waste. Since 2018, this trend has remained largely unchanged and oscillates around this value

4. Discussion

The trajectory of municipal waste development in Slovakia cannot be evaluated overly positively. A persistent increase in waste, correlating with the growth of GDP and household income, does not offer optimistic prospects for overall improvement in circular economy management. Mildly positive is the small decline in the proportion of mixed municipal waste, which still constitutes the largest part of the total municipal waste in Slovakia. In all regions, over 50 % of waste is valorized, setting Slovakia on a positive course. As a consequence of this fact, there is a decline in the amount of waste that is disposed of or collected. An annual improvement in this situation can also be favorably evaluated. However, the downside is that, according to EU regulations, the identified pace of improvement is inadequate for

meeting the European Commission's goals in reducing landfill municipal waste. In June 2021, the European Commission (EC, 2023) in its Early Warning Report, included Slovakia among the 18 Member States at risk of failing to meet the targets for the preparation for re-use and recycling of municipal waste and packaging waste by 2025, and landfill waste reduction goals by 2035.

Current practice shows that the lowest proportion of landfilled municipal waste is in the Bratislava and Kosice regions, which have facilities for energy valorization of municipal waste. This substantially contributes to valorized waste accounting for approximately 70% of municipal waste in these cases. The worst in this parameter is the Banska Bystrica Region, where the rate of valorized municipal waste is just under 50%. In most other regions, valorization through the recovery of organic substances, including composting, slightly outweighs material valorization. The exception is the Zilina Region, where the situation is reversed. To bring Slovak Republic closer to the established European targets in waste management, it would be appropriate for individual regions to intensify the implementation of measures and procedures that enable them to achieve higher annual volumes of valorized waste. For further research, it would be apt to map the utilization capacities of valorizing municipal waste in different regions and to examine more determinants influencing the development of municipal waste, employing a more comprehensive analysis of their interrelationships. It would also be fitting to compare the situation in Slovakia with similar EU states and identify opportunities for building new capacities and introducing new procedures based on good practice examples. The results could subsequently serve as a valuable source of information for waste management governance, shaping environmental policies, and thus contributing to the transition to a circular economy.

Funding: This research was funded by VEGA, grant number 1/0462/23, entitled "Circular economy in the context of social requirements and market constraints", grant share: 100%

References

- 1. Cigáňová, S. (2019). Hľadajú sa najlepšie inovačné riešenia v oblasti cirkulárnej ekonomiky. *Veda na dosah*. NCP VaT pri CVTI SR https://vedanadosah.cvtisr.sk/ludia/ekonomia/hladaju-sa-najlepsie-inovacne-riesenia-v-oblasti-cirkularnej-ekonomiky/
- 2. Cheng J, Shi F, Yi J, Fu H (2020). Analysis of the factors that affect the production of municipal solid waste in China. J Clean Prod 259: 120808.
- 3. EC (2008). European Parliament and Council Directive 2008/98/ EC on waste (Waste Framework Directive) (OJ L 312/3, 22,11,2008). Brussels: European Commission
- 4. EC (2018 a). Consolidated text: *Directive* 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (Text with EEA relevance) Brussels: European Commission. http://data.europa.eu/eli/dir/2008/98/2018-07-05
- 5. EC (2018 b). Communication from the commission to the european parliament, the council, the european economic and social committee and the committee of the regions on a monitoring framework for the circular economy, Strasbourg, COM/2018/029 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2018%3A29%3AFIN
- EC (2018 c). EU Monitoring Framework for a Circular Economy. https://ec.europa.eu/news-room/env/items/623933.
- 7. EC (2023). Waste Early Warning Report 2023. https://environment.ec.europa.eu/publications/waste-early-warning-report_en.
- 8. EEA (European Environment Agency) (2013). *Towards a green economy in Europe. EU environmental policy targets and objectives* 2010-2050. Report 8/2013. Luxembourg: European Environment Agency. https://doi.org/10.2800/6337.
- 9. EPRS (2016). *Circular economy*. European Parliamentary Research Service. https://www.europarl.europa.eu/thinktank/infographics/circulareconomy/public/index.html.
- 10. European Parliament (2023). Circular economy: definition, importance and benefits. https://www.europarl.europa.eu/news/en/headlines/economy/20151201STO05603/circular-economy-definition-importance-and-benefits
- 11. Eurostat (2023). Policy Context. https://ec.europa.eu/eurostat/web/waste/policy-context
- 12. Gharfalkar, M., Court, R., Campbell, C., Ali, Z., Hillier, G. (2015). Analysis of waste hierarchy in the European waste directive 2008/98/EC. *Waste Manag.* 39, 305–313. https://doi.org/10.1016/j.wasman.2015.02.007

- 13. Mensah, I. (2020). Waste management practices of small hotels in Accra: An application of the waste management hierarchy model. *Journal of Global Business Insights*, 5(1), 33-46. https://digitalcommons.usf.edu/globe/vol5/iss1/3/
- 14. Moraga, G., Huysveld, S., Mathieux, F., Blengini, G.A., Alaerts, L., Acker, K., Meester, S., Dewulf, J., (2019). Circular economy indicators: What do they measure? *Resources, Conservation and Recycling*, 146, 452-461, ISSN 0921-3449. https://doi.org/10.1016/j.resconrec.2019.03.045.
- 15. Knickmeyer, D. (2020). Social factors influencing household waste separation: A literature review on good practices to improve the recycling performance of urban areas. *Journal of cleaner production*, 245, 118605. https://doi.org/10.1016/j.jclepro.2019.118605
- 16. Kumar, A. & Samadder, S. R., (2017). A review of technological options of waste to energy for effective management of municipal solid waste. *Waste Manag*, 69, 407–422. https://doi.org/10.1016/j.wasman.2017.08.046
- 17. Kureková, I. (2019). Obehové hospodárstvo šanca na lepší život. Enviro magazín. Ministerstvo životného prostredia SR, 6, 9 11. https://efaidnbmnnnibpcajpcglclefindmkaj/https://www.enviromagazin.sk/enviro2019/06_enviromagazin_2019.pdf.
- 18. OECD (2023). Waste: Municipal wast. OECD Data. https://data.oecd.org/waste/municipal-waste.htm.
- 19. Park, J.Y. & Chertow, M.R. (2014). Establishing and testing the "reuse potential" indicator for managing wastes as resources, *Journal of Environmental Management*, 137, 45-53, ISSN 0301-4797. https://doi.org/10.1016/j.jenvman.2013.11.053
- 20. Rajca, P., Biniek, A., Skibinski, A., Zajemska, M. (2022). Review of Selected Determinants Affecting Use of Municipal Waste for Energy Purposes. MDPI, *Energies*, 15(23), 9057. https://doi.org/10.3390/en15239057
- 21. Ríos, A-M. & Picazo-Tadeo, A. J. (2021). Measuring environmental performance in the treatment of municipal solid waste: The case of the European Union-28, *Ecological Indicators*, 123, 107328. https://doi.org/10.1016/j.ecolind.2020.107328.
- Rybová, K., Slavík, J., Burcin, B. et al. (2018). Socio-demographic determinants of municipal waste generation: case study of the Czech Republic. J Mater Cycles Waste Manag, 20, 1884–1891. https://doi.org/10.1007/s10163-018-0734-5.
- 23. Scarlat, N., Fahl, F. & Dallemand, JF. (2019). Status and Opportunities for Energy Recovery from Municipal Solid Waste in Europe. *Waste Biomass*, 10, 2425–2444. https://doi.org/10.1007/s12649-018-0297-7.
- 24. Smernica EP EÚ (2018) SMERNICA EURÓPSKEHO PARLAMENTU A RADY (EÚ) 2018/851 z 30. mája 2018, ktorou sa mení smernica 2008/98/ES o odpade. https://efaidnbmnnnibpcajpcglclefindmkaj/https://eur-lex.europa.eu/legal-content/SK/TXT/PDF/?uri=CELEX:32018L0851.
- Smol, M., Duda, J., Czaplicka-Kotas, A., Szołdrowska, D. (2020). Transformation towards Circular Economy (CE) in Municipal Waste Management System: Model Solutions for Poland. MDPI, Sustainability 2020, 12(11), 4561. https://doi.org/10.3390/su12114561
- 26. Soukiazis, E. & Proença, S. (2020). The determinants of waste generation and recycling performance across the Portuguese municipalities A simultaneous equation approach. *Waste Management*, 114, 321-330. https://doi.org/10.1016/j.wasman.2020.06.039.
- 27. Shah, A. V., Srivastava, V. K., Mohanty, S. S., Varjani, S. (2021). Municipal solid waste as a sustainable resource for energy production: State-of-the-art review, *Journal of Environmental Chemical Engineering*, 9 (4), 105717. https://doi.org/10.1016/j.jece.2021.105717.
- 28. ŠÚ SR (2023 a). DATAcube. https://datacube.statistics.sk/#!/lang/sk/?utm_source=susr_portalHP&utm_medium=page_database&utm_campaign=DATAcube_portalHP.
- 29. ŠÚ SR (2023 b) STATdat. http://statdat.statistics.sk/cognosext/cgi-bin/cognos.cgi?b_action=xts.run&m=por-tal/cc.xts&gohome=
- 30. Yang, M., Chen, L., Wang, J. *et al.* (2023). Circular economy strategies for combating climate change and other environmental issues. *Environ Chem Lett*, 21, 55–80. https://doi.org/10.1007/s10311-022-01499-6.
- 31. Zambrano-Monserrate, M. A., Ruano, M. A., & Ormeño-Candelario, V. (2021). Determinants of municipal solid waste: a global analysis by countries' income level. *Environmental Science and Pollution Research*, 28, 62421-62430. https://doi.org/10.1007/s11356-021-15167-9.
- 32. Zákon č. 79/2015 Z.z. Zákon o odpadoch a o zmene a doplnení niektorých zákonov. https://www.epi.sk/zz/2015-79.

Fostering Transnational Wine Tourism in the Danube Region as the Key Element of the Sustainable Tourism Strategy

Kristián Kalamen 1, Mária Kmety Barteková 1

University of Economics in Bratislava, Faculty of Business Management, Dolnozemská cesta 1, 85235 Bratislava, Slovak Republic

Abstract: In this comprehensive overview of sustainable tourism, we explore the complex web of principles, definitions and strategies that underpin responsible travel. At the heart of sustainable tourism is an underlying ethos that balances the grace of discovery with the imperative to preserve our planet's natural wonders, cultural riches, and local communities. The European Union has become a champion of sustainable tourism, promoting strategies that combine economic benefits with environmental and social governance. Wine tourism, which is an inseparable part of cultural and gastronomic discovery, has come to the forefront of sustainable tourism as regions like the Danube use their wine heritage to attract visitors in a sustainable manner. The Danube region, which is full of cultural and natural heritage, uses projects such as INSiGHTS, Transdanube Travel Stories and Cult-CreaTE to create holistic strategies. Transnational cooperation is built into these projects to foster partnerships, promote knowledge exchange and policy learning. The main objective of the research is to deliver a comprehensive analysis of wine and sustainable tourism in the Danube region through the Interreg Danube projects and the main scientific methods used are analysis and synthesis, with decomposition and abstraction forming an integral methodological support instrument.

Keywords: wine tourism, sustainability, Danube region, sustainable tourism

Introduction

Wine tourism represents an activity deeply intertwined with the appreciation of the agricultural practices related to grape cultivation and the intricate art of winemaking. However, its scope extends beyond these fundamental aspects. It encompasses visits to wineries and participation in events such as fairs, festivals, and demonstrations, all motivated by the desire for sensory enjoyment and a quest for knowledge about the diverse wine cultures (Brochado et al., 2019). Some scholars classify wine tourism as a subset of cultural tourism, primarily due to the broader perspective that regards wine as an integral component of a region's culinary culture. Wine, in its various forms, is not only what people consume but is also deeply embedded in the culinary and beverage culture of a specific locale (Medina, 2015). From an anthropological viewpoint, wine becomes more than a beverage, it transforms into a commodity that encapsulates knowledge and social expressions passed down through generations. It becomes an integral part of identity and cultural heritage, signifying both tangible and intangible aspects of a culture (Wang, 2020). Consequently, from a tourism perspective, wine tourism is intrinsically linked to both material and immaterial culture. Nevertheless, it is essential not to lose sight of the strong connection between wine and the agricultural sector. A significant portion of the wine production process transpires in predominantly rural territories. Therefore, when individuals partake in the wine tourism experience, which includes visits to landscapes adorned with vineyards, wineries, and complementary attractions, it can be rightfully categorized as a form of rural tourism or tourism within rural spaces (Holmes, 2017; Visentin and Vallerani, 2018).

Wine tourism, a dynamic fusion of viticulture, culture, and travel, has garnered global attention as an experiential and immersive industry. Among the myriad wine destinations worldwide, the Danube Region emerges as a hidden gem. Stretching through ten countries in Central and Eastern Europe, the

Danube River gracefully winds its way through landscapes rich in wine heritage and tradition. This region boasts a complex mosaic of cultures, terrains, and grape varieties, making it a prime candidate for the elevation of transnational wine tourism. Wine tourism has witnessed a global surge, catering to a diverse audience seeking immersive educational encounters beyond mere wine tasting. The "Carta Europeia do Enoturismo" (Sakala et al., 2019) defines wine tourism as a holistic system comprising three interconnected components: the geographical territory, the tourism sector, and the wine-making culture. Central to this concept is the notion of the "winescape" or "wine-growing landscape," encompassing vineyards and their surrounding environs. This rich tapestry offers a profound engagement with rural life, local culture, and age-old traditions, immersing visitors in the culinary delights and architectural heritage (Yadav and Dixiv, 2023) of the region. Within this context, wine routes emerge as vital drivers of economic prosperity for rural communities. Today, wine tourism transcends the conventional wine-tasting experience. It has evolved into a multifaceted offering (Haller et al., 2020), emphasizing authentic encounters and top-notch service quality (Hess-Misslin et al., 2020). This transformation positions wine tourism as a composite tourist product, centered on creating memorable experiences (Tahar et al., 2021). Ultimately, the quality of service and the authenticity of these experiences are pivotal in delivering the full "winescape" immersion. Transnational wine routes within the Danube Region serve as potent catalysts for economic growth, invigorating rural communities and preserving cultural legacies (Martín-Caňadas et al., 2021). However, the essence of wine tourism here extends far beyond the simple act of wine tasting. Today, it encompasses a diverse spectrum of experiences and activities, emphasizing authenticity and service quality. What distinguishes transnational wine tourism in the Danube Region is its capacity to provide a multifaceted voyage, appealing not only to wine connoisseurs but also to those seeking cultural immersion, culinary adventures, and breathtaking landscapes (Moutinho L., & Hutcheson G., 2019). The application of the principles of sustainability is thus one of the basic determinants of the long-term survival of market economies, or even entire economic ecosystems as we know them today. In view of these facts, it is possible to assess the issue of sustainable development, as extremely topical, even key, for all industries, as well as for any entities using resources of a physical nature (Pollak et al., 2021).

1. Theoretical background

Wine tourism is a burgeoning sector of the global travel industry, attracting connoisseurs and enthusiasts seeking to explore the intricate relationship between wine, culture, and place. The Danube Region, known for its rich history and diverse landscapes, has been steadily gaining recognition as an emerging destination for wine tourism. Sustainable tourism, often referred to as responsible tourism or ecotourism, is a concept that has been defined and debated by various authors and organizations over the years. The United Nations World Tourism Organization (UNWTO) offers a definition of sustainable tourism as tourism that comprehensively considers its current and future economic, social, and environmental impacts. This approach includes addressing the needs of visitors, the tourism industry, the environment, and host communities (UNWTO, 2013). C. Michael Hall provides another perspective and defines sustainable tourism as a tourism mode that considers the needs of current tourists and host regions while providing and enhancing opportunities for the future (Hall, 1998). Similarly, The International Ecotourism Society (TIES) characterizes sustainable tourism as responsible travel to natural areas that prioritizes environmental protection, the well-being of local communities, and includes interpretation and education (TIES, 2015).

The European Union (EU), with input from the European Parliament and the European Commission, has defined several strategies for sustainable tourism development (European Commision, 2013, 2016) These strategies aim to strike a balance between the economic benefits of tourism and the environmental and social aspects. Strategies focused on sustainable tourism often involve a combination of planning, development, and management approaches that aim to maximize the benefits of tourism while minimizing its negative impacts on the environment, culture, and local communities.

1. European Tourism Indicators System (ETIS): the EU, in cooperation with the European Commission, has developed ETIS to measure and monitor the environmental and socio-economic

impact of tourism at destination level. The system helps destinations to set benchmarks and track progress in sustainable tourism development.

- 2. Green Destinations: The EU supports the Green Destinations programme, which encourages destinations to adopt sustainable practices. It provides a platform for sharing best practices and experiences in sustainable tourism across the EU.
- Council of Europe Cultural Routes: The Cultural Routes programme promotes sustainable tourism by highlighting Europe's rich cultural heritage. It promotes responsible travel along these routes and stresses the importance of preserving cultural diversity and heritage.
- 4. European Charter for Sustainable Tourism in Protected Areas: this charter encourages protected areas and national parks across the EU to adopt sustainable tourism practices. It aims to protect natural and cultural resources while offering visitors unique and responsible experiences.
- 5. European Ecotourism Labelling Standard (EETLS): the EU has developed EETLS to certify ecotourism services and accommodation that meet specific sustainability criteria. It helps travellers identify environmentally responsible options within the EU.
- 6. Low Impact Tourism Development: EU Member States are encouraged to prioritise low-impact tourism development that aims to minimise the negative effects of tourism on sensitive ecosystems and communities.
- 7. Investing in sustainable infrastructure: the EU provides funding for projects that improve infrastructure related to sustainable tourism, such as public transport, renewable energy, and waste management systems.
- 8. Digitization and innovation in tourism: the EU supports the use of digital technologies for sustainable tourism management, including data-driven decision-making, smart tourist destinations and digital marketing strategies.
- 9. Responsible tourism marketing: the EU supports the promotion of responsible and sustainable tourism through marketing campaigns and initiatives that raise awareness among tourists.
- 10. Community involvement: the strategies emphasise the involvement of local communities in decision-making processes, ensuring that they benefit from tourism development while preserving their cultural heritage and way of life.

These strategies reflect the EU's commitment to promoting sustainable tourism to foster economic growth, protect the environment and support local communities. They provide a framework for EU Member States and tourism stakeholders to work together to ensure that tourism benefits both visitors and the destinations they explore.

2. Methodology

The methodology section of the paper provides a clear and detailed explanation of how we conducted the research on wine and sustainable tourism in the Danube region, using the Interreg Danube projects as a focal point.

1. Research Design:

- a. Research Type: This study is primarily an exploratory and analytical research, aimed at providing a comprehensive analysis of wine tourism in the Danube region within the context of sustainable tourism. It involves an extensive literature review, analysis of relevant data, and synthesis of findings.
- b. Data Sources: Data sources include primary data from the Interreg Danube projects (INSiGHTS, Transdanube Travel Stories, and Cult-CreaTE), as well as secondary data from scholarly articles, reports, and official documents related to sustainable tourism and wine tourism in the Danube region.

Data analysis consists of:

- a. Analysis and Synthesis: Data from document analysis, literature review, and interviews will be systematically analyzed and synthesized to identify key trends, challenges, and opportunities in sustainable wine tourism in the Danube region.
- b. Decomposition and Abstraction: Utilizing decomposition and abstraction techniques to break down complex issues into manageable components and extract essential insights and patterns.

3. Results

The discussion will revolve around previous projects and studies that have explored similar topics within the field of tourism. This examination of existing research provides valuable context and insights into the subject matter. Herein, we delve into the literature to understand the trends, findings, and gaps that have emerged from prior investigations. Before addressing specific projects, we would like to describe the project evaluation process. In the first stage of the evaluation process for project selection, two distinct sets of criteria are employed. These criteria serve as the foundation for determining whether an application should be approved:

Eligibility Criteria: The primary purpose of the eligibility criteria is to ensure that essential aspects of the proposal are in line with program requirements. This includes verifying that the proposal was submitted by the stipulated deadline, confirming that the expression of interest is comprehensive and fulfills the specified requisites, and ensuring that both the partnership and the project align with the criteria established at the program level. The eligibility check is conducted by the Managing Authority and joint secretariat, with support from the National Coordinators, to validate the eligibility of the lead applicant. The ultimate decision on eligibility is made by the Monitoring Committee (MC). Failure to meet these eligibility requirements results in the rejection of the proposal. Quality Criteria: The quality criteria serve as the cornerstone for the evaluation of Expressions of Interest (EoI) to prioritize projects for selection. Each question within the EoI is evaluated against a set of predefined quality criteria. These criteria are scored on a scale from 0 to 5, with a score of 5 indicating an exceptionally high level of quality. For example, the quality assessment scrutinizes aspects such as the alignment of the proposal with the program's focus and the objectives of the call, the logical coherence of the project's intervention strategy concerning the program's objectives, and the extent to which the project unmistakably exhibits a transnational dimension and impact.

In the second evaluation stage, the focus shifts to two additional sets of criteria: Eligibility Criteria: These criteria are designed to confirm that the proposal has met fundamental requirements, specifically that it has been submitted by the deadline and that the application form is complete and complies with the outlined requirements. The eligibility criteria are binary, requiring a simple "YES" or "NO" response as they are not open to interpretation.

Quality Criteria: In this phase, the quality criteria are applied to assess the quality of eligible project proposals. These criteria are intricately linked to the specific objectives and outcomes of the program and are consistent across all priorities. This evaluation stage is led by the Managing Authority and Joint Secretariat, occasionally receiving support from external evaluators as needed. For instance, the quality assessment examines whether territorial needs and challenges are identified and adequately justified, the logical consistency of the intervention strategy, and the extent to which the proposal contributes to

EU strategies and policies. These comprehensive evaluation processes ensure that project proposals meet the fundamental eligibility requirements, adhere to rigorous quality standards, and align closely with the program's objectives and priorities (Applicants Manual 2021).

3.1. Danube Culture Platform - Creative Spaces of the 21st Century

The principal objective of the project was the development of an innovative, multilevel policy framework for cultural routes within the Danube area. The project's activities were designed to address a range of objectives. Firstly, it aimed to facilitate the creation of new tourist destinations along the Danube through the discovery, preservation, and interpretation of concealed heritage, utilizing contemporary arts and technologies. Secondly, the project sought to enable the exploration of the cultures associated with the expanded European cultural routes along the Danube, thereby engaging an international audience and tourists. The project functioned as a driving force for strategic development, shaping future activities and fostering collaboration among culture and tourism stakeholders throughout the Danube region. Its primary focus lay in the promotion of cultural exchange and the establishment of connections between culture and tourism. The Danube Cultural Platform project aimed to extend the scope of European cultural routes by uncovering hidden cultural heritage along the Danube and rendering it visible through the utilization of contemporary arts and technologies. The project defined "hidden heritage" as elements that were relatively obscure due to various factors. These factors included being situated beyond the mainstream, buried underground, destroyed, prohibited or suppressed for political or societal reasons, lost over time, or of an intangible nature (such as submerged communities or heritage submerged due to artificial lake creation, relocated cemeteries, historical communication systems like postal networks, neglected structures like buildings and bridges, and locations ravaged by wars). Additionally, hidden heritage encompassed intangible aspects such as music, literature, river culture, and lifestyles (Kujundzic, 2018).

The Danube Culture Platform project yielded several significant outputs achieved through a comprehensive approach involving transnational conferences, workshops, partner meetings, and collaborative efforts among experts in culture and tourism. These outputs included: 1. Policy Learning Platform: The establishment of a Policy Learning Platform fostered cooperation between culture and tourism stakeholders across the Danube region. Over a period of two and a half years, this platform facilitated knowledge exchange and the development of measures to promote cultural heritage. 2. Transnational Conferences: The project organized transnational conferences with distinct themes, such as "Discovering Hidden Heritage," "Audience Development," "World Heritage," "Creating Memorable Experiences," and "Visible Danube." These conferences conveyed the project's objectives to a broader audience and provided opportunities to engage with international experts, gain inspiration, and showcase best practices in cultural heritage and tourism. 3. Discovery of Hidden Heritage: The project's core mission was to discover historical sites and develop new narratives about them. This involved searching for "hidden places" along the Danube, collecting and elaborating on data, and culminated in the creation of a "Guidebook on Resourcing Hidden Heritage for Tourism" and a compilation of sites termed "Mapping Hidden Heritage Hot Spots." 4. Pilot Projects: Under the banner of "Heritage Reloaded," eight pilot projects were developed and implemented. These projects aimed to make hidden cultural heritage visible through digital, technological, and artistic interventions. They reconstructed lost history, offered unique experiences at historic sites, and enabled encounters with hidden cultural heritage, ultimately supporting the development of new narratives. 5. Interpretation Framework: One of the key results was the development of the "Interpretation Framework for the Cultural Routes Based on Hidden Heritage in the Danube Region." This framework provided a structured approach for interpreting cultural routes based on hidden heritage. 6. Proposal of Themes: The project proposed "Themes for the Prolongation of European Cultural Routes," offering a roadmap for the long-term development of cultural tourism strategies rooted in the Danube region's rich hidden cultural heritage. These outputs were achieved through collaborative efforts, creative interventions, data collection, and strategic planning, collectively contributing to the preservation, promotion, and sustainable utilization of the Danube region's cultural heritage—a vital lifeline within Europe (Federal Chancellery of Austria, Division II: Arts and Culture, 2019) The main goal of the INSiGHTS project was to harness the outstanding natural and cultural resources within the Danube Regions while simultaneously tapping into the rising trend of slow, green, and healthy tourism. With the collaboration of 13 partners across several European countries, including Austria, Bulgaria, Croatia, Germany, Hungary, Romania, Serbia, Slovakia, and Slovenia, this project sought to enhance the appeal of these regions to tourists. The project's primary objectives included the protection of these invaluable natural and cultural resources and the promotion of sustainable tourism practices. Through close engagement with local stakeholders in eight regions, the project aimed to gather crucial feedback on the current state of tourism while also generating innovative ideas and proposals for fostering slow, green, and healthy tourism opportunities. Ultimately, the main outcome of the INSiGHTS project was the development of eight integrated sustainable tourism strategies, designed to be adaptable across the entire Danube Region. These strategies aimed to make the Danube Regions more attractive and environmentally responsible tourist destinations while preserving their unique heritage.

The INSiGHTS project achieved significant outcomes in the pursuit of sustainable tourism development in the Danube Region. It introduced a self-assessment manual to evaluate partner regions' current tourism situations and sustainability aspects. Furthermore, transnational workshops and self-assessment exercises educated partners on using indicators to measure sustainability, resulting in a comprehensive "Status Quo Synthesis." In addition to this, partner regions established regional stakeholder groups, which were essential for transparent and well-accepted vision and strategy development. A manual guided partners in setting up effective stakeholder groups, and capacity-building workshops ensured participatory development approaches were implemented. These realistic visions were based on selfassessment, stakeholder involvement, and good practice examples, reflecting each region's unique cultural and natural features. The identification of development gaps and desired goals informed futureoriented visions, leading to the creation of eight sustainable regional tourism strategies. Moreover, transnational learning through walkshops, bilateral study visits, thematic panels, and master classes facilitated knowledge exchange and mutual learning. Partners participated in activities like walkshops, which focused on integrated tourism management, coordinated tourism product development, and thematic panels addressing vital elements of tourism development. Additionally, transnational policy recommendations were drafted based on an inventory of policies influencing sustainable development. Roundtables involving regional policy influencers provided a forum for practitioners to propose policy recommendations, enhancing their capacity to work within policy frameworks across governance levels. Furthermore, a collection of 15 state-of-the-art good practices in slow, green, and healthy tourism from around the world was compiled. Research and evaluation were conducted to select outstanding examples that could serve as guides for sustainable tourism development in the Danube Region. Lastly, partners conducted pilot actions to assess the viability and effectiveness of novel solutions and tools developed within the project's three thematic pillars. These actions were tested in less developed regions within the Danube macro-region to advance sustainable tourism practices (Cooperation with INSiGHTS partners, 2019).

3.3. TRANSDANUBE TRAVEL STORIES Sustainable mobility linking Danube Travel Stories

The main goal of the project "Transdanube Travel Stories" was to harness the rich cultural and natural heritage of the Danube region for sustainable tourism while preserving this invaluable legacy. Recognizing the significance of sustainable tourism in this context, the project aimed to leverage the potential of European Cultural Routes and other networks to initiate this endeavor. Firstly, the project aimed to develop captivating new narratives that would effectively promote the Danube macro-region as a sought-after tourist destination. It recognized that individual sites alone might not sufficiently attract tourists. Therefore, the strategy involved linking carefully selected sites along a thematic trail, enabling tourists to immerse themselves in a coherent and memorable Danube experience. Secondly, the project focused on the integration of mobility management tools, such as mobility managers, mobility centers, and mobility plans, into the institutional structures at both the route and destination levels. This integration was intended to facilitate tourist mobility through environmentally-friendly transport options, thus mitigating the adverse effects of increased tourism-related transportation. Thirdly, the project sought to establish tourism product clubs at the destination level and enhance

thematic and institutional connections between European Cultural Routes and other networks. This approach aimed to foster stronger collaboration among key stakeholders and bolster their capacity to promote sustainable tourism in the Danube region effectively. Ultimately, by combining these elements—new narratives, mobility management, and enhanced institutional capacities—the project aimed to create a robust framework for positioning the Danube as a unique and sustainable tourism destination. The envisioned outcome was an increased number of European citizens experiencing the rich cultural and natural heritage of the region in a sustainable and environmentally-conscious manner. The primary objective of the project was to bolster sustainable tourism development, and this was accomplished through a multifaceted approach. By combining innovative storytelling, sustainable mobility management (MM), and enhanced institutional capacity, the project aimed to achieve its central outcome: improved management for the sustainable utilization of tourism potential, ultimately

central outcome: improved management for the sustainable utilization of tourism potential, ultimately resulting in more European citizens experiencing the cultural and natural heritage of Europe. The project's activities effectively intensified cooperation among key stakeholders involved in sustainable tourism and sustainable mobility at both destination and route levels. As sustainable tourism contributes significantly to the responsible use of natural and cultural resources, the project played a pivotal role in this regard. The project's outputs strengthened collaboration among key actors through several key strategies: Firstly, it established eight Tourism Product Clubs (PCs) that convened relevant service providers dedicated to sustainable tourism development at the destination level. These PCs met regularly throughout the project's implementation, fostering collaboration and knowledge sharing. Secondly, the project facilitated the convergence of management organizations from eight distinct routes and networks. This collective effort promoted cross-route cooperation and synergies among various stakeholders. Additionally, the project successfully bridged the Tourism PCs with the management organizations of these eight different routes and networks, creating a cohesive network of stakeholders. Moreover, the project organized cooperation events that brought together management organizations from routes not directly involved in the project, as well as key players from the tourism market. These events facilitated broader industry collaboration. Furthermore, the project significantly enhanced institutional capacities among key stakeholders through various training initiatives: It trained seven mobility managers at the route level, empowering them to disseminate MM concepts to other parts of their respective routes. It also trained at least six additional mobility managers who would work directly within the six newly established mobility centers at the destination level. Moreover, the project empowered approximately 20 guides from various destinations through a specialized Winter School program, equipping them with effective story-telling techniques. In sum, the project's holistic approach, which combined storytelling, sustainable mobility management, and capacity-building, led to a strengthened collaborative network among stakeholders, thereby promoting sustainable tourism and enabling more European citizens to experience Europe's rich cultural and natural heritage responsibly (Cooperation within project partners, 2022).

3.4 Cultural and Creative Industries contribution to Cultural and Creative Tourism in Europe

The main goal of the project was to enhance the competitiveness of small and medium-sized enterprises (SMEs) by supporting their capacity to grow in regional, national, and international markets and encouraging their active engagement in innovation processes. This goal aligned with the broader objective of improving the implementation of regional development policies and programs, particularly those related to Investment for Growth and Jobs, as well as relevant European Territorial Cooperation (ETC) programs. The project aimed to assist SMEs at all stages of their life cycle in developing and achieving growth while fostering innovation within their operations.

The Cult-CreaTE project aimed to harness the potential of Cultural & Creative Industries (CCIs) to develop new Cultural & Creative Tourism (CCT) products and services, fostering growth and job creation in eight regions. The project addressed common challenges such as the underutilization of CCIs in cultural tourism and the need to attract new generations of tourists. It recognized the concept of Creative Tourism, involving tourists and locals in co-creating tourism products, as a promising approach. The project's overall objective was to redeploy CCIs for the development and promotion of CCT strategies, emphasizing sustainability, innovation, policy change, capitalization, and capacity building. It pursued several key activities to achieve this goal. Firstly, thematic workshops on various aspects of CCIs'

contribution to CCT were organized, focusing on identification, best practices, product development, governance, and business models. These workshops allowed partners to exchange experiences and knowledge. In addition, study visits complemented the workshops, providing firsthand insights into best practices in deploying CCIs for sustainable cultural and creative tourism. Moreover, peer reviews were conducted to enhance policy instruments and action plans related to creative tourism product development. Partners cooperated to improve these instruments according to their needs and expertise. Furthermore, the project also aimed to apply relevant research results to mainstream them into operational programs and ESIF. Simultaneously, stakeholder engagement played a crucial role throughout the project, ensuring a broad understanding of the project's goals and the need for policy change. Consequently, policy learning was a continuous process, with the policy change occurring at the local/regional level. Additionally, relevant inputs were provided to the Policy Learning Platform of the Interreg Europe program. In parallel, capacity building initiatives were implemented to train partners' staff, policymakers, and key stakeholders in creative tourism product development based on CCIs. Ultimately, the project ensured broad dissemination to pan-European fora, EU institutions, international organizations, and destination authorities. Innovatively, the character of the project lay in effectively harnessing CCIs to develop and deliver CCT, exploiting the synergies between the two sectors. In conclusion, the Cult-CreaTE project successfully leveraged CCIs to promote sustainable cultural and creative tourism, fostering growth and innovation in the participating regions. Through a series of activities, knowledge exchange, and policy improvements, the project advanced its objectives and contributed to broader EU policies and initiatives in the cultural and creative sectors (Cooperation within project partners, 2022).

Figure 1. Summary of analyzed projects.

Project title	Project duration	Project budget in €
Danube Culture Platform	2017-2019	1 676 878.64
INtegrated Slow, Green and Healthy Tourism Strategies	2017-2019	2 308 170.55
TRANSDANUBE TRAVEL STORIES	2020-2022	1 820 926.66
Cultural and Creative Industries contri-		
bution to Cultural and Creative Tour- ism in Europe	2018-2022	1 798 270.00

Source: Interreg Danube platform https://www.interreg-danube.eu/

4. Conclusions

Wine tourism as a main objective of our research together with sustainable tourism represents an activity deeply intertwined with the appreciation of the agricultural practices related to grape cultivation and the intricate art of winemaking. Sustainable tourism, as defined by various authors and organizations, involves responsible and ethical travel practices that take into account economic, social and environmental impacts while preserving cultural diversity and heritage. Authors such as C. Michael Hall and organizations such as UNWTO and TIES offer valuable insights into this concept. The Danube region, rich in natural and cultural heritage, has embarked on initiatives such as the INSiGHTS project and Transdanube Travel Stories to use its resources to develop sustainable tourism. These efforts include self-assessment, stakeholder engagement, policy recommendations and the collection of best practices. In conclusion, sustainable tourism is not just a concept but a global imperative. It is a responsibility to travel in a manner that respects nature, culture and communities, while promoting economic growth. The European Union, together with its Member States and regions, is at the forefront of this effort and is leading the way with strategies that can serve as a model for sustainable tourism. As travelers and stakeholders, we have a common responsibility to adopt and promote sustainable tourism practices, ensuring that the beauty and diversity of our world remains untouched for generations to come.

Funding - This article is one of the partial outputs of the currently implemented research grants VEGA no. 1/0140/21 and VEGA no. 1/0462/23.

References

- 1. Applicants Manual 2021 2027. https://www.interreg-danube.eu/uploads/media/de-fault/0001/53/e0a7e60df6bc5e866b9dfc1f9e5e768011c70c62.pdf
- 2. Brochado, A., Stoleriu, O. y Lupu, C. (2019). Wine tourism: a multisensory experience. Current Issues in Tourism, 1-19.
- 3. Cooperation with INSiGHTS partners, 2022, Project results https://keep.eu/projects/25322/Sustainable-mobility-linkin-EN/
- 4. Cooperation with INSiGHTS partners, 2022, Project results https://projects2014-2020.inter-regeurope.eu/cultcreate/
- 5. Collective of authors from World Tourism Organization (UNWTO), 2013, Sustainable Tourism for Development Guidebook https://www.e-unwto.org/doi/pdf/10.18111/9789284415496
- 6. Cooperation with INSiGHTS partners, 2019, Final project brochure introduction project results https://www.interreg-danube.eu/uploads/media/approved_project_public/0001/33/9301f5bd08f5871f412b7ba28aff6bd7f68d709d.pdf
- 7. Collective of authors from World Tourism Organization (UNWTO), 2013, Sustainable Tourism for Development Guidebook https://www.e-unwto.org/doi/pdf/10.18111/9789284415496
- 8. European Commission. The European Tourism Indicator System—ETIS Toolkit for Sustainable Destination Management; Publications Office of the European Union: Luxembourg, 2013
- 9. Federal Chancellery of Austria, Arts and Culture Division, 2019, CultPlatForm_21: The Danube Culture Platform Creative Spaces of the 21st Century, Project documentation https://www.interreg-danube.eu/uploads/media/approved_project_out-put/0001/31/e2f737c87ae91f7f46924b87498dad43e5e2ad9e.pdf
- 10. Haller, C.; Thach, L.; Olsen, J. Understanding eWinetourism Practices of European and North American wineries. J. Gastron. Tour. 2020, 3, 141–156. [CrossRef]
- 11. Haller, C.; Hess-Misslin, I.; Mereaux, J.P. Aesthetics and conviviality as key factors in a successful wine tourism experience. Int. J.Wine Bus. Res. 2020. ahead-of-print. [CrossRef]
- 12. Hall, C. M., & Lew, A. A. (Eds.). (1998). Sustainable tourism: A geographical perspective. Longman.
- 13. Holmes, M. R. (2017). Integrated rural wine tourism: a case study approach. Journal of Wine Research, 28(3), 216-238.
- 14. Martín-Caňadas, G. M., et al. (2019). Wine Tourism: A Segmentation Analysis for Spanish Tourists.
- 15. Medina, F.X. (2015). Turismo y cultura en denominaciones de origen enogastronómicas: el caso de la región de Tokaj-Hegyalja (Hungría). International Journal of Scientific Management and Tourism, 3, 167-177.
- 16. Moutinho, L., & Hutcheson, G. (2019). The SAGE Handbook of Wine and Health.
- 17. Pollák, F.; Vodák, J.; Soviar, J.; Markovič, P.; Lentini, G.; Mazzeschi, V.; Luè, A. Promotion of Electric Mobility in the European Union—Overview of Project PROMETEUS from the Perspective of Cohesion through Synergistic Cooperation on the Example of the Catching-Up Region. Sustainability 2021, 13, 1545. https://doi.org/10.3390/su13031545
- 18. TIES (2015) The Components of Successful Ecotourism. The International Ecotourism Society (TIES).collective of authors, https://www.scirp.org/(S(czeh2tfqyw2orz553k1w0r45))/reference/referencespapers.aspx?referenceid=2533924
- 19. Tahar, Y.B.; Haller, C.; Massa, C. Business tourism in the wine sector: An exploratory study. J. Wine Res. 2021, 3, 262–280.[CrossRef]

- 20. Sigala, M.; Robinson, R.N.S. Introduction: The evolution of Wine Tourism Business. In Management and Marketing of Wine TourismBusiness: Theory and Cases; Sigala, M., Robinson, R.N.S., Eds.; Palgrave McMillan: London, UK, 2019; pp. 1–24.
- 21. Visentin, F. y Vallerani, F. (2018). A countryside to sip: Venice inland and the Prosseco's uneasy relationship with the wine tourism and rural exploitation. Sustainability, 10: 1-18.
- 22. Wang, C. (2020). Creating a wine heritage in Japan. Asian Anthropology, 1-16.
- 23. Yadav, M.K.; Dixit, S.K. The growth and evolution of global wine tourism. In Routledge Handbook of Wine Tourism; Dixit, S.K., Ed.;Routledge: Oxfordshire, UK, 2023; pp. 1–22.

Creative clusters in Textile industry within the EU countries

Denisa Gajdová 1

1 Faculty of Business Management, University of Economics, Bratislava, Slovakia; denisa.gajdoval@euba.sk

Abstract: The main function of clothing has been the same for a long time. Cover the body from bad weather, protect it from injury and avoid unwanted looks. Gradually, it also became a tool to show status or origin, and later also character, opinions, taste and style. The nature of its production has also changed radically over the past decades. To fulfill the clothing needs of people from all over the world, the textile and clothing industry gradually developed. The element of creativity required for the creation of proposals in the field of textile and clothing industry in the field of design is very important and enables the strengthening of the competitiveness of enterprises through the creation of cooperation at the regional level and the emergence of textile and clothing clusters. In the article, we focus on the current situation and prospects for the development of such clusters within the European Union.

Keywords: clothing industry, clusters, European Union.

Introduction

In 2015, the estimated average amount of new clothing purchased in the EU was approximately 6.4 million tons, which is approximately 12.7 kg per person (European Clothing Action Plan, 2017). If the comprehensive environmental impact of all textile and clothing consumption in the EU were to be calculated, diverse data and impacts, mostly occurring outside the EU, would have to be analyzed. Therefore, it is not easy to get exact numbers. However, estimates from the Joint Research Center from 2006 say that clothing accounts for 2-10% of the EU's overall impact on the environment related to consumption. Šajn (2019) describes in detail the current EU policy regarding textiles and clothing. The first measure, which also directly applies to textiles and clothing, is the adoption of the so-called Circular Economy Package from 2018 (European Parliament, 2018). It contains four approved legislative proposals and for the first time obliges EU member states to collect municipal and textile waste separately. Further obligations will gradually come from the EU, as the European Commission adopted a new action plan for the circular economy in March 2020. The latter has the ambition to solve mainly the improvement of product life, the presence of dangerous chemical substances, the limitation of single use, the reduction of the carbon footprint and the support of the "product as a service" model.

1. Theoretical background

The pioneer of the creative economy is John Howkins (2002), who was the first to focus on the relationship between creativity and the economy. Howkins particularly highlighted the ability to combine, which creates extraordinary value and prosperity. On the basis of his work, two different approaches to the perception of creativity have been developed, as a phenomenon that belongs to the satisfaction of a person as a being, and creativity aimed at creating results. Kloudová (2010) followed up on the primary theoretical approaches of the mentioned area and pointed to the fact that the creative economy supports the development of scientific fields, art and culture, while these areas are increasingly significantly commercialized. a company that focuses primarily on innovations and their dispersion in the environment, while also supporting the science and technology development sector. However, the field of creative economy is not only connected with technological development, but also with social and cultural needs. Changes in the consumption of modern society lead to the promotion of creativity in all disciplines that deal with the processes of preparation and creation of visual products

and services that provide the basis for competitive advantages in the environment of global markets (Levickaite, 2010). The creative economy is thus linked to changes in the lifestyles of society and the field of entertainment. This creates an environment for development sector of services and new challenges and opportunities in areas such as media, communication with an emphasis on intellectual property, and at the same time the area of consumption for pleasure, which includes design, tourism, software, fashion, sports and the like. Among other approaches to the theoretical base of the creative economy, Colette (2007) contributed, who defines the creative economy as a set of creative industries that represent mutual association and knowledge-oriented sectors focused on the creation and use of intellectual property. In this respect, the creative economy is built on creativity, thus it depends more on the resources (capital) of ideas and human creativity than on physical capital itself. Creativity and ideas stimulate development based on information and the creation of new media, especially in the digital world, which ultimately reduces overall costs. In his professional publication, O'Connor (2009) focuses more closely on the classification of the creative economy, focusing on the link between the cultural sector and the economy, which mutually result in the creative industry, which represents the basis for the development of metropolitan areas and thus influences spatial planning, policy and competitiveness. As part of the connection between the fields of culture and the economy, O'Connor focused on the mutual relationship between the creator and the consumer and their interactions. It is thus a mutual involvement, which is characterized by common links (feedback) and customization of results. In contrast to O'Connor, Araya (2010) divides the creative economy into two models, the first emphasizing the production of cultural and creative goods and services, while the second emphasizes the role of intellectual innovation as the key to economic development in a period of social change caused by development media and digitization. It mainly focuses on innovations that are not primarily technological in nature, but highlights mainly the area of process, management and marketing innovations. Despite the variety of definitions of the professional public within the theorization of the creative economy, the authors agree that the basic building block is the cultural and creative industries (CCI), and the critical mass are creative individuals. Thus, the creative economy also supports areas that are part of the development of society and highlight the issues of social inclusion, cultural diversity and the development of human resources. The development of the creative economy is related to the growing number of representatives of the creative class and the basic common feature, creativity itself. A characteristic feature of creativity is, in addition to original and unique ideas and results, the ability to cover social and aesthetic needs. In this direction, according to Guilford (1968), it is important to point out the influence of nature and education, which affect the personality and social characteristics of individuals, with an impact on their flexibility, openness to new experiences and the will to take risks with learning new things. From the point of view of competitiveness, creativity is associated with innovative activities, while creativity itself is reflected in the process of producing new ideas, approaches and activities. However, innovative activities are connected by the subsequent application and use of new approaches that are later reflected in tangible and intangible nature, in the form of commercial goods, services, business practices and technologies (Houghton and DiLiello, 2010). Currently, there is a deepening of the concept of creative industries with culture, with the aim of using talent, creativity and unique ideas (Howkins, 2002). Creative industries have thus come to a new form of representation and attention from planning and strategies, within a knowledge-oriented society, with the aim of using knowledge in all areas of economic life. Creative industries have a strong link to urban areas, but even stronger to local agglomerations. The approach of locating a specific place in a creative concept results from a significant connection between the impression of the location and the motives for the location choices of companies (Potts, 2009). This raises the question of what are the special characteristics of the creative industries and at the same time what are the forms of creativity potential and what is characteristic of creative fields. As Florida (2005) states, it is the overall concept of the lifestyle of a specific creative class and creative environment. The overall concept consists of the relationship between culture and urban development that creative locations require. The concept of CCI represents the division into three primary groups:

- 1. Core Creative Industries
 - Literature
 - Music
 - •Visual Arts

- Performing Arts
- 2. Other Creative Industries
 - •Film
 - Museums
 - Galleries
 - Libraries
 - Photography
- 3. Wider Creative Industries
 - •Cultural Heritage
 - Publishing
 - Television and Radio
 - Sound and Video
 - Design
 - Video Games

The textile industry can be classified as a creative type of industry precisely through design. Textile designing is a creative field that includes fashion design, carpet making and any other area related to fabric. Within the fashion industry, textile designers have the ability to inspire collections, trends and styles.

2. Methods and methodology

For the evaluation and processing the contribution, we have used available data from statistical databases of Eurostat and regional data. Within individual countries of the Europe, we have calculated the localization coefficient as a prerequisite for specialization in the researched textile industry area, which we subsequently also subjected to a sensitivity analysis within the monitored data. The localization coefficient (1), although it could be seen as non-systematic approach, is one best and frequently used instrument for evaluating the potential of a region (in this case country) for the formation of a cluster of a certain (textile and clothing) industry. The localization coefficient (LQ) shows how the employment in the researched area in the region is higher than the average in general (Gajdová, 2022).

LQ = (x/X)/(y/Y) (1) where

LQ -localization coefficient in the region

x – number of employees in the industry in the requested region

X – total number of employees in the region

y – number of employees working within the industry in the country

Y – total number of employees within the country

The region was, in that examination, individual country and for country we have used the whole areal of Europe. Value of the LQ higher than one, it is the evidence of high representation of the industry in the region. Coefficients of localization higher than the 1.2 could be seen as the regional specialization in a given region/country

3. Results

In the case of CCI, it is possible to observe some specific and at the same time identical motives, attitudes and specifics with traditional clusters, in connection with the emergence and development of

the mentioned issue. In the case of the creation of CCI clusters, from the point of view of specifics, it is specifically about the creation of a top brand (brand name) with which the clusters operate at the national and international level (support of competitiveness). Openness to joint activities was identified as another motive, especially in connection with the non-standardized production of the CCI area and the support of innovation activities (open innovation, quadruple-helix). In the case of openness, as an attitude, there is also an interest in new ideas and procedures, which at the same time support the competitiveness of clusters. The common motive is the interest in entering new markets, which bring the cluster new opportunities for self-presentation and applicability of outputs. From the point of view of the specifics of the CCI clusters, the creation and support of the development of a common identity, not only of an economic but also of a social nature, linked to urban regeneration, through the creative economy, was presented. It is about building the image of the CCI area, clusters and, at the same time, the places where they operate in the form of competitiveness support. The motives and specifics of the development of the area of traditional and CCI can be observed on the following diagrams. In the issue of CCI, when establishing clusters, emphasis is mainly placed on internal factors, such as mutual trust, especially in the case of a diversity of industries and mutual cooperation and inspiration, in case of nonstandardized production. From a subjective point of view, it is openness to new ideas in functioning and interest in work procedures (process innovations) that focus on the area of cooperation, not only within the cluster (micro environment). A personal approach, which is supported by informal communication (knowledge sharing) and meetings, also contributes to joint success. The membership base of CCI clusters places emphasis on building a common brand (brand name), which also supports internationalization, in the form of presentation at foreign exhibitions, fairs and competitions. In the case of an objective point of view, it is mainly about the quality of the membership base, where the interest in quality prevails over quantity and at the same time also the possibility of developing joint projects. As part of the development, primary activities focused on the development of human capital were identified, through educational programs with the aim of supporting the competitiveness of the cluster organization. At the same time, the activities are aimed at supporting networking (networking/matchmaking) and building business cooperation, both within the cluster organization and also with external partners, especially in the case of technically focused R&D projects and participation in foreign exhibitions and conferences (activities supporting the internationalization of the cluster organization). In the context of external factors, the public sector's interest in supporting the CCI area and clusters was identified, along with the economic situation (micro) and the environment. From the point of view of external factors, the primary barriers to creation and development were identified, which consist in the rigidity of the support mechanism, which often cannot respond to real needs, together with the bureaucratic burden. In contrast to the barriers of public support, at the same time there is pressure on the functioning of clusters on the basis of membership fees, a supporting and limiting factor. However, to support independent functioning, within the framework of CCI clusters, projects to increase competitiveness are implemented on the basis of business orientation. The specifics of the area of creation and support for the development of cultural and creative clusters are graphically presented in the following table.

Table 1. Textile and clothing industry in European countries.

Country	No of employees in TI	No of employees in country	LQ
Belgium	14190	5350607	1.08
Bulgaria	11823	3130364	1.54
Czech Republic	22850	5320617	1.76
Croatia	3662	1727065	0.87
Cyprus	535	675104	0.32
Denmark	3361	3132170	0.44
Estonia	1058	732290	0.59
Finland	5650	2823107	0.82

France	40392	31649853	0.52
Greece	7544	4700676	0.66
Netherland	13010	9895709	0.54
Ireland	1982	2680949	0.30
Lithuania	9541	1509591	2.58
Latvia	3790	971430	1.60
Luxembourg	748	337221	0.91
Hungary	8880	4946680	0.73
Malta	269	288767	0.38
Germany	80174	44515312	0.74
Poland	59337	18585470	1.31
Portugal	45514	5289425	3.52
Austria	7820	4774187	0.67
Romania	27031	8304526	1.33
Slovakia	6415	2826275	0.93
Slovenia	3150	1060410	1.21
Spain	49312	23716311	0.85
Sweden	1840	5600661	0.13
Italy	108086	25481769	1.73
together	537964	220026546	

Source: own processing, Eurostat 2023

The results in table 1 brought to us by the localization coefficient point to the assumption of the formation of clusters in several European countries. This is primarily a traditional country associated with the clothing industry, such as Italy or Romania. However, a high assumption also appears in countries such as Bulgaria, the Czech Republic, Poland, Latvia and Slovenia. In Lithuania and Portugal, this coefficient is even higher, which gives, at first glance, the assumption of a very strong regional state.

The 67 clusters operating primarily in countries traditionally associated with the textile and clothing industry within EU countries, now. Countries where could be observed any clusters are Germany, Italy, France, Romania, but also Poland, Belgium, Bulgaria, the Czech Republic, Austria, Spain, Portugal, Hungary and Slovakia (Hollanders-Merkelbach, 2023). These clusters are in Germany (15), Italy (9), Romania (6), France (6) or Poland (5). For us, it has to be hard to understand that more than a half of EU countries (14 from 27) has no textile or clothing type of cluster, although production, employment, education (in universities) and enterprises in this area that could be seen as basic preconditions for clustering in this area of activity.

4. Discussion

There are clusters in the textile and clothing industry within Europe, but they are not many. The prospect of merging companies in this area would not only bring economies of scale, but above all would strengthen the competitiveness of the companies associated in them as well as the respective regions. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted.

Taking into account the specifics of the studied area, the following activities could be proposed for clusters within the textile and clothing industry:

- Knowledge sharing especially in connection with the use of new technologies in creation and the use of new trends in production.
- Access to foreign markets spatial expansion with an orientation to the available metropolitan regions, there is the potential of using the role of "back office" for individual branches of design.
- Internationalization in the field of design, it is primarily participation in foreign exhibitions and fairs, with a focus on events with a global character (e.g. Milan Expo), as a form of presentation, networking and gaining new contacts.
- Education in the field of entrepreneurship and current trends cooperation with educational organizations, especially in the field of entrepreneurship (economically oriented), to supplement the necessary knowledge with the aim of applying it to the market. However, at the same time, education in the field of new trends and the use of technologies within non-standardized production.
- Use of technical infrastructure (graphics software) sharing of technical infrastructure for the membership, especially in the case of more demanding technological tools (computer technology and software) for creation and modeling.
- Common brand name (support of a common identity) creation of a top international brand that would help in the development of the cluster organization and at the same time the design and CCI industry. Building a common brand in the context of local identity, in the context of urban regeneration and tourism support (culture-led regeneration).

Active involvement in the use of public resources – active access to public resources within the EU (Creative Europe), national and regional grant schemes, in connection with the support of the competitiveness of the cluster organization and the environment in which it operates.

5. Conclusions

The textile industry employs millions of people worldwide, making it one of the largest industries globally and an important part of the European manufacturing industry. However, the production and consumption of textiles entails significant environmental, climate and social impacts, as they use resources, water, land and chemicals and emit greenhouse gases and other pollutants.

The limits of the work are connected with the issue of defining cultural and creative clusters, which affects the processing methods and, of course, the results themselves. Limitations are simultaneously connected to the data base of both quantitative and qualitative analysis. From a quantitative point of view, this is the use of secondary data that is not completely complete, so it is not possible to achieve the completeness of the input data. We also see the limitations of our investigation in the understanding of regions in the sense of countries (states). however, the cooperation of enterprises and the creation of clusters could also take place within a region consisting of several countries. Therefore, we are convinced of the suitability of further, more detailed investigation.

Funding: This paper is an outcome of project VEGA no 1/0462/23 "Cirkulárna ekonomika v kontexte spoločenských požiadaviek a obmedzení trhu" "<u>Circular economy in the context of social requirements</u> and market constraints"

References

- Araya, D. Education in the creative economy: Knowledge and learning in the age of innovation. Peter Lang; 2010.
- 2. Colette, H. et al. *Entrepreneurship in the creative industries: an international perspective*. Edward Elgar Publishing; 2007.
- 3. European Clothing Action Plan, 2017. Mapping clothing impacts in Europe: The environmental cost, 2017. http://www.ecap.eu.com/ wp-content/uploads/2018/07/Mapping-clothing-impacts-in-Europe.pdf [Accessed on August 2023].
- 4. Európsky parlament, 2018. Obehové hospodárstvo: Viac recyklácie a menej skládkovania. Dostupné online: https://www.europarl.europa.eu/news/sk/headlines/priorities/ obehove-hospodarstvo-a-redukcia-

- odpadu/20180411IPR01518/ obehove-hospodarstvo-viac-recyklacie-a-menej-skladkovania) [Accessed on September 2023].
- 5. Florida, R. Cities and the creative class. Routledge; 2005.
- 6. Gajdová, D., 2022. Pandemic Covid 19 and Its Impact on Creative Industry Clusters in Slovakia. *Ekonomika a manažment: vedecký časopis Fakulty podnikového manažmentu Ekonomickej univerzity v Bratislave*. Bratislava: Nadácia Manažér, 2022, 19(1), 63-74.
- 7. Guilford, J. Intelligence, creativity, and their educational implications. San Diego: RR Knapp; 1968.
- 8. Hollanders, H., Merkelbach, I.: European Panorama of Clusters and Industrial Change. 2020. Available at: file:///C:/Users/EU/Downloads/European%20Panorama%202020%20(1).pdf [Accessed on August 2023].
- 9. Houghton, J. and Dililo, T. Leadership development: The key to unlocking individual creativity in organizations. *Leadership & Organization Development Journal*. 2010, 31(3), pp. 230-45.
- 10. Howkins, J. The creative economy: How people make money from ideas. Penguin UK; 2002 Jun 27.
- 11. Kloudová, J. et al. Kreativní ekonomika. EUROKÓDEX, 2010.
- 12. Levickaite, R. Four approaches to the creative economy: general overview, *Management and Education*, 2011, 9(1), pp. 81–92.
- 13. O'Conor, J. Creative industries: a new direction?. *International journal of cultural policy*. 2009, 15(4), pp. 387-402.
- 14. Potts, J. Why creative industries matter to economic evolution. *Economics of innovation and new technology*. 2009, 18(7), pp. 663-73.
- 15. Šajn N., 2019. Environmental impact of the textile and clothing industry What consumers need to know. http://www.europarl.europa.eu/ RegData/etudes/BRIE/2019/633143/EPRS_BRI(2019)633143_EN.pdf [Accessed on Septemer 2023].

Mapping the Sustainable Development in Enterprises of the Electronics & Electrical Components Industry in Slovakia

Patrik Richnák 1*

- ¹ Faculty of Business Management, University of Economics in Bratislava, Slovak Republic; patrik.richnak@euba.sk
- * Correspondence: patrik.richnak@euba.sk

Abstract: Entrepreneurial sustainability is crucial for business today because it ensures long-term business success, and the delivery of value to society as a whole through markets. The intention of the article was to provide a selected industry's perspective on sustainable development, which looks to maximise value in the economic, social, and environmental spheres while responding to the challenges of the modern world. The object of the research were 61 enterprises of the electronics & electrical components industry from the Slovak Republic. The following research methods were used in the preparation of the article: literature review, comparative analysis, system analysis, induction, deduction, questionnaire survey and visualisation method. The article interpreted the results regarding the promotion of sustainable development goals, the preference of individual pillars within sustainable development, the identification of the concept of sustainable development, the perspectives within sustainable development, tools used within sustainable development, and programs that the surveyed enterprises have in place/planned within sustainable development. Significant progress has been made in the area of business sustainability over the last period, however, a number of enterprises are still in need of continuous improvement in this area. Sustainable development will have an increasing impact on business activity in the coming years, mainly through the implementation of new regulations and greater demands for transparency.

Keywords: Sustainability, Sustainable Development, Sustainable Development Goals (SDGs), Electronics & Electrical Components Industry

Introduction

In the current socio-economic context, enterprises are facing global challenges, so it is essential to find new ways, and more effective methods to become competitive and increase their value in the market of environmental, and social requirements in order to ensure sustainable business performance. Given the growing interest in this area, any research that maps sustainable development in the context of enterprises is beneficial and significant.

In the first part of the article, attention was devoted to the comparison of 39 domestic and foreign authors' views on sustainable development. Then, in the next part of the article, sustainable development in 61 enterprises of the electronics & electrical components industry in Slovakia was explained, thus involving a commitment to balance economic growth with environmental responsibility and social progress.

1. Theoretical Background

The challenge of sustainable development to modern civilization is enormous. The present issues and disasters highlight how urgently a sustainable society must be established, representing a significant turning point in human evolution. The idea of sustainability is becoming more and more important from a political, social, and scientific standpoint. The EU places a lot of emphasis on the shift to a circular economy as a long-term strategy for economic expansion. One of the revolutionary initiatives of the Green Deal, the circular economy model aims to create the conditions for a sustainable future. Since it integrates, and links the environmental, social, and economic facets of sustainable development, it is currently acknowledged as one of several methods for reaching sustainability (Huttmanová et al., 2023).

In terms of economics, sustainability entails both a thriving industry and economy as well as the effective management of limited resources. Sustainability in the context of the environment refers to not overloading the ecosystem and maintaining the natural support system for life. From the perspective of society, sustainability means that people are the primary focus of attention. The greatest possible degree of equality, freedom, social justice, and security must be offered, especially in light of the global population growth (Zodape et al., 2015). Sustainability refers to achieving our goals without affecting the capacity of coming generations to achieve their goals. We require social and economic resources in addition to natural resources. Environmentalism is only one aspect of sustainability. Most definitions of sustainability include considerations for social fairness, and economic development, particularly growth that meets current demands without compromising the capacity of future generations to meet their own. This is a well-known example of sustainable development (University of Alberta, 2013). In the complex socio-economic environment of today, it ensures the growth, sustainability and success of enterprises (Majerník et al., 2023a). There are various methods to understand and approach sustainability. The idea might be more closed-off and predefined, or it can be left open to be dealt with during the process (Majerník et al., 2023b). According to economic and societal factors, sustainability theory emphasizes the development of environmentally friendly products and processes (Sikdar, 2007; Cockerill, 2004). Government mandates organizations to apply sustainability to reduce resource utilisation because enterprises consume a lot of energy and supply (Yagi & Halada, 2001). Organizations are forced to produce sustainable products because environmental rules are getting increasingly rigid. As a result, modern businesses are using sustainable production. Concepts of sustainability are applied to practically every aspect of life, not only the social and economic spheres. The methods for assessing sustainable development are still largely unrefined and complex, nevertheless. Using the Sustainable Development Goals (SDGs) outlined in Agenda 2030 as a guide for assessment is one way to evaluate and attain sustainable development and sustainability (Huttmanová et al., 2018). The United Nations Member States' adoption of the Sustainable Development Goals (SDGs) in 2015 gives countries a roadmap for pursuing sustainable development while balancing social, environmental, and economic sustainability. When formulating policies and strategies to advance development and sustainability, the SDGs have evolved into the global standard for policymakers (Le Blanc, 2015; Mbanda & Fourie, 2019). Additionally, the general public has learned to know and recognise them (CBEY, 2020). In order to address global concerns, the international community must abide by the SDGs. By better preserving the natural world and all forms of life on the globe, they are intended to ensure that humans can live in complete dignity, peace, and prosperity for future generations. With concern for people, the earth, peace, prosperity, and cooperation, the aims work in three areas: social development, environmental development and financial development (Chien et al., 2021; Kutan et al., 2017; Tan et al., 2021). Nonetheless, since the SDGs were first announced, NGOs, governments, and international organizations have mostly committed to attaining them by releasing yearly reports. Numerous big businesses and multinational enterprises have also demonstrated how important it is to participate in the SDGs (Fidlerová et al., 2022). Due to the probable increase in the depletion of non-renewable resources, and an increase in eco-disposals, sustainable development has emerged as a major worldwide concern (Esmaeilian et al., 2016). To lessen the impact of carbon emissions on economic growth, green strategies, and renewable energy sources could be adopted (Rehman Khan et al., 2018). There is widespread debate about the potential effects of sustainable development goals on the business environment, and related enterprise development, and it is important to strike a balance between meeting enterprise development needs and safeguarding sustainability, the interests of future generations and the environment (Holotová et al., 2020; Mentel et al., 2020).

The triple-bottom-line strategy, which aims to balance social, environmental, and economic dimensions in the management of organisations, is where sustainable development on a business level first emerged (Andersson et al., 2002; Elkington, 1998; Ozbekler & Ozturkoglu, 2020; Park, 2018; Rajesh & Rajendran, 2019). We define sustainable industrial development in terms of three factors: improvement in the environmental performance of industry; growth in endogenous productive capacities, particularly the capacity for innovation; and improvements in living standards and a reduction in inequality, particularly via growth in the number and pay of manufacturing sector jobs (Matthews, 2003). We define corporate sustainability as a business's efforts to control its environmental, social and broader economic impact on the market and society as a whole (Svensson et al., 2018). This definition is inspired by

and consistent with earlier works. In addition, we contend that the emphasis on business sustainability covers all parties involved in the supply chain network as well as other players in the environment of the enterprise (Baranova, 2022; Golicic & Smith, 2013, Joardar & Sarkis, 2020). Sustainable entrepreneurship integrates three seemingly incompatible ideas: generating value for the economy, society, and environment while also taking into account the needs of future generations. Sustainable enterprises are competitive, productive, and promote social inclusion in addition to creating respectable, well-paying jobs. The Sustainable Development Goals (SDGs) can be greatly aided by industry that is environmentally sustainable. Therefore, ongoing development and growth are the objectives of a sustainable businesses (Bajdor et al., 2021). Enterprises are forced to adapt to current conditions and find ways to thrive in a sustainable market due to the changing, turbulent environment in which they operate (Čambalíková, 2021). For this reason, managers themselves are faced with challenging situations in which they have to react agilely to turbulent changes in the business environment (Čambalíková, 2022).

Global warming is an urgent problem that is affecting people all around the world. As a result, there is a growing market for sustainable goods, and producers must employ more socially and environmentally conscious production techniques. The electronics & electrical components industry is currently one of the state's competitiveness factors in the global market, a tool for assuring the state's economic development in a volatile environment and a catalyst for the expansion of other industrial sectors. The electronics & electrical sector is currently one of the largest and fastest-growing markets in the world and it has a lot of room to grow (Gavlovskaya & Khakimov, 2020). The electronics & electrical sector, which is responsible for 4 % of the world's greenhouse gas emissions, will have to adapt to the new demands and regulations (Manor, 2023). In this sense, it has recently been made easier to apply environmental ethics as a core principle in industrial enterprises, and the focus is now on greening various industries (Junsheng et al., 2020). Indeed, businesses emphasise morality and environmentally friendly practises in an effort to use resources sustainably and cut back on environmental expenditures (Chen, 2007). Long-term product value increases and environmental problem-solving costs decline when green habits spread throughout businesses (Junsheng et al., 2020). Sustainable development in the electronics & electrical components industry integrates ecological, social and economic considerations to minimise negative impacts, reduce resource consumption and promote ethical practices throughout the product lifecycle. Enterprises that prioritise sustainability not only benefit the environment but also enhance their reputation, attract socially conscious customers, and often achieve longterm business success.

2. Methods and Methodology

The main objective of the article was to identify, and clarify concepts related to sustainable development based on a knowledge base that included comparative analysis of domestic, and international journals and studies, and then to interpret the results of the quantitative research. The intention of the article was to provide the perspective on sustainable development that seeks to maximise value in the economic, social, and environmental spheres while responding to the challenges of the modern world.

The following research methods were used in the preparation of the article: literature review, comparative analysis, system analysis, induction, deduction, questionnaire survey and visualisation method. The questionnaire contained questions that allowed to identify enterprises of the electronics & electrical components industry in Slovakia according to the size of the enterprise, legal form and territorial division of the Slovak Republic. Subsequently, the questionnaire contained questions related to sustainable development. The article interpreted the results regarding the promotion of sustainable development goals, the preference of individual pillars within sustainable development, the identification of the concept of sustainable development, the perspectives within sustainable development, tools used within sustainable development, and programs that the surveyed enterprises have in place/planned within sustainable development. From the visualisation methods, a ring graph was applied to interpret the summarised data.

Enterprises were classified according to size on the basis of the European Commission 2003/361/EC, which distinguishes between small enterprises (10-49 employees), medium-sized enterprises (50-249 employees) and large enterprises (>=250 employees). The object of the research were 61 enterprises of the electronics & electrical components industry from the Slovak Republic. Large enterprises participated in the survey conducted by questionnaire with the largest percentage (55.74 %).

Medium-sized enterprises were represented with a share of 40.98 %. The participation of small enterprises was significantly lower (3.28 %). For the purpose of the analysis carried out, it can be stated that the sample of respondents represented by enterprise size is at a very good level, as large and medium-sized enterprises predominated.

According to the legal form of enterprise, the most represented (77.05 %) were private limited liability companies. Enterprises that indicated the legal form of joint-stock company had a share of 21.31 %. Limited partnership had a share of 1.64 % among the respondents from the electronics & electrical components industry.

According to the territorial division of the Slovak Republic, enterprises from the Bratislava Region dominated the research (21.31 %). An identical high share of participation was also achieved by enterprises from the Nitra and Trenčín Regions, where the share of participation was at the level of 18.03 %. Further, enterprises from the Žilina Region were represented in the research (14.75 %), and enterprises from the Trnava Region and the Prešov Region were represented by the same percentage (9.84 %). Respondents from the Banská Bystrica Region (4.92 %) and the Košice Region (3.28 %) were the least represented.

3. Results and Discussion

The following selected questions from the questionnaire, which dealt with sustainable development in enterprises of the electronics & electrical components industry in Slovakia, were evaluated by means of descriptive analysis. In the research, enterprises were asked about the promotion of sustainable development goals. The results of the analysis are graphically illustrated by the ring graph, which shows that 91.80 % of enterprises in the electronics & electrical components industry in Slovakia promote sustainable development goals. Only 8.20 % of the surveyed enterprises do not promote the SDGs.



Figure 1. Promoting the Sustainable Development Goals in enterprises of the electronics & electrical components industry in Slovakia.

Source: Author's own elaboration.

Figure 2 illustrates that 74.40~% of the respondents prefer the environmental pillar in sustainable development. The results illustrated in the graph show that 18.80~% the enterprises of the electronics & electrical components industry in Slovakia prefer the social pillar. The summarised data in the graph visualises that the economic pillar within sustainable development is important to 6.80~% of the research participants.

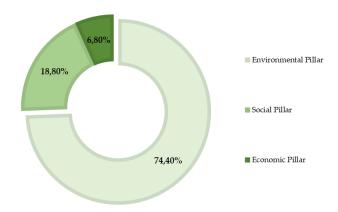
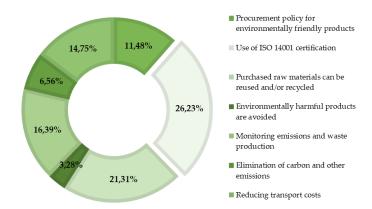


Figure 2. Preference for individual pillars in the framework of sustainable development in enterprises of the electronics & electrical components industry in Slovakia.

Source: Author's own elaboration.

Sustainable development in all its dimensions should be a central part of a business strategy. The identification of sustainable development in enterprises in the electronics & electrical components industry in Slovakia is illustrated in Figure 3. Based on the answers of the respondents, it was found that 26.23 % of the surveyed enterprises understood sustainable development as the use of ISO 14001 certification. More than twenty-one percent of enterprises (21.31 %) in Slovakia understand sustainable development to mean that purchased raw materials can be reused and/or recycled. More than sixteen percent (16.39 %) of respondents understand sustainable development as monitoring emissions and waste production. 14.75 % of enterprises in the electronics & electrical components industry in Slovakia consider reducing transport costs as sustainable development. The procurement policy of environmentally friendly products is perceived as sustainable development for 11.48 % of the enterprises surveyed. Sustainable development was least perceived by the surveyed enterprises as elimination of carbon and other emissions (6.56 %) and avoidance of environmentally harmful products (3.28 %).



 $\textbf{Figure 3.} \ \ \textbf{Identifying sustainable development in enterprises of the electronics \& electrical components industry in Slovakia.}$

Source: Author's own elaboration.

Competitive advantage is being rapidly reshaped by sustainability, or an enterprise's ability to have a good impact on society and the environment. It is creating fresh waves of growth, reshaping the electronics & electrical sector. Over the coming decades, there will be a staggering amount of disruption, along with the opportunities it brings. Although the opportunity is obvious, it is less clear how to lead a successful sustainable transformation. Enterprises must concurrently incorporate an environmental,

social, and governance perspective into every aspect of their enterprise and realise the value that this change provides if they are to flourish and gain a competitive advantage.

Based on the data visualisation, we can see in Figure 4 that the dominant environmental management of the enterprises in the electronics & electrical components industry in Slovakia is influenced by the SDGs, which has reached a share of 34.43 %. Sustainable development significantly affects business competitiveness with a share of 29.51 %. More than twenty percent (21.31 %) of the surveyed enterprises in Slovakia report that the use of environmental management is fundamental to compliance with legislation. Collaboration with stakeholders to reduce the environmental impact throughout the value chain is rated by respondents at a share of 14.75 %.

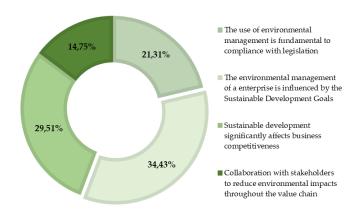


Figure 4. Sustainable development efforts in enterprises of the electronics & electrical components industry in Slovakia

Source: Author's own elaboration.

The goal of sustainable development is to establish a system of guidelines, parameters, and operational frameworks that will enable the business to operate continuously without negatively impacting the environment and other stakeholders. With the climate crisis becoming clearer and more pronounced, the electronics & electrical components industry must use the tools within sustainable development to truly meet environmental goals. Figure 5 identifies the tools within sustainable development in the electronics & electrical components industry in Slovakia. The ring graph illustrates that 21.31 % of the research participants use ecological packaging, while 18.03 % of the respondents use sustainable marketing. Total quality environmental management is preferred by 16.39 % of respondents. More than thirteen percent (13.11 %) of the participants use sustainable distribution as part of sustainable development. Among the tools, respondents with 11.48 % prefer sustainable logistics. Almost ten percent (9.84%) of the respondents use sustainable manufacturing. The least used by enterprises from the electronics & electrical components industry were ecological design (6.56 %) and green public procurement (3.28 %).

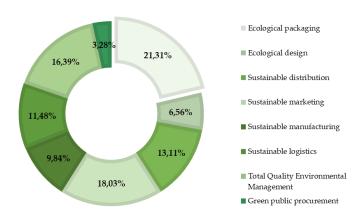


Figure 5. Which tool in the framework of sustainable development is used by enterprises of the electronics & electrical components industry in Slovakia.

Source: Author's own elaboration.

Awareness of sustainability is growing, increasing pressure on manufacturers to continually come up with new technologies and products that are more energy efficient and sustainable. Efforts to promote sustainable development in the electronics & electrical sector are becoming more important than ever. Figure 6 identifies the sustainability programs that enterprises in the electronics & electrical components industry have in place or are planning to implement. As illustrated in the ring graph, 27.87 % of the research participants are members of various environmental organizations, while 24.59 % of the respondents recycle consumables. Respondents with 21.31 % have a business-wide recycling program. 18.03 % of the respondents use an energy management system. More than eight percent (8.20 %) of the respondents identify themselves as a carbon neutral enterprise.

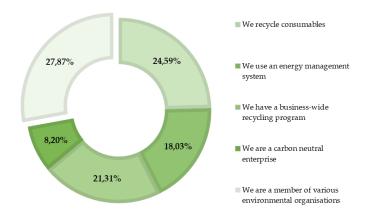


Figure 6. Which programs are in place/planned within the framework of sustainable development in enterprises of the electronics & electrical components industry in Slovakia.

Source: Author's own elaboration.

4. Conclusions

The environment is mainly affected by the activities of manufacturing enterprises in individual sectors. Due to the fact that environmental impacts have become a global problem, it is necessary to address this situation and find ways to reduce the adverse impact on nature (Rakovská, 2022). These demands are leading enterprises to adjust their business practices and transform themselves towards sustainability. Significant progress has been made in the area of corporate sustainability in recent years, but many businesses still need to continuously improve this area. Sustainability will have an increasing impact on business activity in the coming years, especially with the implementation of new regulations and greater demands for transparency.

Only 20 % of the world's 74 million tonnes of electronic garbage will be effectively collected or recycled by the year 2030. The availability of essential resources and the mounting push to reduce its environmental impact and move towards circularity are significant problems for the electronics & electrical sector (VTT, 2023). By changing from conventional production methods to printed electronics, and from materials derived from fossil fuels to those derived from renewable resources, the environmental impact of the electronics & electrical sector can be greatly decreased. Sustainable development in the electronics & electrical components industry aims to promote clean, efficient, and socially responsible practices, reducing environmental impact and contributing to a more sustainable and equitable future. Enterprises that prioritise sustainability in this sector often benefit from cost savings, enhanced reputation, and a stronger competitive edge in an increasingly environmentally conscious market.

Within the selected aggregated responses related to sustainable development in enterprises of the electronics & electrical components industry from the Slovak Republic, we obtained that large enterprises participated in the research with the highest percentage. According to the legal form of enterprise, private limited liability companies were the most represented. According to the territorial division of the Slovak Republic, enterprises from the Bratislava Region were dominant in the research. Sustainable development goals are preferred in almost all enterprises from the electronics & electrical components industry in Slovakia. Within the framework of sustainable development, the majority of respondents prefer the environmental pillar. Sustainable development is understood by the majority of the surveyed enterprises as the use of ISO 14001 certification. In the enterprises of the electronics & electrical components industry in Slovakia, the dominant environmental management is influenced by the objectives of sustainable development. Of the tools within the sustainable development in enterprises of the electronics & electrical components industry in Slovakia, ecological packaging is the most preferred. Within the programs that enterprises of the electronics & electrical components industry in Slovakia have implemented or are planning to implement within the framework of sustainable development, most of the research participants are members of various environmental organisations.

Funding: The article is a partial output of VEGA No. 1/0465/23 research project titled "Generic, convergence and model approaches of environmental production and logistics in business development in Slovakia".

References

- 1. Andersson, P. & Sweet, S. (2002). Towards a framework for ecological stategic change in business networks. *Journal of Cleaner Production*, 10(5), 465–478. https://doi.org/10.1016/s0959-6526(02)00011-2
- 2. Bajdor, P., Pawełoszek, I. & Fidlerova, H. (2021). Analysis and Assessment of Sustainable Entrepreneurship Practices in Polish Small and Medium Enterprises. *Sustainability*, 13(7), 3595. https://doi.org/10.3390/su13073595
- 3. Baranova, P. (2022). Environmental capability development in a multi-stakeholder network setting: Dynamic learning through multi-stakeholder interactions. *Business Strategy and the Environment*. https://doi.org/10.1002/bse.3091
- 4. Čambalíková, A. (2021). Selected Modern Management Trends and Their Application by Companies in the Wood Processing Industry in Slovakia. *The Response of the Forest-Based Sector to Changes in the Global Economy: Proceedings*, 11-16.
- 5. Čambalíková, A. (2022). Impact of Industry 4.0 Phenomenon on Development of Wood Processing Industry. Crisis Management and Safety Foresight in Forest-Based Sector and SMEs Operating in the Global Environment: Proceedings of International Scientific Conference, Trnava, Slovakia, Jun 8th 10th 2022, 67-72.
- 6. Chen, Y.-S. (2007). The Driver of Green Innovation and Green Image Green Core Competence. *Journal of Business Ethics*, 81(3), 531–543. https://doi.org/10.1007/s10551-007-9522-1
- 7. Chien, F., Zhang, Y., Sadiq, M. & Hsu, C.-C. (2021). Financing for energy efficiency solutions to mitigate opportunity cost of coal consumption: An empirical analysis of Chinese industries. *Environmental Science and Pollution Research*. https://doi.org/10.1007/s11356-021-15701-9
- 8. Cockerill, K. (2004). Discussions on sustainability. Clean Technologies and Environmental Policy, 6(3). https://doi.org/10.1007/s10098-004-0253-z
- 9. Elkington, J. (1998). Partnerships from Cannibals with forks: the Triple Bottom Line of 21st-century Business. *Environmental Quality Management*, 8(1), 37–51.
- 10. Esmaeilian, B., Behdad, S. & Wang, B. (2016). The evolution and future of manufacturing: A review. *Journal of Manufacturing Systems*, 39, 79–100. https://doi.org/10.1016/j.jmsy.2016.03.001

- 11. Fidlerová, H., Stareček, A., Vraňaková, N., Bulut, C. & Keaney, M. (2022). Sustainable Entrepreneurship for Business Opportunity Recognition: Analysis of an Awareness Questionnaire among Organisations. *Energies*, 15(3), 849. https://doi.org/10.3390/en15030849
- 12. Gavlovskaya, G. V. & Khakimov, A. N.(2020). Modern challenges in the electronics industry. *Revista ES-PACIOS*. 41(19). 1-11.
- Golicic, S. L. & Smith, C. D. (2013). A Meta-Analysis of Environmentally Sustainable Supply Chain Management Practices and Firm Performance. *Journal of Supply Chain Management*, 49(2), 78–95.
- 14. Holotová, M., Nagyová, Ľ., & Holota, T. (2020). The impact of environmental responsibility on changing consumer behaviour sustainable market in Slovakia. *Economics & Sociology*, 13(3), 84–96. https://doi.org/10.14254/2071-789x.2020/13-3/6
- 15. Huttmanová, E., Chovancová, J., Steiner, M. J., Ramharter, P. M. & Kočiščáková, K. (2023). Through Circularity Towards Sustainability: Assessing the Progress and Challenges of the Circular Economy in the EU and Slovakia. *European Journal of Sustainable Development*, 12(4), 366. https://doi.org/10.14207/ejsd.2023.v12n4p366
- 16. Huttmanová, E., Valentiny, T. & Novotný, R. (2018). Assessment of the similarity of the eu countries in the process of sustainable development in the context of agenda 2030 goals. *Współczesne Problemy Zarządzania*, 6 (2(13), 123–133. https://doi.org/10.52934/wpz.97
- 17. Joardar, A. & Sarkis, J. (2020). An examination of sustainable development of supply chain using foreignness perspective. *Business Strategy and the Environment*, 30(1), 630–642. https://doi.org/10.1002/bse.2643
- 18. Junsheng, H., Masud, M. M., Akhtar, R., & Rana, Md. S. (2020). The Mediating Role of Employees' Green Motivation between Exploratory Factors and Green Behaviour in the Malaysian Food Industry. *Sustainability*, 12(2), 509. https://doi.org/10.3390/su12020509
- 19. Kutan, A. M., Paramati, S. R., Ummalla, M. & Zakari, A. (2017). Financing Renewable Energy Projects in Major Emerging Market Economies: Evidence in the Perspective of Sustainable Economic Development. *Emerging Markets Finance and Trade*, 54(8), 1761–1777. https://doi.org/10.1080/1540496x.2017.1363036
- 20. Le Blanc, D. (2015). Towards Integration at Last? The Sustainable Development Goals as a Network of Targets. *Sustainable Development*, 23(3), 176–187. https://doi.org/10.1002/sd.1582
- 21. Majerník, M., Chovancová, J., Drábik, P. & Štofková, Z. (2023b). Environmental Technological Innovations and the Sustainability of their Development. *Ecological Engineering & Environmental Technology*, 24(4), 245-252. https://doi.org/10.12912/27197050/162708
- 22. Majerník, M., Daneshjo, N., Malega, P., Drábik, P., Ševčíková, R. & Vravec, J. (2023a). Integrated Management of the Environment-Safety Risks in the Thermal Power Station. *Polish Journal of Environmental Studies*, 32(5), 4725-4738.
- 23. Manor, O. (2023). 5 trends shaping the electronics industry in 2023 Valor. https://blogs.sw.siemens.com/valor/2023/01/17/5-trends-electronics-industry-2023/
- 24. Matthews, A. (2003). Sustainable Development Research in Agriculture: Gaps and Opportunities for Ireland. *RePEc: Research Papers in Economics*.
- 25. Mbanda, V. & Fourie, W. (2019). The 2030 Agenda and coherent national development policy: In dialogue with South African policymakers on Policy Coherence for Sustainable Development. https://doi.org/10.1002/sd.2025
- 26. Ozbekler, T. M. & Ozturkoglu, Y. (2020). Analysing the importance of sustainability-oriented service quality in competition environment. *Business Strategy and the Environment*, 29(3), 1504–1516. https://doi.org/10.1002/bse.2449
- 27. Park, S.-B. (2018). Multinationals and sustainable development: Does internationalization develop corporate sustainability of emerging market multinationals? *Business Strategy and the Environment*, 27(8), 1514–1524. https://doi.org/10.1002/bse.2209
- 28. Rajesh, R. & Rajendran, C. (2019). Relating Environmental, Social, and Governance scores and sustainability performances of firms: An empirical analysis. *Business Strategy and the Environment*, 29(3), 1247–1267. https://doi.org/10.1002/bse.2429
- 29. Rakovská, J. (2022). Vplyv moderných technológií na životné prostredie: Impact of Modern Technology on the Environment. *Ekonomika, financie a manažment podniku XVI.: zborník vedeckých statí pri príležitosti Týždňa vedy a techniky*, 243-249.
- 30. Rehman Khan, S. A., Zhang, Y., Anees, M., Golpîra, H., Lahmar, A. & Qianli, D. (2018). Green supply chain management, economic growth and environment: A GMM based evidence. *Journal of Cleaner Production*, 185, 588–599. https://doi.org/10.1016/j.jclepro.2018.02.226
- 31. Sikdar, S. K. (2007). Sustainability and recycle–reuse in process systems. Clean Technologies and Environmental Policy, 9(3), 167–174. https://doi.org/10.1007/s10098-007-0087-6
- 32. Streimikis, J., Karbach, R., Vysochyna, A., Mentel, G., Samusevych, Y., & Vasilyeva, T. (2020). The evaluation of economic, environmental and energy security: composite approach. *International Journal of Global Environmental Issues*, 19(1/2/3), 177. https://doi.org/10.1504/ijgenvi.2020.10037581

- 33. Svensson, G., Ferro, C., Hogevold, N., Padin, C. & Sosa Varela, J. C. (2018). Developing a theory of focal company business sustainability efforts in connection with supply chain stakeholders. *Supply Chain Management: An International Journal*, 23(1), 16–32. https://doi.org/10.1108/scm-12-2015-0461
- 34. Tan, L. P., Sadiq, M., Aldeehani, T. M., Ehsanullah, S., Mutira, P. & Vu, H. M. (2022). How COVID-19 induced panic on stock price and green finance markets: global economic recovery nexus from volatility dynamics. *Environmental Science and Pollution Research International*, 29(18), 26322–26335. https://doi.org/10.1007/s11356-021-17774-y
- 35. University of Alberta. (2013). What Is sustainability? https://www.mcgill.ca/sustainability/files/sustainability/what-is-sustainability.pdf
- 36. VTT. (2023). Towards a sustainable electronics industry. https://www.vttresearch.com/en/sustainable-electronics
- 37. Yagi, K. & Halada, K. (2001). Materials development for a sustainable society. *Materials & Design*, 22(2), 143–146. https://doi.org/10.1016/s0261-3069(00)00056-x
- 38. Yale Center for Business and the Environment (CBEY). (2020). *Report of Results Global Survey on Sustainability and the SDGs.* https://www.globalsurvey-sdgs.com/wp-content/uploads/2020/01/20200205_SC_Global_Survey_Result-Report_english_final.pdf
- 39. Zodape, H., Patil, P. & Ranveer, A. (2015). Sustainable Industrial Development. *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*. 3. 111-116.

How education in schools prepares Slovak women in digital skills

Róbert Hanák 1, Nina Kocúrová 1 *

- Affiliation 1 (Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia); <u>robert.ha-nak@euba.sk</u>; nina.kocurova@euba.sk
- * Correspondence: <u>robert.hanak@euba.sk</u> (Róbert Hanák)

Abstract: School education is generally considered as very important in acquiring digital skills. We tested how Slovakian schools prepared 262 women in digital skills. We found that Slovakian formal school education at university is not related to the level of advanced digital skills. The role of school in advanced digital skills education was replaced by the role of women's employers. Ordinary daily practice, official on-the-job training and other employer activities were found to be the most significantly related with women's expert level of digital skills. Too few courses, formal, theoretical and impractical curriculum are among main reasons for failure, while insufficient qualification of teachers was not the case. Improving curriculum, extending number, modernizing content of lessons are proposed remedies for the current grim picture.

Keywords: education of digital skills in school; women in IT;

Introduction

An indelible part of modern life is the digital world and we urgently need a coordinated response to help students acquire digital skills, which are needed to keep pace with this fast changing landscape (Jackman et al., 2021). The appropriate place to assess acquisition of functional ICT skills is the secondary education as it completes the provision of basic education that began at the primary level (Bhandari et al., 2021). There exist many factors that affect students' digital skills, and the differences observed in students' digital skill levels for different reasons are defined as -digital divide. Principal factors affecting the digital skills and causing a digital divide is their access to digital tools and internet (Ertl et al., 2020). Digital skills improve the quality of work performance, lead to higher incomes and a higher chance of employment (Stofková et al., 2022). Many universities were focused on the development of instrumental skills, but now are broadening their focus to include the development of informational and strategic skills, which tend to be underdeveloped when students first enter higher education. While learners often report knowing how to use the Internet, not all are able to search for information relevant to their academic work (Ben Youssef et al., 2022).

1. Theoretical background

A clear definition of the term digital competence does not exit and its terminology is continuously developed by technological changes (Cabero-Almenara et al., 2023; Park et al., 2020). Digital competence can be defined as the confident, creative and critical use of ICT to achieve goals related to work, learning, employability, leisure, inclusion and participation in society (Ala-Mutka, 2011).

In recent years, there is expected to be a greater demand for digital skills. The COVID-19 pan-demic has shown how digital skills, environments and resources can be important for our societies and economies. One of the essential pillars when considering or assessing the impact of new technologies in any society is human capital, for this reason it is necessary to constantly education (Ferreira et al., 2020). Information and communication technologies (ICT) can impact student learning when teachers are digitally literate and understand how to integrate it into curriculum (UNESCO, 2021). Indices that relate to the digital economy are analyzed, such as the digital economy and society index (DESI) and e-Government digital skills (EGDI)- from 2018 to 2021- revealed a stagnant state in 2018 and 2019, and in 2020, there was a decrease in basic digital skills (Stofková et al., 2022).

Based on the state survey in Slovakia, the majority of primary (63%) and lower secondary schools (62%) offer only weak support for digital education (EU-27 68% and 45%, respectively) and teachers almost always allow students to use ICT for projects or class work. (Monitor Vzdelávania a Odbornej Prípravy, 2020). Young people and children make extensive use of digital tools and the Internet for entertainment, but the DESI report states that only four out of ten are able to create presentations, graphs, or work with spreadsheets (Stofková et al., 2022).

In higher education, the focus on digital competence continues to grow in popularity. College students in the 21st century are the generation that have grown up with the rapid development of computer networks, and they are the experiencers of the unprecedented development of online media represented by the internet, virtual reality, artificial intelligence, while the Covid-19 has brought increased social attention to the need for digital skills (Iansiti & Richards, 2020). Developing the digital competences of students can be done in different ways and their effectiveness is different, especially considering the age of the students, their family and social background and also the strategy teaching (Brunovský, 2023).

Generally, the effects of ICTs on student performance depend on the intensity of their use. Low and sporadic use does not improve academic performance, however, intensive use for educational purposes like searching for bibliographical references, using translation software, engaging in forums and chats, etc. stimulates involvement in their studies and results in improved skills and performance. The acquisition of digital skills requires ICT specific training and appropriate education strategies. Many universities are offering specific ICT training courses which are integrated in student curricula or offered alongside them. Preliminary knowledge in computer science has a positive influence on student performance. If teaching material is digitized and made available to students, asynchronous forms of learning facilitate the adaptation of work rhythms compared to the rhythm of traditional teaching (Ben Youssef et al., 2022).

The fundamental educational document in Slovakia is the State Educational Program, which, as a mandatory educational document, defines the general goals of education and key competencies towards which education should be directed (Rumanová, 2021). According to European Commission (2018), digital competence involves the confident, critical and responsible use of digital technologies for learning, working and participating in society, as well as interacting with digital technologies. The computer is not primarily a tool for the teacher to teach, but a tool for the student to learn. Every teacher working with digital technologies should develop all levels of their digital literacy-level of use, level of understanding and level of creative application information and at the same time apply it in the educational process. In Slovakia we have the opportunity to use the most modern technologies, however the overall balance of the population's digital capabilities and skills as of the population as a whole is relatively favourable, there is a social groups and environments have been found significant differences (Rumanová, 2021).

In European Union, growing number of countries are making computer science a core subject and instituting graduation requirements that necessitate at least some ICT subjects. Many European countries have already implemented policies that integrate computer science into the curriculum at all levels of compulsory education. Initiatives show that classes to cultivate advanced digital skills are shifting from optional to compulsory, and while making digital skills classes mandatory at the secondary level is recommended, it is also important to remember that many girls leave school before this point (UNESCO, 2019). To understand situation in Slovakia we set the aim for this paper to investigate role of the school/university in women's advanced digital skills education, identify barriers and compare school with employer contribution in acquiring these skills.

2. Methods and methodology

Sample: In the years 2022/23 together 262 Slovakian women took part in nongovernmental training courses designed to improve their advanced digital skills (data analysis, SQL programme, security academy) and answered several questions about the topic of this research. They were between 18 and 60 years old. The course for women and data for this paper were provided by organization: Aj ty v It (https://ajtyvit.sk/o-nas/).

Measures: We worked with following variables, which were measured at these scales:

<u>Level of digital skills</u> were measured at three level scale: *Basic level of digital skills, Advanced level of digital skills, Expert level of digital skills*

<u>Source of skills</u>: Women answered at following question: *And where did you get these skills and experience?* Women have list of options (all options are listed in the Table 4) and could answer yes/no and also could select several options or none of them.

Demographic characteristics: <u>Level of education</u> was measured at following scale: High school with graduation -1, Bachelor level -2, Master -3, PhD – 4., <u>Age</u> was measured in intervals: *18-30 years*, *31-40 years*, *41-50 years*, *51+ years*

<u>School preparation in digital skills</u>: *How did the school prepare you?* With answers reported in the section results.

<u>Reasons for failure</u>: Respondents answered to the question: "What do you think was the key - the main reason that the school didn't teach you that or didn't prepare you enough for it?" List of answers we report in the table 3.

3. Results

Firstly, we report summary results about school preparation, measured by question: *How did the school prepare you?* Results indicate, that schools prepared women poorly: "school taught me *very little* that I could use practically" (62,1% of all answers), "school taught me the *basics* and I had to learn the rest the other way" (36,6%), school taught me *everything* I needed to know (1,3 %). For better understanding we performed subsequent analysis of groups according age groups and level of formal education attainment. According age groups we did not found any significant difference in age groups $\chi^2(3) = 2,08$; p = 0,56; $\epsilon^2 = 0,01$ and post hoc Dwass-Steel-Critchlow-Fligner (DSCF) pairwise test show no difference between any combination of groups. Means in specific age cohorts, reported in the Table 1, indicate that quality of school preparation did not improve significantly in the last 30 years and also did not improved in last decade compared to previous decade.

Table 1. Descriptive statistics of the answers to question: *How did the school prepare you?* according to age categories

Age	N	Mean	SD
18-30 years	73	1.38	0.54
31-40 years	107	1.37	0.51
41-50 years	50	1.46	0.50
51+ years	5	1.20	0.45

¹ Tables may have a footer.

And according to the level of education there were also no significant difference in age groups $\chi^2(3)$ = 1,66; p = 0,65; ϵ^2 = 0,01 and post hoc Dwass-Steel-Critchlow-Fligner pairwise tests show no difference between any combination of groups. Surprisingly, we can see downward trend of preparation – mean values where at higher education levels, school preparation is poorer and poorer.

Table 2. Descriptive statistics of the answers to question: *How did the school prepare you?* according to level of education

Level of education	N	Mean	SD
high school with	41	1.49	0.60
graduation	41	1.49	0.00
Bachelor	22	1.41	0.50
Master	158	1.37	0.50
PhD.	14	1.29	0.47

To investigate the possible reasons for insufficient school preparation respondents answered questions listed in the table 3. As we can see, most frequently reported were those related to small offer of courses, formal, theoretical and impractical curriculum. But insufficient qualification of teachers was not the case (13,1%).

Table 3. Reasons for the poor school preparation

Reasons		% of To- tal
few teaching hours were set aside for informatics – the material was covered quickly, often superficially and formally	111	47.0 %
curriculum did not take into account the needs of practical life - we learned too much theory at the expense of practice	34	14.4 %
insufficient teacher qualification – the teacher often knew less than us, the students	31	13.1 %
the curriculum was outdated, did not reflect the latest developments and trends in informatics	60	25.4 %

Very important part of results is those related to source of digital skills (Table 4). We can see that relationship between university education and current level of women's' level of digital skills is weak, insignificant and with trivial effect size. Surprisingly, elementary/secondary schools prepare women students better. Relying at self-education or at friends or expecting that women will learn advanced digital skills at home is wrong strategy, our results are insignificant and with trivial effect size. On the other side employers, their education programs and especially daily ordinary practice in work are those activities which are strongly related with expert level of digital skills. From these results we can conclude that Slovakian women get to the expert level of digital skills almost exclusively in their work and little at primary and secondary school and all other sources of acquiring are insignificant with trivial effect.

Table 4. Relationship between level of skills and source of digital skills

Factor	Chi	P value	Cramer'
ractor	square		s V
In employment by ordinary daily practice	26.1	< 0.001	0.32
Official on-the-job training	17.57	0.0002	0.26
At trainings	11.34	0.003	0.21
Elementary/secondary school	8.31	0.016	0.18
Among friends	4.5	0.106	0.13
With help of my colleagues at work	3.09	0.213	0.11
Herself	1.93	0.381	0.09
University	1.71	0.426	0.08
At home	0.89	0.639	0.06

4. Discussion

Summing our results of school preparation for digital skills we found a grim picture. Two thirds of women reported that school gave them "very little" in terms of digital skills that they could use practically, with one third claim to brought from formal school education only "basics" and the rest they had to learn other way. Staggering only 1,3% reported that school taught me "everything" in digital skills I needed to know. These results were for total sample but deeper investigation according to the groups showed almost the same picture. No significant difference was found according age where graphical description of data shows de facto horizontal line with no improvement for younger generation. In other words, age cohort 18 -30 years old gain at school the same little digital skills as older age cohort (30 – 40 years old) did and even less than 40 -50 age cohort. This could be interpreted as an

indication that in last 30 years' Slovakian formal education system made in terms of learning students advanced digital skills zero progress. In effort to better understanding we looked at these results also from the level of education perspective. We expected that at highest level education - university education the preparation for digital skills will be better and will rise from bachelor level to master and to PhD. level. The absolute opposite is true. In the Table 2 we can see systematic fall in how school prepared Slovakian women from high school with graduation to the university PhD level. We could speculate that especially universities failed to provide up-to-date advanced digital skills at sufficient level. Reasons for failure results shows that almost half women reported that there just not enough lessons, quarter complained about the outdate curriculum not reflecting the latest developments and trends in informatics. Surprisingly, weak qualification of teachers reported only 13.1 % of women. This specific distribution of failure reasons could direct us toward solution. From our results we can say that teachers are mostly prepared, but we need to expand the number of teaching hours and update the curriculum. Another our unique finding is that self-education or education at home is not significantly related with higher level of digital skills. At the same time we can see in the Table 4 that the most important source of skill acquisition is for Slovak women an employment, where they learn skills by daily practise in work and at official trainings and courses.

Funding: This research was funded (95%) by a grant of the University of Economics in Bratislava for young teachers, researchers and full-time PhD students, I-23-103-00: Career and qualification choices of young people towards a specialization in information technology

This work has been supported (5%) by the EUGAIN COST Action CA19122 - European Network for Gender Balance in Informatics

The data for this paper were provided by organization: Aj ty v It (https://ajtyvit.sk/o-nas/)

References

- 1. Ferreira, L. S., Infante-Moro, J. C., Infante-Moro, A., & Gallardo-Pérez, J. (2020, December). Continuous Training in Digital Skills, saving gaps between the needs and the training offer in the field of non-formal education for European Active Citizenship. In 2020 X International Conference on Virtual Campus (JICV) (pp. 1-6). IEEE.
- 2. UNESCO (2021). Information and communication technology (ICT) in education. https://bit.ly/3KYW5j7
- 3. Cabero-Almenara, J., Gutiérrez-Castillo, J. J., Guillén-Gámez, F. D., & Gaete-Bravo, A. F. (2023). Digital competence of higher education students as a predictor of academic success. Technology, Knowledge and Learning, 28(2), 683-702.
- Park, H., Kim, H. S., & Park, H. W. (2020). A scientometric study of digital literacy, ICT literacy, information literacy, and media literacy. Journal of Data and Information Science, 6(2), 116–138. https://doi.org/10.2478/idis-2021-0001
- 5. Stofková, J., Poliakova, A., Stofkova, K. R., Malega, P., Krejnus, M., Binasova, V., & Daneshjo, N. (2022). Digital skills as a significant factor of human resources development. Sustainability, 14(20), 13117.
- 6. Monitor Vzdelávania a Odbornej Prípravy (2020). https://op.europa.eu/ webpub/eac/education-and-training-monitor-2020/countries/slovakia.html#annex1
- 7. Iansiti, M., & Richards, G. (2020). Coronavirus is widening the corporate digital divide. Harvard Business Review. Retrieved from https://hbr.org/2020/03/coronavirus-iswidening-the-corporate-digital-divide. (Accessed January 202
- 8. Brunovský, S. (2023). Rozvoj digitálnych kompetencií žiakov stredných škôl. Digitálne kompetencie žiakov a učiteľov v kontexte informatizácie a digitalizácie školstva, 96.
- 9. Ben Youssef, A., Dahmani, M., & Ragni, L. (2022). ICT use, digital skills and students' academic performance: Exploring the digital divide. Information, 13(3), 129.
- 10. Ala-Mutka, K. (2011). Mapping digital competence: Towards a conceptual understanding. Sevilla: Institute for Prospective Technological Studies, 7-60.
- 11. Rumanová, Ľ. (2021). Rozvoj digitálnych kompetencií Študentov stredných škôl. In SBORNÍK Z MEZINÁRODNÍ KONFERENCE ICOLLE 2020 (p. 112).
- 12. Európska komisia. (2018). PRÍLOHA k návrhu odporúčania Rady o kľúčových kompetenciách pre celoživotné vzdelávanie. https://data.consilium.europa.eu/doc/document/ST-5464-2018-ADD-1/sk/pdf

- 13. UNESCO. (2019). I'd blush if I could closing gender divides in digital skills through education. https://unesdoc.unesco.org/ark:/48223/pf0000367416
- 14. Jackman, J. A., Gentile, D. A., Cho, N. J., & Park, Y. (2021). Addressing the digital skills gap for future education. Nature Human Behaviour, 5(5), 542-545.
- 15. Bhandari, B., Jain, C., & Sahu, A. K. (2021). Are Secondary Schools Imparting Digital Skills? An Empirical Assessment. Margin: The Journal of Applied Economic Research, 15(1), 73-100.
- 16. Ertl, B., Csanadi, A., & Tarnai, C. (2020). Getting closer to the digital divide: An analysis of impacts on digital competencies based on the German PIAAC sample. International journal of educational development, 78, 102259. https://doi.org/10.1016/j.ijedudev.2020.102259
- 17. Ben Youssef, A., Dahmani, M., & Ragni, L. (2022). ICT use, digital skills and students' academic performance: Exploring the digital divide. Information, 13(3), 129.

Factors influencing the level of digital skills of Slovak women

Nina Kocúrová 1, Róbert Hanák 1

- Affiliation 1 (Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia); robert.ha-nak@euba.sk; nina.kocurova@euba.sk
- * Correspondence: robert.hanak@euba.sk (Róbert Hanák)

Abstract: Women in Slovakia are in informatics positions extremely underrepresented and their digital skills are also lower compared to men and also to women in western Europe. Little is known about country specific reasons for this falling behind. The aim was to investigate various factors influencing women's level of digital skills. In the years 2022/23 together 262 Slovakian women took part in a nongovernmental training course designed to improve their advanced digital skills and also answered several questions about the topic of this research. We found that external factors such as motivation from colleagues, friends or employer requests are influencing women to a negligible extent. Internal motivational factors such as "getting to know new approaches" and intention to "develop in general" significantly predict women's current level of digital skills. Women with higher levels of digital skills are motivated internally and external motivation effort in organizations does bring expected effect.

Keywords: factor influencing digital skill; digital upskilling; motivator

Introduction

Today, society embraces the strong link between the use of digital technology and quality of life. From an economic point of view, enhancing digital skills represents a means to a better placement on the labor market, improved human resources and assured competitiveness of the state, organizations, and individuals as a workforce (Gašová et al., 2018). Advances in technology and the increasingly mass use of the internet have led to increased interest in the ICT sector (Ondrejková, 2016). Mastering basic tools and computer applications is only a first step towards advanced knowledge, skills and attitudes. The Digital Agenda for Europe 2020 confirms digital competence as one of the key competences which are fundamental for individuals in a knowledge base society, emphasizing that it is essential to educate European citizens to use ICT and digital media and particularly to at-tract young people to ICT (European Commission, 2010a). Prensky (2001) determines the new gen-eration who grew up with new technologies as digital natives, and individuals who were not born in the digital world but later adapted to this world as "digital immigrants."

1. Theoretical background

One of the main key sources for the growth of the economy are jobs in information and communication technologies (ICT) sectors. The EU's competitiveness depends on attracting and keeping skilled workers in the high-tech sector, however ICT sector suffers from a talent shortage. Europe's young people rarely view ICT as an interesting study or career option. Women and girls in ICT are significantly under-represented in all areas of ICT (Gras-Velazquez, 2009).

The demand for ICT professionals is particularly high. There is a shortage of more than 500 000 ICT experts in the EU forecast by 2020 (Krchová & Švejnová Höesová, 2021).

Due to the penetration of technology into the work environment, basic skills include basic digi-tal skills. These include the ability to operate word processing and spreadsheet applications, to work safely with the internet and electronic media, to communicate through digital technologies, but also to process effectively information. Employers most often ask for knowledge of foreign languages (especially English and German), basic digital skills (Office programs) and professional skills (eco-nomic and accounting, operating machinery and equipment) (Mráz et al., 2021). Employers require a range of skills from

their employees, the study describe the five key disciplines of digital skilling- the Information, Computer, Media, Communication and Technology literacies and by acquiring generic skills within these disciplines, one has a better chance to gain access to entry level employ-ment opportunities (Chetty et al., 2018). A vision for the future predicts that the majority of jobs will require at least a minimum level of digital skills (Gašová et al., 2018).

A suitable way to develop digital skills is to take a course with a tutor in a team of people. The social ties of the participants and the multiple training of the acquired digital skills in the collective are positive factors for motivation. This form can be available both online and offline (Štofková et al., 2015).

UNESCO estimates that men are around four times more likely than women to have advanced ICT skills such as the ability to programme computers. (NPR and Edison Research, 2018). Digital skills can open up opportunities for career advancement and higher pay. Women who develop more advanced digital skills will have also access to the rapidly expanding ICT job market, which tends to produce jobs that are more highly compensated than those in other fields (UNESCO, 2019).

A study according to Divjak et al., (2010) investigated factors influencing motivation for choosing IT. They used a questionnaire, where IT students in Croatia evaluated various items on a Likert scale. They found out that 4 factors influencing motivation for choosing IT. As the first factor it was employment opportunities. It means the opportunities for advancement, a good income, and additional jobs. Even in our sample, the most women of all were interested in a digital skills course for the reason - "to develop in general." We would also include in the employment opportunities the other most important factors that influenced the motivation for participation in the course in our sample: "to learn something completely new," "get to know new approaches," and "a requirement in the future." The second factor according to Divjak et al., (2010) were social factors, which influence by someone known personally, like friends or parents. From our research we would include in the social factors that "my friends motivated me" and "my colleagues motivated me." The third factor according to Divjak et al., (2010) was curriculum attractiveness, it means students enjoyed the study program or liked learning in it and the four factor was- other reasons, e.g., uncertainty as to what to study or a lack of success in their first choice.

Another study by Kori et al., (2015) investigated the reasons why students choose ICT majors, what motivates them most to acquire such skills. The most common reason was "interest", indicating that students are intrinsically motivated to study ICT and on the other hand fewer common reasons were linked to extrinsic motivational factors, e.g. "scholarship" and "salary."

Paura et al., (2018) analyzed the ICT lifelong learning motivation of extramural programming school students in different socio-economic groups- pupils, students, teachers, unemployed and other persons. The results of the research show that the share of women in different social groups, except the pupils group, is higher than man and the gender factor is significant in lifelong learning motivation. Upskilling over a lifetime gives women the chance to reduce the gender pay gap and acquire a broader portfolio of skills.

One of the general objectives is to increase the inclusion of society in the ICT sector by providing education that develops skills to apply and develop ICT solutions, but which also motivates people to continue their ICT-related studies at a higher level of education (Kori et al., 2015). According to Kori et al. (2016) personal contact with IT, the reputation of the IT field, and development had an effect on both starting and continuing IT studies. Based on these findings and conclusions we set our goal to investigate factors which influence Slovakian women level of advanced digital skills.

2. Methods and methodology

Sample: In the years 2022 and 2023 together 262 Slovakian women took part in nongovernmental training course designed to improve their advanced digital skills (courses were: data analysis, SQL programming and security academy) and answered several questions about the topic of this research. The course for women and data for this paper were provided by organization: Aj ty v It (https://ajtyvit.sk/onas/).

Measures: To measure factors influencing the level of digital skills of Slovak women we worked with the following variables.

<u>Level of digital skills</u> were measured as answer at following question: "What is your current level of computer skills?" and anwers were at 3 coded at level scale: "Basic level of digital skills, Advanced level of digital skills and Expert level of digital skills."

Education level was measured at following levels: High school with graduation – coded as 1, Bachelor level -2, Master -3, PhD – 4.

<u>Factors influencing decision to improve</u> own advanced digital skills. Women answered this question: "Why did you choose our course? Who or what motivated you the most?" and had several options to choose from. They could select one option, or more options, which were coded in binary form yes/no. List of all options are in the following Table 1.

Factor in short	Full statement of the factor
To develop in general	I want to develop, educate and progress in general
To learn something completely new	I want to learn something completely new that I haven't mastered so far
Get to know new approaches	I want to get to know new approaches, technologies, solutions in the field that interests me
A requirement in the future	it is a requirement for the job I plan to do (in the future).
Get to know a new environment	I want to get to know a new environment, people, establish contacts in this area
I was convinced by positive experiences	I was convinced by the positive experiences of graduates of this/similar courses
Get better	I want to improve in what I already know / don't know enough
My friends motivated me	I was motivated / convinced by friends, family, acquaintances
Employer's request	it is a requirement / condition of my current employer
My colleagues motivated me	I was motivated / convinced by my colleagues at work / school

3. Results

In the first part of our results we report frequency table of specific factors women reported. As we can see external motivational factors such as friends, employer request and colleagues represent only very marginal percentage of factors.

Table 2. List of factors and their frequency counts how many times women in our sample reported that they would like to improve in that factor. They are answers for the question: "Why did you choose our course? Who or what motivated you the most?"

Factor		% of Total
To develop in general	164	62.6%
To learn something completely new	150	57.3%
Get to know new approaches	76	29.0%
A requirement in the future	66	25.2%
Get to know a new environment		15.6%
I was convinced by positive experiences	33	12.60%
Get better	32	12.2%

My friends motivated me	21	8.0%
Employer's request	2	0.8%
My colleagues motivated me	2	0.8%

¹ Percentage represents percentage of all answers just for that one option. In other words, % represent count of yes answers.

When we performed measurement of relationship between these factors we found that they are mostly independent and are not related in most cases each to other. From dozens of possible relationship combinations between all factors, we identified only five statistically significant. As we can see in the Table 3, the relationships between factors are mostly weak.

Table 3. Relationships between two factors which were at least at weak level (with Cramer's V higher than 0,1).

Factor	Factor	Cramer's V
Get to know new approaches	Get to know a new environment	0.303
Get to know new approaches	Get better	0.17
Get to know a new environment	Get to know a new environment	0.16
To develop in general	Get better	0.14

In the second part of our research we investigated if these factors/motivators are influencing women's level of digital skills. In another words, if those women who want for example to "get better" have higher level of digital skills. When we created several simple ordinal logistic regressions with individual factors reported in the Table 4 we found that most of these factors/motivators are not related to the level of digital skills. In order to save space we summarized results of nine single predictors into one table reporting results for every single regression in one row.

Table 4. Results of simple ordinal logistic regressions reported in one table, where every factor was calculated separately as single predictor.

Predictor	Esti- mate	SE	Z	p	Odds ratio	R ² _N
To develop in general	0.45	0.26	1.75	0,08	1,57	0,01
To learn something completely new	-0,28	0,25	-1,14	0,256	0,76	0,00
Get to know new approaches	0,99	0,27	3,65	< 0,001	2,96	0,04
A requirement in the future	0,3	0,28	1,07	0,284	1,35	0,00
Get to know a new environment	-0,24	0,34	-0,7	0,483	0,79	0,00
I was convinced by positive experiences	-0,28	0,37	-0,77	0,442	0,75	0,00
Get better	0.98	0.38	2.56	0,01	2,65	0,02
My friends motivated me	-1,15	0,53	-2,18	0,029	0,32	0,02
Employer's request	1,6	1,29	1,24	0,215	4,96	0,00

Factor named: "My colleagues motivated me" was reported only by two women, which means that we had just two cases and therefore we did not include this factor into regression analysis. To control results for level of education we performed simple ordinal logistic regressions and we found that no level of education has significant influence on the achieved level of digital skills. We also tested number of children and it was also not significant. When we combined all factors/motivators into multiple ordinal logistic regressions we found that most of them became insignificant. Only two (Table 5) remained significant and this model $R^2N = 0.05$ explained 5% of variability in the level of advanced digital skills.

Table 5. Results of multiple ordinal logistic regressions with two significant predictors.

Predictor	Estimate	SE	Z	p	Odds ratio
Get to know new approaches	0.9	0.28	3.25	0,001	2,45
To develop in general	0,76	0,39	1,94	0,052	2,13

4. Discussion

If we are summing our results, we can say that factors which influence women to participate in upskilling their advanced digital skills are mostly internal and related with internal personal motivation for growth. Colleagues, friends or employer's request play minimal or even trivial role in influence. Those strategies which stress influence of external factors were not supported and if we would like to improve digital skills of Slovakian women we should concentrate at those women who are willing to grow and improve themselves. At the same time, these factors are mostly not related to each other, they are independent. Combining all factors into multiple ordinal logistic regression model we found most of them were insignificant. The best model is consisting of only two predictors: *Get to know new approaches* and *To develop in general*. This model explains reasonable 5% of variability and both factors are related to self-motivation. Those women who would like to: 1. "to get to know new approaches, technologies, solutions in the field that interests me" and 2. "I want to develop, educate and progress in general" have higher level of digital skills.

Funding: This research was funded (95%) by a grant of the University of Economics in Bratislava for young teachers, researchers and full-time PhD students, I-23-103-00: Career and qualification choices of young people towards a specialization in information technology.

This work has been supported (5%) by the EUGAIN COST Action CA19122 - European Network for Gender Balance in Informatics

The data for this paper were provided by organization: Aj ty v It (https://ajtyvit.sk/o-nas/)

References

- 1. Gras-Velazquez, A., Joyce, A., & Debry, M. (2009). White Paper. Women and ICT. Why are girls still not attracted to ICT studies and careers. INSIGHT.
- 2. Krchová, H., & Höesová, K. Š. (2021). Selected determinants of digital transformation and their influence on the number of women in the ICT sector. Entrepreneurship and Sustainability Issues, 8(4), 524.
- 3. Mráz, V., Jerga, M., & Holičková, N. (2021). Inštitút digitálnych a rozvojových politík.
- 4. Chetty, K., Aneja, U., Mishra, V., Gcora, N., & Josie, J. (2018). Bridging the digital divide in the G20: skills for the new age. Economics, 12(1), 20180024.
- 5. Gašová, K., Mišík, T., & Štofková, Z. (2018, September). Employers demands on e-skills of university students in conditions of digital economy. In CBU International Conference Proceedings (Vol. 6, pp. 146-151).
- 6. Ondrejková, A. (2016). Hodnotenie digitálnej pripravenosti krajín EÚ a postavenie Slovenska. In International scientific days 2016. The agri-food value chain: challenges for natural resources management and society: conference proceeding of reviewed articles (pp. 166-176).
- 7. Štofková, J., Madleňák, R., Repková Štofková, K. (2015). Business management. Bratislava: DOLIS, 178 p
- 8. Prensky, M. (2001). Digital natives, digital immigrants part 1, On the Horizon, 9(5), 1–6.
- 9. NPR and Edison Research. 2018. The Smart Audio Report. Washington, DC/Somerville, NJ, NPR/Edison Research
- 10. UNESCO. (2019). I'd blush if I could closing gender divides in digital skills through education. https://unesdoc.unesco.org/ark:/48223/pf0000367416
- 11. B. Divjak, M. Ostroski, and V. V. Hains, "Sustainable student retention and gender issues in mathematics for ICT study," Int. J. Math. Educ. Sci. Technol., vol. 41, no. 3, pp. 293–310, 2010.

- 12. Kori, K., Pedaste, M., Niitsoo, M., Kuusik, R., Altin, H., Tõnisson, E., ... & Paluoja, R. (2015). Why do students choose to study Information and Communications Technology? Procedia-Social and Behavioral Sciences, 191, 2867-2872.
- 13. Paura, L., Arhipova, I., & Vitols, G. (2018). Effect of social and gender factors to ICT lifelong learning motivation. In EDULEARN18 Proceedings (pp. 347-352). IATED.
- 14. Kori, K., Pedaste, M., Altin, H., Tonisson, E., & Palts, T. (2016). Factors that influence students' motivation to start and to continue studying information technology in Estonia. IEEE Transactions on Education, 59(4), 255-262.

Price differentiation in transport services

Iveta Kufelová 1,*

- ¹ University of Economics in Bratislava, Faculty of Business Management, Slovakia
- * Correspondence: iveta.kufelova@euba.sk

Abstract: The presented article provides an overview of price differentiation in transport services on the fares of Dopravný podnik Bratislava a.s., in which the majority shareholder is the capital city of Bratislava. We have addressed this issue, excluding subsidies from the city (state). Supporting innovation focused on the renewal of the vehicle fleet with a positive impact on the company's environmental aspects is an integral part of an efficient and sustainable transportation system. These investments are a significant part of pricing decisions and pricing formation. Pricing in transport services is based on price differentiation, primarily utilizing passenger segmentation.

Keywords: price differentiation, sustainability of the transportation system, revenues, passenger segment.

Introduction

The current priority in the development of transportation services is focused on areas that will lead, in the medium term, to the creation of a sustainable transportation system that supports economic growth and development in Slovakia, rather than burdening the national economy. In line with European strategic and development documents, Slovakia has adopted a targeted development vision with a horizon up to 2030, known as the "Strategic Plan for the Development of Transport in Slovakia by 2030." This is a long-term document that aims to set an effective direction for the development of the transportation sector, with the vision being: "A sustainable integrated multimodal transportation system that meets the economic, social, and environmental needs of society and contributes to the deeper integration of the Slovak Republic within the European economic area" (MINISTERSTVO DOPRAVY SR, 2023). However, investments in building such a system must also be reflected in price decision-making processes and pricing itself.

1. Theoretical background

In the article, we focused on the differentiation of ticket prices within Dopravný podnik Bratislava, a.s., and subsequently its impact on revenues, taking into account the price levels for different passenger segments. Additionally, with a view to making travel more attractive with a modern vehicle fleet, we considered an increase in passengers from various segments, which could have a positive impact on revenue levels.

In the field of developing infrastructure for public personal, sustainable local, and regional transportation, significant issues exist, primarily related to the renewal of the vehicle fleet, which is mainly associated with the high average age of vehicles in public transportation. One measure to address this problem is participating in a project aimed at ensuring the possibility of renewing the public transportation vehicle fleet in the capital city of Bratislava with the corresponding quality. (MINISTERSTVO DOPRAVY SR, 2023). The main goal of the project is to enhance the quality of services provided by Dopravný podnik Bratislava by procuring new tram vehicles for urban mass transportation.

This aims to make the integrated transportation system in Bratislava more attractive as a whole, with the goal of positively impacting the share of transport work in favor of *environmentally friendly* transportation modes. In the price decision-making processes, DPB a.s. uses indirect price differentiation – that is, by combining price and type of fare, it creates an offer for different segments of passengers.

The aim of the contribution is to analyze the impact of price differentiation on selected single-use ticket (SUT) and the subscription ticket (ST) on the volume of passengers as well as the company's sales.

In real market conditions, competition is not solely based on varying quantities and prices but also on differentiation differenciácií (GRISÁKOVÁ, a iní, 2022).

Many companies employ price differentiation during their operations. However, there are certain conditions under which a company can do so successfully (NICHOLSON, 2002).

- It must possess a certain degree of market power the ability to set a price above the marginal cost and simultaneously never set a price higher than that set by a competitive firm.
- It should have the ability to attract customers to instill a willingness in them to pay for each unit while also being able to identify which customers can be targeted with higher prices. Simultaneously, when the individual demand curve decreases, it should be able to set varying price variations for different quantities to any customer.
- The final condition is the ability to prevent or at least limit resale, meaning that customers who paid a lower price for a product will not resell it to customers who originally purchased it at a higher price. If such a situation occurs, then no one from the second group will buy the product directly from the monopoly.

The essence of price differentiation is the appropriate response of a company to different price elasticities of demand for various market segments. Market segments that are more price-sensitive (e.g., older individuals or students) will react very sensitively to even small price increases compared to the adult working category of buyers according to (PETTINGER, 2021). When implementing price differentiation, a company should consider the following advantages and disadvantages:

Table 1. Advantages and disadvantages of price defferentiation

Advantages	Disadvantages	
Companies can offer services that would other-	Some groups have to pay a higher price	
wise not achieve high profitability		
Some groups of consumers benefit		
from lower prices	Consumer surplus is decreasing	
Expands demand and avoids congestion	Potential injustice	
Increased benefits from extraordinary profit	Administrative costs	

Source: processed according to (PETTINGER, 2021)

Price differentiation allows even an unprofitable business to avoid the threat of bankruptcy and turn a loss into a small profit. It follows that the company can continue to carry out its business and provide consumers with an advantage associated with an increasing amount of goods and services. Another of the advantages that price differentiation offers is that firms reduce prices for price-sensitive consumer groups - elastic demand. These groups usually have a lower income than the average consumer, so their demand is more elastic. The downside is that some consumers have to face higher prices. Price differentiation helps the company to become more profitable and thus invest, for example, in increasing capacity, modernization and technology.

2. Methods and methodology

In the preparation of the article, we primarily utilized a literature review as our main tool. Through it, we sought and compiled comprehensive theoretical knowledge related to the addressed issues, particularly in the areas of innovation, pricing, and price differentiation. The data obtained in this way were processed through analysis and synthesis. When characterizing the object of transportation services, specifically the company, we employed the method of analysis. A significant portion of data and information was sourced from online resources and then organized into tabular form. When processing the results, we used the simulation as an imitation of reality, in estimating the acquisition of new passengers due to the attractiveness of travel and price modifications. In this part, we also used methods of simulating alternative scenarios of demand development, combined with impact analysis. The results

of the analysis of the impact of trends have various uses, e.g. when identifying events and the probability of achieving set goals in a certain time horizon.

In evaluating the company's revenues, especially in the context of price differentiation, we used both absolute and relative comparison methods, particularly when assessing changes in revenue and profit over the observed period. We also employed the methods of analogy and comparison to highlight the impact of price differentiation on effective business operations and the functioning of the company.

3. Results

DPB, a.s. is the sole provider of public transportation services within the city of Bratislava. In addition to city public transportation lines, it also operates suburban lines and regular international bus routes. DPB manages trolleybus, bus, and tram transportation.

The fundamental strategy that DPB, a.s. is pursuing for the future is to execute safe, high-quality, and efficient public transportation operations within the city, participate in transportation services, and optimize operations within the integrated public transportation system for individuals in the territory of the Bratislava self-governing region and the capital city of Slovakia, Bratislava.

To achieve this direction, the company has established the following strategic objectives (DPB, a. s., 2023):

- Provide high-quality public transportation services in alignment with public satisfaction.
- Build an energy-efficient, competitive, and sustainable transportation system.
- Operate the integrated public transportation system effectively, purposefully, and with high quality.
- Efficiently manage overall transportation.
- Modernize operational assets.
- Achieve balanced to profitable financial management.

3.1. Price differentiation in Dopravný podnik Bratislava a. s.

The need for decarbonization and minimization of pollution in the future is becoming a central point of public transport and planning the development of European cities. Environmental sustainability is becoming the center of attention and requires much more attention than ever before. This means that in addition to financial sustainability, public transport providers must also consider environmental and social impacts. The speed of innovation is increasingly exceeding the speed at which traditional regulatory systems are able to adapt. The regulatory systems should thus become more dynamic, so that they can respond in a timely and coordinated manner to the emerging types of transport, including the private sector. The growth of costs associated with investments is of course a part of price decision-making and price setting (FENDEK, a iní, 2008).

DPB a.s. uses in pricing processes the setting of a differentiated price for different market segments - different groups of customers. A certain group of customers who are given a lower price for certain reasons are favored. Such type of customers are, for example, students or pensioners, who are given certain discounts from the basic sales prices setting (FENDEK, a iní, 2008).

DPB a.s. registered 166,408 million in 2021 according to the annual report. passengers. Total sales for this period amounted to 25,898 million. €. For the purposes of the impact of price differentiation on sales, we classified individual passengers into groups, as shown in Table 2.

Table 2 Number of passengers (in million people) in 2021 by individual segment

Passenger group	Number of	Share in %
	passengers	

Pupils and students	61 072	36,70 %
Working employees	66 397	39,90 %
Entrepreneurs	8 154	4,90 %
Seniors up to 70 years old	11 149	6,70 %
Seniors over 70 years old	10 650	6,40 %
Children up to 6 years old,	8 986	5,40 %
Passengers together	166 408	100,00 %

Source: processed according to (DPB, a. s., 2023)- Annual report DPB a. s. 2021

According to the tariff system of Dopravný podnik Bratislava a.s. for further analysis, we divided passengers into three groups, namely:

- group 1 passengers who pay the basic fare (without discount),
- group 2 passengers who pay a discounted fare (50% discount),
- group 3 passengers who are entitled to a 100% discount on the ticket price.

Table 3 Number of passengers in percentage terms and in mil. of persons according to individual groups

Passenger group	Share in %	Number of passengers
Group 1	44,80 %	74 551
Group 2	43,40 %	72 221
Group 3	11,80 %	19 636
Together	100,00 %	166 408

Source: processed according to (DPB, a. s., 2023) – Annual report DPB a. s., 2021

Based on the division of passengers into individual segments - groups, we analyzed the share of these groups in the company's sales, with the assumption that for group 3, sales in the amount of zero. The analysis of the share of individual groups in sales is shown in Table 4.

Table 4 Analysis of the share of individual passenger groups in sales

Passenger group	Share of sales in %	Share of sales in €
Group 1	78,30 %	20 278 134
Group 2	21,70 %	5 619 866
Group 3	0 %	0
Together	100,00%	25 898 000

Source: Processed according to (DPB, a. s., 2023) – Annual report DPB a.s., 2021

From the data in the table, we observe that the share of sales for group 2 is lower by half than its share in the number of passengers. The explanation is that DPB a.s. provides this group with a *differentiated price* - a ticket discounted by 50% from the price of the basic ticket.

For group 3, even though passengers make up almost 12% of the total, the revenue share is zero because these passengers do not pay any fares (100% discount from the basic ticket price).

In the next part, we will express what impact on sales would be the *provision of a 50% discount to all residents* of the city of Bratislava, if we assume that they have not traveled by public transport so far. I am considering a discount from both the average single-use ticket (SUT) price and the subscription ticket price (ST).

According to the last census in 2021, the population of Bratislava reached 475,503 inhabitants (Štatistický úrad SR, 2021).

In the age structure: 0 - 14 years: 73 769,

15 – 64 years: 311 404, 65 years and over: 90 330.

Let's assume that there are 10% of those in the 15-64 age group who, according to the tariff system, are not entitled to any discount and use personal motor vehicles to go to work or for entertainment. This would represent 31,140 passengers who, as residents of Bratislava, would be entitled to a 50% discount. We think that a suitable marketing strategy would win them over.

If half of this number used subscription tickets (ST) and other single-use tickets (SUT), the average price of which is 1.34 (own calculation based on all discounted SUT prices), then the income from ST sales would be $15,570 \times 100$ (discounted ST from £199 by 50%) = £1,557,000 and the revenue from SUT would represent, at an average number of 10 trips per month (10×1.34), which with 15,570 passengers would amount to approx. £208,638 per year, in total a total of £1,765,638.

The following table shows the impact on sales of providing a 50% discount to Bratislava residents based on the acquisition of a certain percentage of new passengers (from the 15-64 age group: out of 311,404 persons, e.g. 1.5%, 3.5 or 5, 5%):

Table 5 Impact of price differentiation on revenue from acquired new passengers

Increase in revenue/increase in passengers	1,5 %	3,5 %	5,5 %
	passengers	passengers	passengers
Number of passengers acquired	4 672	10 900	17 128
SUT 50 %	2 336	5 450	8 564
ST 50 %	2 336	5 450	8 564
Increase in revenue from SUT in € for five			
tickets per month (for €1.34/ticket)	15 651	36 515	57 379
Increase in revenue from ST in €	233 600	545 500	856 400
Total revenue increase in €	249 251	582 015	913 779

Source: own processing

The total revenue increase would be $\[\in \] 249,251$ per year if 1.5% of new passengers were acquired, $\[\in \] 582,015$ at 3.5% and $\[\in \] 913,779$ at 5.5%. Even if the stated values seem optimistic, in a comprehensive evaluation of the situation, we must state that a positive effect on total sales will only be felt if the number of newly acquired passengers is not lower than the number of current passengers who will be entitled to a new discount.

4. Discussion

Effective application and appropriate timing of price differentiation can have a growing impact on sales and also profit in a company. Also, on the other hand, it assumes a satisfied customer, not only with the price but also with other services related to the price. Currently, in all areas of business, environmental protection and sustainable consumption are given first place. Application of price differentiation in DPB a. s. it takes into account its main idea, which is that different market segments respond to price changes with different price elasticities of demand. If the company determines a group of passengers for whom it will literally tailor a price, then it can expect that this price will also ensure higher sales.

In the contribution, we analyzed the effect on sales and the amount of profit that the attraction of new customers - travelers would have in view of making travel more attractive. Assuming the acquisition of new passengers, e.g. by 3.5% (Table 5), the company could gain an increase in profit in the amount of approx. 580 thousand € through appropriate marketing.

5. Conclusions

The development of public transport in the trends of sustainable economic growth and opportunities requires the support of investments with long-term financial sustainability. The future of transport in Slovakia will belong to electric vehicles and hydrogen-powered vehicles. In accordance with the Recovery Plan, the main objective of which is the introduction of systemic changes for a sustainable and competitive Slovakia, new financial resources were added for this purpose through the *RE Power EU* chapter for green investments with the aim of reducing the consumption of fossil fuels and solving the climate crisis (European commission, 2023). Modernization in DPB a. s. with the support of ecological passenger transport, it will thus increase its attractiveness and also support emission-free travel, which are factors that attract many passengers.

Funding: This research was funded by 1/0465/23 Generic, convergence and model approaches of environmental production and logistics in business development in Slovakia.

References

- 1. DPB a. s. https://dpb.sk/ [Online] 18. 9. 2023. https://dpb.sk/sk/sprava/prieskum-s-mhd-v-bratislave-su-spokojne-takmer-dve-tretiny-cestujucich.
- 2. DPB, a. s. https://dpb.sk Výročná správa DPB a.s. za rok 2021. [Online] 18. 9 2023.
- 3. DPB, a.s, https://dpb.sk cennik. [Online] 18. 9. 2023. dpb.sk/sk/cennik.
- 4. European commission. ttps://ec.europa.eu/commission/presscorner/detail/en/IP_22_3131. [Online] 29. 9. 2023.
- 5. Fendek, M. Fendeková, E. (2008) Mikroekonomická analýza. Bratislava: Iura Edition, 2008. s. 575. ISBN 978-80-8078-180-4.
- 6. Grisáková, N. Štetka, P. (2022). Cournot's Oligopoly Equilibrium under Different Expectations.
- 7. Laguna, M. MARKLUND, J. (2005). Business Process Modeling, Simulation and Design. New Jersey: Pearson Prentice Hall, 2005. 429 s. ISBN 0-13-091519-X.

- 8. Ministerstvo dopravy SR. (2023). Strategický plán rozvoja dopravy SR do roku 2030. [Online] 10. 9. 2023. h Nicolson, W. (2002). Microeconomic Theory. [ed.] Thomas O. Gay. s.l.: Media Buyer, 2002. s. 528-537. ISBN: 0-03-033593-0.
- 9. Nicolson, W. (2002). Microeconomic Theory. [ed.] Thomas O. Gay. s.l.: Media Buyer, 2002. s. 528-537. ISBN: 0-03-033593-0.
- 10. https://www.mindop.sk/ministerstvo-1/doprava-3/strategia/strategicky-plan-rozvoja-dopravy-sr-do-roku-2030.
- 11. Pettinger, T. (2021). Economics Without the Boring Bits. Welbeck Publishing 2021. 330 s. ISBN 9781787396128.
- 12. Potuček, M. (2006). ed. Manual prognostickych metod. 1. Praha: Sociologické nakladatelství, 2006. Studijní texty (Sociologické nakladatelství). ISBN 80-864-2955-5.
- 13. Štatistický úrad SR. https://slovak.statistics.sk/. [Online] 29.9.2023.

The Importance of Building Small Hydropower Plants in the Concept of the Circular Economy

Milan Kubica 1, Miroslav Uhliar 2

- ¹ Faculty of Business Management, University of Economics in Bratislava, Slovakia; milan.kuica@euba.sk
- ² Faculty of Business Management, University of Economics in Bratislava, Slovakia, miroslav.uhliar@euba.sk

Abstract: Circular economy's aim is to ensure a healthy environment alongside a stable economy. In circular economy, emphasis is placed on the entire product lifecycle, from the extraction of natural resources to production, distribution, and consumption waste. To understand the circular economy in the context of social demands and constraints not only in the Slovak market, it is essential to focus on the initial phase of the production cycle – the extraction of the natural resources, or production. In this regard, the main topic is currently the utilization of renewable energy sources, namely harnessing the power of the sun, wind and water. The aim of this article is to acquaint the Reader with the possibilities of utilizing small hydropower plants on watercourses in Slovakia as alternative sources of renewable and ecologic energy within the circular economy. We present several parameters which influence the decision-making process for the costruction of SHPs, including the technical parameters, potential risks and economic assessment from the potential inverstors' perspective.

Keywords: small hydropower plant (SHP); circular economy; renewable sources of energy

Introduction

The introduction of the presented article is dedicated to a quote by David Attenborough, which says: "Anyone who thinks that you can have infinite growth in a finite environment is either a madman or an economist." In the current society, the economic model is mostly linear. This means that we extract natural resources and we transport them to the other side of the world where they are turned into products. Subsequently, these products are once again shipped to distant corners of the world, where the consumers purchase, use and dispose of them, thus creating an enourmous amount of waste. In this linear system, the essence of profit lies in the high consumption of non-renewable resources, which, of course, is not sustainable in the long run. Therefore, we can logically consider the current economic system unsustainable, both economically, socially and, most importantly, environmentally.

Circular economy is the opposite to this linear model and it has been a key politic topic in the European Union since 2015.

1. Theoretical Background

Circular economy, as a conceptual direction, began to take shape at the beginning of the 21st century. It represents a new theoretical breakthrough within the field of economics, based on a broad societal consensus to prioritize such parameters of the economic environment, which should, among other things, lead to entirely new production cycles in terms of effective resource utilization. The traditional linear production chains, such as raw material – product – waste, should disappear in the circular economy and they should be replaced by chains of a circular type, such as secondary material – product – secondary material (Kislingerová & Co., 2021)



Image 1. Linear economic model

Source: Circular Economy Institute (2023). Circular economy. https://www.incien.sk/cirkularna-ekonomika/



Image 2. Circular economy

Source: Circular Economy Institute (2023). Circular economy. https://www.incien.sk/cirkularna-ekonomika/

Circular economy is one of the main pillars of the European Green Deal, which plays a crucial role in decarbonization and the efforts to achieve climate neutrality by 2050, as well as in the fight against environmental pollution. The new action plan for the circular economy puts the emphasis on the entire product lifecycle and it describes specific requirements and regulatory changes which apply to a wide range of industries (denkstatt Group, 2023).

To understand the circular economy in the context of societal demands and limitations, not just within the Slovak market, it is necessary to focus on the initial phase of the production cycle, which involves the extraction of natural resources or production. The circular model aims to ensure a healthy environment alongside a stable economy. Therefore, the current key topic in this regard is the utilization of renewable energy sources, i.e. harnessing the power of the sun, wind, and water.

The need for a more pronounced utilization of renewable energy sources was highlighted also by the military conflict in Ukraine involving Russia, which primarily compelled European countries to reduce their energy dependence on Russian gas, oil, and nuclear fuel.

One of the steps toward greener energy includes the reduction of coal usage. The Government of the Slovak Republic has decided to close the last coal mine in Slovakia, located in the town of Nováky. In 2018, it was decided that the State would stop subsidizing the production of electricity and heat from domestic brown coal through consumers' invoices. From an economic standpoint, coal mining thus became unprofitable for the State. The last ton of coal will be extracted from the brown coal mine in Nováky in December 2023 (Frantová, 2023).

These aforementioned factors highlight the necessity for a more significant utilization of renewable energy sources.

Currently, one of the most commonly used sources of energy is hydropower. This primarily involves large hydroelectric power plants or, in some cases, pumped storage hydroelectric power plants, which usually depend on larger water reservoirs. Their construction often requires significant alterations to the surrounding landscape, resulting in changes to its character, which can be undesirable from an ecological perspective. The construction of **small hydropower plants (SHPs)** is a far less intrusive option for the environment; their ecological consequences are minimal. In Slovakia, there are numerous locations where these SHPs can be built.

The term "small hydropower plants" refers to hydroelectric power plants with an installed capacity of up to 10 MW. These can be further categorized based on various criteria, with the most important

being the installed capacity, head (the difference between the upper and lower water levels, i.e., before and after the turbines), and flow rate (the amount or volume of water passing through the profile per unit of time). (HYDROINVEST, spol. s r.o., 2011)

SHPs are relatively simple and technically undemanding energy facilities. Nevertheless, they are associated with significant environmental and socio-economic impacts. These impacts depend primarily on the location and type of the specific hydropower plant. It is important to emphasize that, in general, these impacts include both negative and highly positive effects.

The main **positive impacts** are the following (Ministry of Environment of the Slovak Republic, 2015):

- using the hydroenergy potential of the watercourses for electricity generation with appropriately
 chosen technical solutions can be a long-term positive measure to reduce some of the significant
 negative environmental and health impacts. It can be one of the environmentally acceptable ways
 to obtain electrical energy;
- electricity production in hydroelectric power plants impacts certain environmental components significantly less compared to the production based on traditional fossil fuels;
- using the hydroenergy potential can contribute to the reduction of greenhouse gas emissions and harmful substances;
- using hydroenergy potential can contribute to the diversification of energy sources and, therefore, to energy security of the Slovak Republic;
- hydropower plants play a significant role in the country's energy mix with positive socio-economic impacts;
- they play a crucial role in regulating the fluctuations in energy consumption in the power grid;
- they use domestic energy sources, which means that there is no need to import them from politically and economically unstable regions;
- they have a positive impact on the foreign trade balance;
- they use energy from renewable sources;
- they produce electricity without significant work-related risks;
- the energy source is not burdened with high transportation costs;
- by eliminating the transportation of the energy source, they contribute indirectly to the reduction of the transportation's environmental impact;
- they create new job opportunities, with this significant increase in job opportunities expected primarily during the construction phase, as the actual operation is highly automated;
- secondary job growth can occur in connection with the development of tourism, sports activities, travel, and more;
- the construction of cross-water structures contributes to water retention within the territory of the Slovak Republic, thus slowing down drainage, ensuring sanitary flow, and filling underground basins (reservoirs) in sections above the cross structures;
- positive impact on the climate in the vicinity of the water facility.

The negative impacts include (Ministry of Environment of the Slovak Republic, 2015):

- possible effects on critical structures within the ecosystems of watercourses, especially on the characteristic organization of still and flowing sections and the adaptations of biota to them;
- disruption of channel-forming (erosive-transport-deposition) processes in the flow and related hydromorphological changes (e.g., changes in the width and depth of the channel), including alterations in the hyporheic zone (the zone of interaction and exchange between surface and shallow groundwater), which can lead to bed erosion below the barrier and, consequently, lowering of the groundwater level below the barrier;
- reduction in flow velocity, changes in water flow and states, and water level regimes in the channel and adjacent floodplains;
- possible increase in water temperature, or decrease in its annual amplitude, reduced oxygen
 concentration, reduced self-purifying capacity, increased turbidity, deposition of fine sediments
 (which would naturally be transported much further downstream under normal conditions and

- would naturally disintegrate), nutrient loading, and clogging of river sections affected by impoundments, disruption of sediment transport, erosion and adverse changes in ice phenomena;
- possible losses of water and riparian habitats of national and European significance and changes in their representation and conservation status (e.g., reduction in habitat diversity/heterogenity, increase in standing water habitats, losses of flowing water, floodplain forests, and more);
- possible creation of new source habitats for aquatic and terrestrial invasive and spreading plants and animals in areas affected by construction, facilitating or promoting their spread along watercourse corridors and into the surrounding landscape;
- disruption of the longitudinal and lateral connectivity of watercourse ecosystems with impacts on aquatic communities and populations, potentially leading to blockages in migration and dispersal routes and causing challenging habitat fragmentation, which reduces the anti-erosion, retention, and refuge efficacy of riparian vegetation and ecosystem resilience;
- possible changes in the mortality, mobility (migration and dispersal) and living conditions of water
 and riparian organisms, especially fish, benthic invertebrates, and vascular plants, reproductive
 isolation of populations, especially migratory fish species, changes in fish communities, benthos
 and their habitats, and disturbances to food webs in ecosystems, leading to a deterioration of the
 ecological state/potential of surface water bodies;
- possible cumulative impacts of cascades and reservoirs (series of hydropower plants) on watercourse ecosystems in the overall (or partial) watershed, which increase with the number of SHPs in the system;
- potential disruption of the landscape structure of river valleys and floodplains, reducing their appeal to visitors, and negative urbanistic intervention into the surrounding natural environment;
- disruption of navigation in affected river ecosystems and a worsening of opportunities for their sustainable multifunctional use, whether for sports and recreation (fishing, canoeing, rafting), "soft" tourism (traditional rafting, nature observation), and more;
- in derivative hydropower plants, insufficient ecological flow in affected sections can have various
 impacts on the river ecology, particularly stream character homogenization and environmental
 degradation, disruption of continuity for migratory fish species, and changes in natural
 temperature conditions;
- land aquisition;
- local changes in flood risks;
- Local increase in noise levels.

2. Methods and Methodology

The aim of this article is to acquaint the Reader with the possibilities of utilizing the construction of small hydropower plants on watercourses within the territory of Slovakia as alternative sources of renewable and environmentally friendly energy.

In this article, we present several parameters that influence the decision-making for the construction of small hydropower plants, from the perspective of technical parameters of small hydropower plants, possible risks, as well as economic assessment from the viewpoint of potential investors.

3. The Results

In order to minimize the aforementioned negative impacts of small hydropower plant (SHP) construction, it is essential to reliably identify potential profiles. This means that when evaluating and selecting suitable profiles for SHP placement, two fundamental categories of issues need to be taken into account:

- accurately estimate the transient parameters of the SHP;
- capture as many potential risks as possible.

To accurately estimate the transient parameters of the SHP means that in the identified profile it is possible to construct SHPs with parameters that are transient in terms of utilizing the overall

hydroenergy potential of the profile. The technical solution will be acceptable in terms of environmental impact assessment, and the economic indicators will be acceptable for the investor.

To capture as many potential risks means to acquire as many available data for each of the registered potential profiles as possible, primarily from those areas which will present the greatest risk in the subsequent phase of investment preparation (territorial proceedings). The individual areas of assessment were proposed as follows (HYDROINVEST, spol. s r.o., 2011):

- 1. **engineering-geological conditions** outputs from the survey of engineering-geological conditions for the implementation of the construction directly within the profile or in its immediate vicinity;
- 2. **hydrological and climatic conditions** distribution of the runoff, sediment movement, temperature, altitude, freezing (number of days per year), etc.;
- 3. **hydrological conditions** stream regulation, water regime, flow conditions, regulation by other water structures, etc.;
- 4. **ecology and environment** protected areas, existence of other water structures, opinions of fishermen and other conservation organizations;
- 5. **ownership and lease relationships –** land settlement, ownership relationships, encumbrances, land acquisition complexity;
- 6. induced and related investments the need for the construction of waterworks (dam + reservoir + SHP), protective measures, possible complications in the implementation of the engineering networks, investments in environmental measures, removal of existing objects, construction of access roads, flood protection measures, and more.

For the **economic assessment** of the SHPs construction, from the possible investor's perspective, the following economic parameters need to be thoroughly planned and analyzed (HYDROINVEST, spol. s r.o., 2011):

- rough estimation of investment costs processed with the available data in such way, that the result shows the total investment costs for the construction of SHPs. The overall construction costs of SHPs consist of partial costs, which include direct construction costs and other construction costs. *Direct construction costs* include expenses directly related to the construction of the facility, specifically its construction objects and operational units. They are categorized by nature into: construction, hydro-technological, mechanical-technological, electro-technological, and control and regulation costs., *Other construction costs* include expenses related to: project and survey work (costs for the preparation of the project documentation, engineering-geological survey, land surveying, environmental assessment), secondary costs (site equipment with regards to local impacts, location, and building position), patent and license costs, unforeseen costs (reserves), completion work, engineering work (costs for preparing the documentation, studies, investment intentions, and engineering work by the investor), damage compensation and other expenses, land acquisition costs;
- defining the acquisition price of the basic assets the acquisition price of basic assets for water
 management investments is calculated as the sum of direct budgetary costs and a portion of other
 costs, including project and survey works, secondary costs, patent and license costs, and
 unexpected costs (reserve);
- **defining the annual depreciation amount** the average service life (economic life of the investment) should closely approximate the actual life of the facility. Many components of the water structures have an extremely long physical life. The lifespan of used materials, especially earth constructions, reinforced concrete, crushed stone, etc., can exceed 100 years;
- determining the economic life of the investment the economic life of the investment can be
 defined as the period during which the sum of the depreciation equals the acquisition price of basic
 assets;
- calculating the production costs the production costs for water management structures with
 energy utilization are calculated as the sum of the depreciation for the water management facility
 components over its economic life and operating expenses. The operating expenses for the water
 management facilities with energy utilization are defined as the sum of maintenance costs,
 operating material costs, salary costs, and management costs;

- calculating the annual revenues the basic input data for the definition of annual revenues are the production of electricity and its purchase price. The calculation of the power and electricity production from the SHP water source is based on the flow rate (the total volume of water passing through the turbine in 1 second), head (the portion of static head that the turbine can use at certain efficiency) and turbine efficiency (the ratio of the actual turbine output on the shaft to its theoretical output; it expresses the losses that occur when converting the hydraulic energy into mechanical energy). The purchase prices for electricity from SHPs are legislatively regulated in the Slovak Republic;
- calculating the economic efficiency indicators for further investor decision-making on SHP
 construction, other economic indicators of the investment project need to be considered, such as
 gross profit, reproductive return on investment, production costs per unit, specific costs per unit
 of production, specific marginal cost, and others.

4. Discussion and Conclusion

Projects focused on investments in ecological future are coming to the forefront. In the concept of implementing the circular economy, one of the possibilities that can be applied in Slovakia is the use of small hydropower plant (SHP) constructions as an ecological source of electrical energy. However, it is necessary to conceptually approach the decision-making for the construction of small hydropower plants on Slovak rivers and to take into account many technical, economic, and, most importantly, ecological parameters when deciding on their construction in a specific location. In conclusion, we return to David Attenborough's initial quote, emphasizing the need for practical implementation of the circular economy principles, as infinite growth in a finite environment is not possible, even in theory.

Funding: This research was funded by VEGA 1/0462/23.

Reference

- 1. denkstatt Group (2023). Cirkulárna ekonomika. https://denkstatt.eu/sk/oblasti-zaujmu/cirkularna-ekonomika/
- 2. Frantová, E. (2023). Čo príde po uhlí alebo definitívny koniec baníkov na Hornej Nitre. https://index.sme.sk/c/23160110/uhlie-na-hornej-nitre-konci-bane-hladaju-nove-vyuzitie.html
- 3. HYDROINVEST, spol. s r.o. (2011). Metodika na vyhľadanie vhodných lokalít pre výstavbu MVE
- 4. Kislingerová, E. a kol. (2021). Cirkulární ekonomie a ekonomika. Spoločenské paradigma, postavení, budoucnost a praktické souvislosti. 264 p. ISBN 978/80-271-4618-5
- 5. Inštitút cirkulárnej ekonomiky (2023). Cirkulárna ekonomika. https://www.incien.sk/cirkularna-ekonomika/
- Ministerstvo životného prostredia SR (2015). Aktualizácia koncepcie využitia hydroenergetického potenciálu vodných tokov Slovenskej republiky do roku 2030. https://www.enviroportal.sk/voda/vyuzitiehydroenergetickeho-potencialu-vodnych-tokov-sr-2030

Evaluation of the sugar companies in the Czech Republic

Elena Moravčíková 1, Eduard Hyránek 3,*

- 1 Affiliation 1 (University of Economic, Faculty of business management, Bratislava, Slovakia) elena.moravcikova@euba.sk
- 2 2Affiliation 2 (University of Economic, Faculty of business management, Bratislava, Slovakia) eduard.hyranek@euba.sk

Abstract: Industrial enterprises have been affected by the corona crisis, rising energy prices and the related increase in in the prices if production factors in recent years. Sugar factories also had to deal with the consequences of the end of sugar production in September 2017. This contribution dedicated to the analysis of the evaluation of the company positions on the market based on selected performance indicators, its goal is to explain the company position, possible causes and the situation on the Russian market. This contribution is dedicated to the evaluation of the companies positions on the market based on selected performance indicators, its goal is to explain the company position, possible causes and deviation from the use of the method of standardized values. The results the performance of sugar mills fell already in 2018 and is gradually consolidating. After overcoming these-obstacles sugar factories have chance to secure a long-term chance.

Keywords: sugar factory; performance; position

Introduction

This article is devoted to the position of sugar factories in the Czech Republic as of 2018, the standardized variable method. In recent years, on a global scale, several non-standard situations have been caused 14) by various economic problems manifested by economic difficulties at the level of the national economies of individual countries and trough financial stability of companies, especially the performance of their business efforts. The performance of the business effort is manifested by the ability of the business to "transform" business inputs into business outputs with all the place and dynamics.

1. Theoretical background

The new type of coronavirus complicated these efforts to consolidate the position of sugar factories, and brought not only the problem of unemployment among the population, but also the rise in prices of energy and other production factor, while Porvazník (2014) drew attention to this three earlier. Árendáš (2023) also stated that sugar is one of the commodities that moved differently on the market during the crisis, which is correspond to the findings of Chowdhury (2022) and Žak (2020). Malorgio (2021) and Brunori (2020) are devoted to the preservation of economic viability and promoted environment and social sustainability based on the document Paris Agreement from Responsibility in terms of the UN 2030. Onofri (2019) emphasizes mainly to preservation of soil soil fertility - Agenda a the Paris Agreement from 2015, at the same time also emphasizing for preservation for subsequent processing of the product of enterprises in the climatic process. And the end, Treio-Pech (2020) brings a positive message - which confirmed the improvement in the performance of sugar processing enterprises, even in the case of rising sugar prices. An any case, as follows from the article Dvořák (2023), absolute values are not comparable between companies. Each company works in a different context, some have socalled "cash pooling", which is strongly reflected not only in their value of net working capital, but also in their liquidity indicators and thus also in the credibility of creditors - whether banks or business partners. In this case, indicators based on net profit were also used (e.g. net profit after tax!), which in various countries is influenced not only by the accounting law, but also by the income tax law, as well as by the current situation on the financial and banking) of the market. However, most analysts are aware of the fact that not only the bank's confidence in the business plan of the company is a necessary

prerequisite for granting a loan to the bank, but especially the possibility of bank guarantees. At the same time, it is appropriate to realize that this article is dedicated to the period of the corona crisis, the Russian invasion and the subsequent increase in the prices of production factors. she was exceptional) for sugar market.

2. Methods and methodology

This contribution is devoted to selected indicators of the business performance of Czech sugar companies, subsequently, we present the sugar mills and the abbreviations assigned to them, which we will use in the following text:

- MSC Moravia-Silesian sugar factories, joint-stock company
- LIT Litovelská sugar factory, joint-stock company
- TER- Tereis TTD, joint-stock company
- VRB Sugar factory Vrbátky, joint-stock company
- HAN Hanácká Food Company, Limited Liability Company.

The data used in the processing are publicly available, the source of the financial statements is the Czech Commercial Register. The analyzed Period is the years 2019 to 2021, partly also the year 2022 (the reason is that two of the companies have not yet entered their data in the Commercial Register). The selected indicators are the following:

- 1. The net return on equity we chose as an indicator expressing the performance of equity capital after taxation, i.e. it takes into account the comprehensive result of corporate efforts after comping state intervention (taking into account income tax) in relation to equity capital.
- 2. Self-financing as a ratio of own and total capital informs about the structure of financial resources. A high share of own resources helps the stability of the company and its independence, their low share can cause corporate instability and make creditors nervous.
- 3. The indicator of sales from realization/production consumption indicated the performance of production consumption (consumed material, energy, services, respectively purchased goods), i.e. what sales from realization (of products, services or goods) the company can create from the mentioned factors of production consumed in the company.
- 4. Profitability of revenues indicates the evaluation of the outputs achieved by quantifying the amount of profit in euros of revenues and relatively simply characterizes the economy of the activity carried out in the company.

In this paper, we decided to use the standardized variable method, which makes it possible to express the difference between the results of an individual company and the results of other selected companies. Its essence lies in the calculation of arithmetic averages of individual indicators; we transformed the indicators into a standardized form in a simple way: considering that maximization was desired for all indicators selected for the calculation, we divided the difference between the company value and the average value by the quartile range (quartile 3 and quartile 1).

3. Results

In the following text, we present the results of the individual indicators of the listed companies in the selected periods calculated on the basis of the financial statements.

Table 1. Results of individual indicators in the year 2019.

2019	1.	2.	3.	4.
MSC	0,25034	0,63357	1,04369	-0,16470
LIT	0,00435	0,28011	1,08899	-0,00031
TER	-0,04174	0,65556	1,21265	-0,31700
VRB	-0,01419	0,87307	1,40028	0,00527
HAN	-0,00451	0,70133	1,16047	-0,03248

Source: Source: own calculations.

The years 2018 a 2019 are called the years of the sugar crisis, and the results correspond to this. Although the operating cost indicator achieves results higher than 1, at the same time, not all companies are able to carry our

their normal operating activities from sales revenue. The result of financial activity also "contributes" to Litovelas good result (notes result from studying the financial statements of companies).

Table 2. Results of individual indicators in the year 2020.

2020	1.	2.	3.	4.
MSC	0,06994	0,49751	1,30343	0,02691
LIT	0,00101	0,20095	1.38663	0,00212
TER	0,03527	0,67002	1,22876	0.02859
VRB	0,00861	0,87968	1,36251	0,00574
HAN	-0,00898	0,72518	1,41486	-0,00483

Source: Source: own calculations.

In 2020, the situation changes, except for the Vrbátky and Haná sugar factories, the other companies achieve a positive economic result, despite this, the indicators are affected by the positive economic result (notes result from studying the financial statements of companies).

Table 3. Results of individual indicators in the 202year 2021.

2021	1.	2.	3.	4.
MSC	0,06994	0,41827	1,25277	0,07700
LIT	0,00101	0,22229	1,28869	0,06373
TER	0,03527	0,72918	1,23316	0,07758
VRB	0,00861	0,84365	1,33297	0,05761
HAN	-0,00179	0,72517	1,27062	0,00093

Source: Source: own calculations.

In 2021, all sugar mills show a positive development in operating costs, which contributes to the overall economic result.

Table 4. Results of individual indicators in the year 2022.

2022	1.	2.	3.	4.
MSC	0,11350	0,45959	1,21415	-0,60116
LIT	n/a	n/a	n/a	n/a
TER	0,09017	0,70312	1,15994	0,39884
VRB	0,08269	0,77105	1,37304	0,20232
HAN	n/a	n/a	n/a	n/a

n/a = the financial statements of the were not available

Source: Source: own calculations.

In 2022, the financial statement of all sugar mills were not available, so we only report the results for the three available enterprises.

Table 5. Standardized indicators of individual indicators in the year 2019.

2019	1.	2.	3.	4.
MSC	0,89107	0,16765	-0,57273	-0,23901
LIT	0,17491	-12,0704	-0,38407	0,41676
TER	-0,46701	0,92902	0,13091	0,34381
VRB	-0,18703	8,46001	0,91229	-0,43902
HAN	-0,13196	2,51380	-0,08640	0,288413

Source: Source: own calculations.

In the next table shows the calculations of the standardized value of selected indicators for all enterprise in a given year 2020.

Table 6. Standardized indicators of individual indicators in the year 2020.

2020	1.	2.	3.	4.
MSC	0,86181	-0,21438	-0,26593	0,52238
LIT	-0,35265	-1,15673	0,35196	-0,32936
TER	0,24916	0,21577	-0,82048	0,58011
VRB	-0,22195	0,81613	0,17283	-0,20498
HAN	-0,53270	0,37371	0,56162	-0.56815

Source: Source: own calculations.

In the next table shows the calculations of the standardized value of selected indicators for all enterprise in a given year 2021.

Table 7. Standardized indicator of individual indictors in the year 2021.

2021	1.	2.	3.	4.
MSC	1,39459	-0,43612	-0,15204	0,65861
LIT	-0,356247	-0,94054	0,13135	0,38227
TER	0,249161	-0,95733	-0,45458	0,67069
VRB	-0,221947	0,65875	0,59857	0,25482
HAN	-0,532780	0,35380	-0,05932	-0,92552

Source: Source: own calculations.

In the next table shows the calculations of the standardized value of selected indicators for all enterprise in a given year 2022.

Table 8. Standardized indicators of individual indicators of the year 2022.

2022	1.	2.	3.	4.
MSC	0,58730	-0,59397	-0,1674	-0,60116
LIT	n/a	n/a	n/a	n/a
TER	-0,17146	0,18793	-0,41813	0,39884
VRB	-0,41427	0,40603	0,58187	0,20232
HAN	n/a	n/a	n/a	n/a

n/a = the financial statements of the company were not available

Source: Source: own calculations.

Table 9 contains a summary of individual standardized values in individual years organized by companies.

Table 9. Sum of standardized variables of selected companies in 2019-2022.

SUMMARY	2019	2020	2021	2022
MSC	0,24697	0,90388	1,46505	0,77314
LIT	-11,86280	-1,49037	-0,78317	n/a
TER	1,00968	0,22455	-0,49206	-0,00283
VRB	9,34431	0,56202	1,29019	0,77596
HAN	2,58382	-0,16560	-1,16382	n/a

Source: Source: own calculations.

The final table shows the order of the sum of the values of the standardized values of the selected indicators for individual years for all companies with available financial statements.

Table 10. Ranking of companies according of the sum of standardized variables of selected companies in individual years.

Ranking	2019	2020	2021	2022
MSC	4.	1.	1.	2.
LIT	5.	5.	4.	n/a

TER	3.	3.	3.	3.
VRB	1.	2.	2.	1.
HAN	2.	4.	5.	n/a

Source: Source: own calculations.

4. Discussion

The ranking of companies according to the sum of the standardized variables of the selected companies varied significantly in individual years. There could be several reasons, e.g. the reactions of companies to the corona crisis, the increase in the price of production factors, the situation with the Russian sugar market, and companies have not yet come to terms with the removal of sugar quotas. These facts are the reason for the fluctuation of performance results throughout the period. However, the crisis years in the sugar industry gave rise to a more flexible response in order to improve future results. However businesses focused on staying in business. In the long term, however, it is the possibility to ensure the stabilization the position and performance of enterprise. The results of 2021 almost copy 2020, but they have not yet returned to the original level before the crises. In the long term, however, it is possible to expect a stabilization of the positions of sugar mills on the market.

Funding: Financing: "This research was financed by VEGA of the Ministry of Education, Science, Research and Sports of the Slovak Republic no. 1/0359/23".

References

- 1. Árendáš, P. & Kotlebová, J. (2023). Agricultural commodity markets and the Turn of the month effect. *Agricultural Economics*, 69(3), 101-108. https://doi.org/10.17221/17/2023-AGRICECON
- Brunori, G., Branca, G, Cembalo,, L. & col. (2020) Agriculture and food economics: the challenge of sustainability. *Agric Econ* 8, 12 (2020). https://doi.org/10.1186/d40100-020-00156-2SPAA.2001.969541
 Comparative Analysis of Private Labels-Private Labels from the Point of View of a Millennial Customer in Slovakia, Czech Republic and Hungary
- 3. Dvořák, M.; Smutka, L.; Pulkrábek, J.; Moravčíková, E.; Viquillón, P.M.; Gregáňová, R.H.; Kádeková,, Z. (2023), https://www.scopus.com/record/display.uri?eid=2-s2.0-85160535209&origin=in-ward&txGid=9e6462317bb25c5491595db813a102bfhttps://www.scopus.com/record/display.uri?eid=2-s2.0-85160535209&origin=inward&txGid=9e6462317bb25c5491595db813a102bf
- 4. Chowdury, EK, Branca, G., Cembulo, L. & col. (2022). The catastrophic impact of Covid-19 on global stock markets and econonomic activity. *Bus Soc Rev.* 2022. 127(2), 437-460, https://doi.org./10/1111.basr.12219
- 5. Krivko, M., Smutka, L., Pulkrábek, & Timoshenková, I. (2022). Development of the Russian sugar market in years 2010-2019 in the context of economic sanctions and import bans. *Listy cukrovarnické a řepařské*, 2022(5-6), 206-211, http://www.cukr-listy.cz/online/2022/PDF/206-211.pdf
- 6. Malorgio, G. & Marangon, F. (2021) Farm economics: the challenge of sustainbality. *Aric ECON9*, 6 (2021). https://doi.org./10.1186/s40100-021-00179-3.
- Onofri, L., Bianchin, F, & Boatto, V. Ako hodnotiť budúcu poľnohospodársku výkonnosti v rámci zmeny? Prípadová štúdia o regióne Benátsko. (2017). Agric ECON 7, 16 (2019), https://doi.org/10.1186/s401000-019-0131-y
- 8. Porvazník, J. (2014). Príležitosti a hrozby podnikania v globálnom prostrední a možnosti ich riešenia. *Aktuálne problémy podnikovej sféry 2014*, 411-416.. https://www--write/files/veda-vyskum/Zborniky-APPS/2014.pdf
- 9. Trejo-Pech, C. J. O., & col (2020). Vplyv cien cukru v USA na finančnp výkonnosť amerických firiem využívajúcich cukor. *Agric ECON8*, 16(2020), 274–295. https://doi.org/10.1187/s40100-020-000161-5
- 10. Žak,, M. & Grarncarz, J. (2020). Hospodárska politika reaguje na výzvy pandémie COVID-19 vo vybraných krajinách Európskej únie.. *International Entrepreunrship Review*, 66(4). 21-34.

Phenomenal Forms of Ethical Behaviour of Economics Entities

Gabiela Dubcová 1, Jana Kissová 2*

- ¹ FBM, University of Economics in Bratislava, Slovakia; gabriela.dubcova@euba.sk
- ² FBM, University of Economics in Bratislava, Slovakia; jana.kissova@euba.sk
- * Correspondence: Gabiela Dubcová, gabriela.dubcova@euba.sk

Abstract: This contribution is focused on the philosophy categories in the area of business ethics: content \leftrightarrow form \leftrightarrow function. Research is based on these relations and their usage in the concrete scientific disciplines, first of all business ethics. The core research - is the evaluation of specific attributes of the ethical behaviour of economics entities, with partial goals: to analyse derivative concepts of ethical business, to describe alternative theories of ethical business and to present the adapted pyramid of ethical behaviour. This article will continue in "Functioning Ethical Management Presented on the Basis of the Credible University".

Keywords: ethical behaviour, alternative theories of ethical business, derivative concepts of ethical business

Introduction

For the practical usage of ethical behaviour of economics entities in daily life, it is important to understand standard moral principles and rules and to effectively use this instrument system of ethical conduct in daily life economics entities. Although the content of the ethical behaviour is relevant, in this case we devote our attention to the research of alternative theories and derivative concepts of ethical business.

1. Theoretical Background

A transformation of moral content into practical form of organisational ethical conduct of an entity is visualisation and communication form of the acceptable ethical behaviour in accordance with common aims of all stakeholders. (Crane, 2019, Nelson & Stout, 2022, Collins & Kanashiro, 2021).

The business ethics is the one of the applying philosophy disciplines and its relation to the philosophy categories we can find in few theory schools. (Stewart, 2013, Fosl & Baggini, 2020, Flavel & Robbiano, 2023).

The relation of the content and form determined with applying function describe and analyse several authors in the theory field of applied communication. (Jensen, 2020, Ready, 2023, Neher, 2023), in the best visualisation:

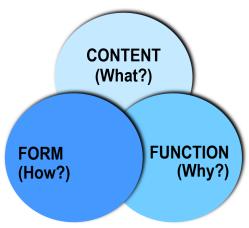


Figure 1. Relation: content \leftrightarrow form \leftrightarrow function.

Source: https://www.iktforum.at/

In the next part we will devote our attention to the forms of ethical behaviour because is missing systematics and classification related to the real practice of economics entities.

2. Methods and Methodology

All research activities during the whole period were carried out based on the application of the three-dimensional perspective logic of the research process:



Figure 2. Three-Dimensional Perspective of the Research Process.

Source: Self elaboration.

2.1 Research Aims

It is the evaluation of specific attributes of the ethical behaviour of economics entities, with partial goals:

- To define of general principles of the relation: content ↔ form ↔ function,
- To analyse derivative concepts of ethical business.
- To analyse alternative theories of ethical business
- To present the adapted pyramid of ethical behaviour.

2.2 Object of the Research

This article takes big importance in the providing of real information with a real view on the object of this research. The central part of our research is focused on specific attributes of the forms of ethical behaviour.

2.3 Methodology of the Research

Considering the complexity of the problem regarding the economical and managerial activities of the organization in the area of specific attributes of the forms of ethical behaviour, such a combination of methods was applied which was appropriate to accomplish the exacting goals (due to saving of space, only the outline is stated here in Figure 3):

APPLICATION OF METHOD COMBINATION FOR RESEARCH PURPOSES		
General methods Specific methods		
A/ Logical methods	■ questionnaire	
■ analysis – synthesis	■ benchmarking	
■ induction – deduction	structured interview	
abstraction – concretization	direct and indirect diagnosticities (via indicators)	
	■ mathematical methods	
B/ Empirical methods	statistical methods	
observation	■ graphical methods	
■ measurement	■ simulation	
■ experiment	application of information and communication technologies	
Synergy (interaction)		

Figure 3. Particular Scientific Methods in our Co-author Tandem.

Source: Self elaboration.

3. Results

Examining responsible entrepreneurship from the aspect of form is objectively necessary, because current theoretical schools, but especially real business practice, offer very diverse phenomena of ethical entrepreneurship, which often appear on the surface as an "indefinite mix" of different approaches to ethical entrepreneurship. For this reason, it is important and also interesting for one's own orientation to be able to identify in companies practicing ethical principles, whether it is directly the concept of responsible business, or derivative concepts, or alternative theories to responsible applied in practice. In the following section, I present a succinct summary proposed by me:

3.1 Derivative Concepts of Ethical Business

The intense interest of experts in scientific research activity, but also of the professional public, in the topic of what form the content of the concept of ethical business takes and what are the derivative concepts of ethical business - i.e. ethical business derived (modified) with an emphasis on a certain attribute, the reason for which is the content of the research, can be evaluated very positively of a specific derivative concept:

DERIVATIVE CONCEPTS OF RESPONSIBLE BUSINESS			
Title	Representatives	Basic Attributes	
Stakeholder Theory	Werther, Jr., W., B. Chandler, D. Ferrell, O.C. Beauchamp, T., L. Freeman, R. E. Harrison, J., S. Wicks, A., C. Parmar, B., L. de Colle, S.	 * Within the framework of the business, stakeholders (stakeholder groups): customers, investors and shareholders, employees, suppliers, government agencies, communities and many others who have a stake or claim in any aspect of the company's products, operations, markets, industry and results, and the company has a responsibility towards them. * These groups are not only influenced by entrepreneurship, but also have the ability to actively influence entrepreneurship. * The most recent trends focus on: (a) identifying, coordinating, synergizing and measuring the implementation of roles through which stakeholders influence the enterprise and its performance; (b) attributes of power, legitimacy and urgency of stakeholder groups. * Characteristic aspect of the concept: concentration on a constructive and effective dialog between the company and the stakeholders, by stakeholder group and subject of dialog (responsibility in question). 	
Corporate Citizenship	Werther, Jr., W., B. Chandler, D. Blowfield, M. Murray, A. Ulrich, P. Andriof, J. McIntosh, M.	 Extends part of the activities that fall within the sphere of interest of "Responsible Entrepreneurship" (RE) enterprises. Refers to the engaged solution of societal problems in the locality where the enterprise operates. Characteristic aspect of the concept: the enterprise acts as a "good citizen" in its place of operation, i.e. in addition to achieving its economic objectives, it also has a medium-term strategy for building good relations with the community and a strategy for the overall development of its surroundings. Includes e.g., donation, sponsorship, volunteer projects for employee volunteering and corporate foundations. 	
Corporate Philanthropy	Benioff, M. Adler, C. Godfrey, P., C. Sasse, C., M. Trahan, R. T.	 * Involves the voluntary involvement of an enterprise in public benefit projects to promote the development of a company in which it operates or over which it has influence through its business activities. * Extends beyond the scope of the enterprise's commercial activity; these activities are often carried out jointly by enterprises and non-profit organization (NPO). * Accepted in corporate practice as one of the more modern types of donation whose aim is to contribute to solving the problems of the community and society in general through various forms of support for education, innovation and the development of people's personal abilities to support and motivate their own potential to help themselves. * In comparison with sponsorship (often mentioned), it is also specific in that enterprises do not expect any consideration, advertising or any tax-deductible consideration for the results of their philanthropic activities (this does not apply in the case of sponsorship - sponsorship is a business relationship in which the 	

		supported party of the recipient undertakes to promote the name of the donor
		within its activity). * Characteristic aspect of the concept: it represents a conventional win-win relationship, mutually beneficial and although it is an integral part of responsible business, RE cannot be degraded to it.
Corporate Social Performance	Cooper, S. Agudo-Valiente, J., M. Cohen, J. Eccles, R. G. Ioannou, I. Serafeim, G.	 * Linking CSR and the financial performance of the enterprise. * In practice, a model can be a tool for managers to eliminate problems within enterprise. * Solving of the enterprise's economic problems is implemented as follows: identification of the deficit area → determination of the scope of responsibility for individual areas → determination of adequate sub-strategies. * Characteristic aspect of the concept: financial performance is not sufficient (only one of the attributes of measuring the performance of an enterprise), therefore it focuses on the total contribution of the enterprise.
Shareholder Value Theory	Crane, A. McWilliams, A. Donald, S. Siegel, D.S. Wright, P. M. Becchetti, L.	 * This scientific approach is based on critical views on CSR. * Representatives of neoclassical economic theory, with the priority objective of maximizing benefits and profit. * Characteristic aspect of the concept: shareholders are the most important foundation of an enterprise with concentrated power in their hands. * Management of an enterprise decides on the basis of a set objective to reconcile its own economic interests with maximizing value for shareholders.
Corporate Social Responsivenes	Scherer, A. G. Frederick, W. C. Iamandi, I.	 * Linking CSR and strategic corporate conduct in the context of an existing societal challenge. * It is a sensitive pragmatically responsible response of the enterprise to an external problem with adequately adapted internal tools (e.g., method of financing, adaptation of the production program, etc.). * Characteristic aspect of the concept: great emphasis is placed on the quality of management decisions – requires active and flexible management, in parallel economically and ethically competent.
Corporate Social Rectitude	Glowik, M., Smyczek, S. Frederick, W. C. Rao, T. S. Zaidi, A. M.	 * The name of the concept exists only in theory – enterprises that realistically strive for an intensive degree of honesty in the implementation of their activities prefer to use RE. * Characteristic aspect of the concept: the ethical dimension is dominant in operational and strategic decisions of the management. * In the period of economic crisis, interest in this concept has increased in theory (verbally) and in business entities (substantially in content) as a response and prospective way of dealing with negative consequences, but mainly the causes of the crisis.
Corporate Social Spirituality	Bubna-Litic, D. Frederick, W. C. Pruzan, P. Barrett, R. Miller, D. W. Ewest, T.	 * The concept was predominantly focused on nature and overall environmental orientation in the first years of the millennium (spiritual orientation towards nature and space). * Modern trends of the concept are devoted to the relationship between the personality of the manager/owner (their spiritual orientation) and the management of the company in terms of the strategic management aspect of the enterprise. * Characteristic aspect of the concept: shows from various perspectives how the spiritual values of the manager/owner's personality actively contribute to the implementation of the enterprise's activities, solving social problems and contributing to social well-being.

Figure 4. Derivative Concepts of Responsible Business

Source: Own elaboration

3.2 Alternative Theories of Ethical Business

Since in practice there are various alternatives for the application of ethical principles in the economy, it is all the more difficult to realize the content and form of the concept of ethical business. For this reason, I also present other forms, the content (essence) of which is the application of ethical principles, but it is an alternative to responsible business. This automatically raises the question, what is the difference between derivative concepts of ethical business and alternative theories of ethical business?

According to my findings, while derivative concepts of ethical business operate in conventional enterprises (business entities) and are derived (with a common basis) from the basic concept of ethical business with an emphasis on a certain attribute, alternative theories of ethical business are identified in these entities and their combinations:

- public administration organizations (state administration and local government), including universities
- organizations of the "third sector",
- members of civil society,
- businesses in non-standard situations,
- organizations in crisis situations,
- companies with a special focus on the social dimension,
- enterprises with a special focus on the environmental dimension.

ALTERNATIVE THEORIES OF RESPONSIBLE BUSINESS			
Title	Representative	Basic Attributes	
Social Economics	Becker, G. Murphy, K. Benhabib, J. Jackson, M. O. Bisin, A. Zamagni, S. Bruni, L.	* That part of the economy that cannot be classified as either private or public, but is constituted of an organization of voluntary groupings of members, a board of directors, a management committee or the management of the organization and develops the implementation of activities to provide diverse benefits to the community in which it operates, * The objectives of the entities' activities are different from those of commercial enterprises. * Existing challenges are a prerequisite for promoting social cohesion in addressing new socio-economic challenges, not met through the market or the state, in particular in generating job integration opportunities, with priority: (a) combating unemployment and social inclusion at risk; (b) sustainable local development and quality of life; (c) social inequalities between developed and lagging areas; (d) population aging and family change. * The main values of the social economy actors involved: (a) the democratic principle is promoted as an essential element of governance; (b) the principle of one person - one vote is the decision-making rule; (c) the principle of free participation of members in the organization; (d) education and information is a means of strengthening relations between members; (e) the right to the development of each entity; (f) the right to a positive surplus. It may not be used for personal gain but must serve the common purpose of capturing members or the interests of the organization. * Has three categories of sub-sectors: (a) social; (b) non-profit making; (c) social-enterprise sector. * Frequently referred to as the "third sector". * Social enterprises, NGOs, civic associations, etc., operate on its principles.	
Economics of Giving, Altruism and Reciprocity	Kolm, S. CH. Ythier, M. Fehr, E. Schmidt, K. M. Zamagni, S. Bruni, L. Abdulkadiroglu, A. Bagwell, K. Opp, K. D.	 * Within altruistic behavior, classification into two basic altruistic trends is important: (a) purity and uncalculated sacrifice; (b) accommodativeness coupled with the expectation of reciprocal value or other specified advantage. * In the category of cooperative behavior characterized by the existence of 2 types: a) "hard-core altruism" – activities where the altruistic impulse is identifiable as irrational; b) "soft core altruism" – is generated by the potential of interpersonal and economic interconnection, called reciprocity. * The essence is the understanding that pro-social behavior, altruism, giving and reciprocity are an integral part of the existence of any entity and the performance of the community and society, through diverse activities – here is also the real application of the theory: (a) members of civil society, families – broad-spectrum motivation; (b) foundations – different motives from the field of public and political life, enabling more acceptable conditions of existence, caused by market distortions and the actions of institutions. 	
New Institutional- ism	Clegg, S. Bailey, J. R. Powell, W.W. Di- maggio, P. J. Padgett, J. F. Croce, M. Salva- tore, A.	* Demonstrates that the institutions operate in an environment consisting of other institutions, called the institutional environment. * Each institution is influenced by a wider environment (institutional pressure of equals) and the main objective of the organization is to remain in this environment. * In order to promote further existence, it is necessary to do more than just succeed economically, but to confirm the legitimacy of existence, also facilitated by the application of adequate social and ethical principles and rules. * The relevant section addresses the extent to which institutions influence human behavior on the basis of rules, standards and other frameworks. * Individuals can influence the functioning of an institution in one of two ways: (a) they can operate within institutions in order to maximize benefits (e.g. regulators, etc.); (b) they can act out of duty and with knowledge of "what needs to be done" (e.g. normative institutions, etc.).	

Sustainable Development	Amini, M. Bienstock, C. C. Fredericks, S. E. Welford, R. Emders, J.C. Remig, M. Moore, S. B. Manring, S. L. Blewitt. J.	* Emphasizes the cognitive type of influence — workers not only act in accordance with regulations (fulfill obligations), but also think conceptually and creatively. * Emphasis is placed more on a competitive logic that focuses on different sources of diversity of areas and institutional anchoring of technical reasons. * The application of (competitive) logic increasingly highlights the wider potential of ethical, social and cultural principles and rules that need to be actively exploited in solving tasks and problems: in the phase of knowledge, and in particular in the decision-making process. * The latest trends combine new institutionalism with the theory of the system of social rules, which shows new facts — individual institutions and their organizational units are deeply anchored in the cultural, social and political environment and that, in particular, structures and procedures are a response to rules, laws, conventions, paradigms integrated in a wider environment. * Significant contribution is in positively influencing not only the functioning of the system of institutions and their internal organizational units and rules but also the extensive active contribution to influence changes in ethical, social and cultural principles and rules of the community and society. * In practice, the institutions (organizations) of state administration and self-government operate according to this theory. * Represents a way of developing the organization which reconciles the economic and social development of the organization with the full maintenance and development of the environment. * Organizations shall take into account the needs and expectations of different interest groups in ensuring the standard operation of the organization. * Solutions that respond to these requirements not only naturally include the economic aspect: financing, investment, ensuring the company's own production or solving market environment problems. * Interaction and deepening dialog between the organization and interest group
Economy of Communion	Gold, L. Lopez, K. J. Martínez, Z. L. Specht, L. B. Lubich, C. Bruni, L. Crivelli, L.	 * The community economy is dominated by the principles of culture with an emphasis on ethical interpersonal relations and thus becomes significantly different from the majority economic business practice. * We can specify it as a variant of the giving culture: "Give and it will be given to you". * Emphasis is placed on the ethical principle – respect for the dignity of each person, and based on a sophisticated strategy and operational tools, it has the disposition to implement the principles of this theory also into the real practice of the enterprise. * The following attributes are typical: (a) prudent entrepreneurship; (b) above-standard development of employees and workers; (c) strategic prospective development of the enterprise based on the principles of humanism and respect for the dignity of each person. * The foundations of the theory provide for the distribution of profits to third parties, in order to carry out assistance activities against those who show a certain need to: (a) enable them to work; (b) satisfy their needs; (c) reduce the number of needy to a minimum. * Management investments in various areas of the activity of the enterprise according to the degree of urgency of their needs are not only of economic, but also of synergistic and ethical importance. * The structure of the distribution and allocation of funds (investments) of the enterprise is as follows: (a) 1/3 inserted into the social program for the development of employees and workers (education, spiritual and cultural formation) – investment in persons; (b) 1/3 intended for the strategic development of the enterprise; (c) 1/3 allocated to cover the needs of the needy. * In practice, business entities (especially cooperatives and Ltd.) operate according to this theory with proportional financing of the above-mentioned 3 areas (currently mostly as anticrisis management).

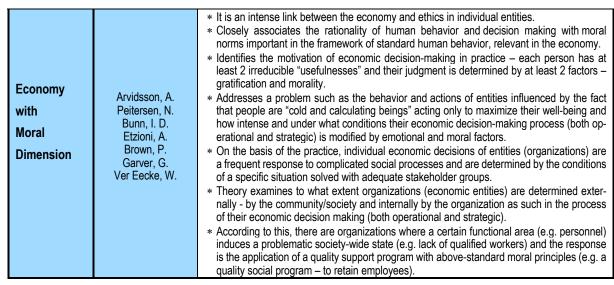


Figure 5: Alternative Theories of Responsible Business

Source: Own elaboration

4. Discussion

After our researches from the comparison of theory and practice related to the ethical content of an entity structured in the concrete functioning form of an entity in the BLF (https://www.blf.sk/en/members-and-supporters-of-business-leaders-forum/) and UN Global entities (https://unglobalcompact.org/what-is-gc/participants), we can define transformation from the conventional pyramid of ethical behaviour of an entity into the adapted pyramid of ethical behaviour:

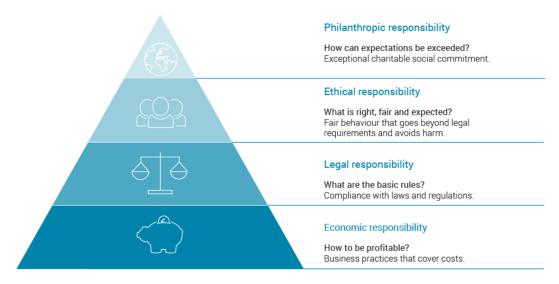


Figure 6: The Conventional Pyramid of Ethical Behaviour

Source: https://blog.item24.com/en/workbenches/corporate-social-responsibility-definition-and-example/

This transformation of the ethical content of an entity into different structure is visible as real measurable effect of existing and developing crises (Covid pandemic, energy and material crisis, war situation, immigration situation.....) with still more frequented government protection in a form of extraordinary legislation:



Figure 7: The Adapted Pyramid of Ethical Behaviour

Source: Own elaboration

5. Conclusions

It's not only responsible but crucial that businesses improve their organizational ethics and consider their impact on workers, communities, and society. Once armed with that information, they can choose to do the right thing, even if it time and cost demanding. This is the practical definition of business ethics and what we believe can and will positively change our economical entities, communities, our environment, our country, and our world. The list of benefits and advantages of managing the ethics conduct:

- A focus on business ethics has substantially improved society and working conditions: If it wasn't for ethical standards being set, children would still be working in factories; 16-hour workdays would be the norm; and discrimination, abuse, and unfair labour practices would still be part of doing business. What's important to recognize is that change is happening and new standards around business decisions, ethics and social responsibility are now being set. This is good for all of us.
- Having a code of ethics provides a moral compass during tough times: By having a code of ethics,
 it provides you a tool to make consistent decisions about what is right and wrong and promote
 ethical behavior. This is especially helpful when making decisions in times of conflict or deciding
 how to solve ethical dilemmas. For senior executives and human resources managers, creating a
 company culture of ethical behaviour simplifies their jobs and allows them to be more successful
 leaders.
- Ethics in the workplace support employee growth and provide meaning to the work they do: By running an ethical operation, employees feel like they are contributing to society in a positive way. This sense of accountability provides meaning and context to what they do on a daily basis and highlights how ethics and social responsibility contribute to employee retention.
- Ethics programs can align with personal values and improve performance: If clear ethics are consistently communicated in your organization and straight talk discussions take place on how they align with personal values, it can develop motivation and collaboration in your organization and a healthy business environment. Employees that feel strong alignment with their personal values as human beings and the ethics of an organization react with strong commitment and performance and more often choose ethical behaviour.
- Clear business ethics can promote a strong public image and goodwill: Aligning human behaviour with values is important in developing a positive image for your business. Today's new edition savvy consumer is doing more research and watching more closely how businesses conduct themselves and if they truly "walk the talk" to do it right. Consistently applying ethical values to

everyday ethical decision making is the foundation to building a truly successful and socially responsible business (Power, 2015).

Or we can describe the benefits of ethical practices in organizations, generally. Because with ethical conduct, organizations can derive huge advantages. Even though the primary constructs of ethical practices are humanity and compassion for the stakeholders, it can provide the following advantages to organizations:

1. Competitive advantage:

Customers favour those organizations, which are known for their ethical practices. Hence, ethical violation reduces the company's market share, reduces their sales and revenues and ultimately adversely affects their bottom line.

2. Better staff attraction and retention:

Ethics compliant organizations also de-velop their brand image and such employer branding help them to attract and retain the best people, which eventually contribute to their sustainable competitive advantage. On the contrary, ethical violation means a high attri-tion rate of employees, recruitment of average performers and overall cost inefficiency.

3. Investment:

Ethics compliant organizations also attract investors, as people repose their confidence only on those who show integrity, a sense of respon-sibility and who are trustworthy.

4. Morale and culture:

Ethics compliant organizations also create a workplace, where employees feel compelled to work. Ethical organizations develop high-integrity, become socially responsible, globally considerate. And all these make such organizations less prone to stress, attrition and dissatisfaction. Therefore, complying ethics, organizations develop a work culture, free from stress, which makes employees to feel happier and become more pro-ductive.

5. Reputation:

Building organizational reputation, takes years of effort, and ruining it hardly requires one violation. Ethically responsible organizations are less prone to scandals and disasters. And they become more sensitive to any such practice that may adversely affect the reputation of the organization.

6. Legal and regulatory reasons:

Even though compliance with ethics is still voluntary and organizations comply with these for their long-term business interests, globally ethical issues are likely to come under legal and regulatory norms, making it compulsory for organizations to comply with the same. Hence early preparedness of the organization will benefit them in the long run, when ethical issues become legally enforceable.

7. Legacy:

It is the human nature to be good. Ethical consideration is changing our perception of legacy, which is not the pile of money at the cost of others' sufferings, but decisions and business practices which are beneficial to man-kind. Hence organizations believe the test of real legacy is ethical decision making (Disha, 2023).



Figure 2: Importance of Ethics in Management & Accounting

Source: https://auroratrainingadvantage.com/articles/ethics-in-accounting/

Funding: This research was funded by VEGA 1/0836/21 "Creation of a Flexible ESG Controlling Model for Typologically Heterogeneous Enterprise Systems with Specific Conditions and Institutionalization Attributes for Standardized Functioning and Optimization and Creation of the Adequate Model of Ethics and Integrity Conduct of Institutions in the Area of Scientific-Research Activities on the Basis International Comparison and Setup of Related Determining Attributes for its Effective Implementation and Functioning" (50%) and KEGA 019EU-4/2022 "Strengthening the Position of Institutionalized Sustainable Development and Inclusion by Supporting Agenda 2030 Research and education and Inclusive Diversity Behaviour" (50%).

References

- Agudo-Valiente, J., M. et al. (2013). Corporate Social Performance and Stakeholder Dialogue Management. In Corporate Social Responsibility and Environmental Management. Vol. 20, no. 6 http://onlinelibrary.wiley.com/doi/10.1002/csr.1324/full.
- 2. Amini, M. Bienstock, C. C. (2014). Corporate Sustainability: an Integrative Definition and Framework to Evaluate Corporate Practice and Guide Academic Research. In Journal of Cleaner Production. Vol. 76, no. 1., p. 12-19.
- 3. Andriof, J. Mcintosh, M. (2001). Perspectives on Corporate Citizenship. Sheffield: Greenleaf Pub.
- 4. Arnold, D. G. Beauchamp, T. L. Bowie, N. L. (2013). Ethical Theory and Business. Upper Sadler River: Pearson.
- 5. Arvidsson, A. Peitersen, N. (2013). The Ethical Economy: Rebuilding Value After the Crisis. New York: Columbia University Press.
- 6. Barrett, R. (2013). Liberating the Corporate Soul. Abingdon: Routledge.
- 7. Becchetti, L. et al. (2007). Corporate Social Responsibility and Shareholder's Value: An Event Study Analysis. In Federal Reserve Bank of Atlanta. Working Paper Series. Working Papers (2007-2006), 33 p. http://www.frbatlanta.org/filelegacydocs/wp 0706.pdf.
- 8. Becker, G. Murphy, K. (2003). Social Economics. Harvard: Harvard University Press.
- 9. Benhabib, J. Jackson, M. O. Bisin, A. (2011). Handbook of Social Economics. Amsterdam: Elsevier.
- 10. Benioff, M. Adler, C. (2006). The Business of Changing the World: Twenty Great Leaders on Strategic Corporate Philanthropy. New York: McGraw Hill Professional.
- 11. Blewitt. J. (2008). Understanding Sustainable Development. New York: Routledge Publishing.
- 12. Blowfield, M. Murray, A. (2011). Corporate Responsibility. New York: Oxford University Press.
- 13. Brown, P. Garver, G. (2009). Right Relationship: Building a Whole Earth Economy. San Francisco: Berrett-Koehler Publishers.
- 14. Bruni, L. Crivelli, L. (2004). Per una economia di Comunione: un approccio multidisciplinare Roma: Città Nuova.
- 15. Bruni, L. Gold, L. (2002). The Economy of Communion: Toward a Multidimensional Economic Culture. New York: New City Press.
- 16. Bubna-Litic, D. (2009). Spirituality and Corporate Social Responsibility. Farnham: Ashgate Publishing, 244 p.
- 17. Bunn, I. D. (2012). The Right to Development and International Economic Law: Legal and Moral Dimensions. Oxford: Hart Publishing.
- 18. Business Leaders Forum (2004). Memorandum o spoločenskej zodpovednosti firiem. Bratislava: BLF, (http://www.nadaciapontis.sk/data/files/ Business%20Leaders%20Forum/Memorandum_BLF.pdf.
- 19. Clegg, S. Bailey, J. R. (2008). The New Institutionalism. In The International Encyclopedia of Organization Studies. Thousand Oaks: Sage Publishers.

- Cohen, J. et al. (2011). Retail Investors' Perceptions of the Decisionusefulness of Economic Performance, Governance and Corporate Social Responsibility Disclosures. In Behavioral Research in Accounting. Vol. 23, no. 1, p. 109-129.
- 21. Collins, D.& Kanashiro, P. (2021) Business Ethics: Best Practices for Designing and Managing Ethical Organizations. Sage Publications
- 22. Cooper, S. (2004). Corporate Social Performance: A Stakeholder Approach. Farnham: Ashgate.
- 23. Crane, A. (2019). Business Ethics. Oxford University Press.
- 24. Crane, A. et al. (2008). The Oxford Handbook of Corporate Social Responsibility. New York: Oxford University Press.
- Croce, M. Salvatore, A. (2007). Ethical Substance and the Coexistence of Normative Orders. Carl Schmitt, Santi Romano, and Critical Institutionalism. In The Journal of Legal Pluralism and Unofficial Law. Vol. 39, no. 56, p. 1-32.
- 26. DOI:10.1093/oso/9780192870971.003.0008
- 27. Eccles, R. G. Ioannou, I. Serafeim, G. (2014). Corporate Social Responsibility and Access to Finance. In Strategic Management Journal. Vol. 35, no 1, p. 1-23.
- 28. Emders, J. C. Remig, M. (2012). Perspektiven nachhaltiger Entwicklung: Theorien am Scheideweg.
- 29. Etzioni, A. (2010). Moral Dimension: Toward a New Economics. New York: Simon and Schuster.
- 30. Ferrell, O. C. Fraedrich, J. Ferrell, L. (2006). Business Ethics: Ethical Decision Making & Cases [online]. Mason South-Western College Pub.
- 31. Flavel, S.& Robbiano, Ch. (2023). Key Concepts in World Philosophies: A Toolkit for Philosophers. Bloomsbury Academic.
- 32. Fosl, P.S. & Baggini, J.(2020). Philosopher's Toolkit A Compendium of Philosophical Concepts and Methods John Wiley and Sons Ltd.
- 33. Frederick, W. C. (2006). Corporation, be Good!: The Story of Corporate Social Responsibility. Indianapolis: Dog Ear Publishing.
- 34. Fredericks, S. E. (2013). Measuring and Evaluating Sustainability. Ethics in Sustainability Indexes. New York: Routledge Publishing.
- 35. Freeman, R. E. Harrison, J.– Wicks, A.– Parmar, B. De Colle, S. (2010). Stakeholder theory: The State of the art. Cambridge: Cambridge University Press.
- 36. Glowik, M. Smyczek, S. (2011). International Marketing Management: Strategies, Concepts and Cases in Europe. München: Oldenbourg Verlag.
- 37. Godfrey, P., C. (2005). The Relationship Between Corporate Philanthropy And Shareholder Wealth: A Risk Management Perspective. In Academy of Management Review. Vol. 30, no. 2, p.777-798.
- 38. Gold, L. (2010). New Financial Horizons: The Emergence of an Economy of Communion. New York: New City Press.
 - 39. Iamandi, I. (2007). Corporate Social Responsibility and Social Responsiveness in a Global Business Environment A Comparative Theoretical Approach. In Romanian Economic Journal. Vol 10, no. 23, p. 3-18.
 - 40. Jensen, K.B.(2020). Theory of Communication and Justice. Taylor & Francis Ltd.
 - 41. Kadiroglu, A.– Bagwell, K. (2013). Trust, Reciprocity, and Favors in Cooperative Relationships. In. American Economic Journal: Microeconomics, American Economic Association. Vol. 5, no. 2, p. 213-259.

- 42. Kolm, S., Ch. Ythier, M. (2006). Handbook of the Economics of Giving, Altruism and Reciprocity. Amsterdam: North Holland Publishing.
- 43. Lopez, K. J. Martínez, Z. L. Specht, L. B. (2013). The Economy of Communion Model. A Spirituality-Based View of Global Sustainability and its Application to Management Education. In Journal of Management for Global Sustainability. Vol.1, no.1, p. 71–90.
- 44. Lubich, C. (2007) Toward an Economy of Communion. In Essential Writings. New York: New City Press, s. 269–289.
- 45. Mcwilliams, A. S. Siegel, D. S. Wright, P. M. (2006). Corporate Social Responsibility: Strategic Implications. In Journal of Management Studies. Vol. 43, no 1, p. 1-18.
- 46. Miller, D. W. Ewest, T. (2013). The Present State of Workplace Spirituality: A Literature Review Considering Context, Theory, and Measurement/Assessment. In Journal of Religious & Theological Information. Vol. 40, no. 1-2, p. 29-54.
- 47. Moore, S. B. Manring, S. L. (2009). Strategy Development in Small and Medium Sized Enterprises for Sustainability and Increased Value Creation. In Journal of Cleaner Production. Vol. 17, no. 2., p. 276-282.
- 48. Neher, W. (2023). Communicating Ethically. Character, Duties, Consequences, and Relationships. Routledge.
- 49. Opp, K. D. (2013). Norms and Rationality. Is Moral Behavior a Form of Rational Action? In Theory and Decision. Vol. 74, no. 3, p. 383-409.
- 50. Padgett, J. F. Powell, W. W. (2012). The Emergence of Organizations and Markets. Princeton: Princeton University Press.
- 51. Powell, W.W. Dimaggio, P. J. (2012). The New Institutionalism in Organizational Analysis. Chicago: University of Chicago Press.
- 52. Rao, T. S. Et Al. (2013). Corporate Social Responsibility for Sustainability and Good Governance: A Glimpse of Drb-Hicom Initiatives. In Global Engineers & Technologists Review. Vol. 3, no. 6, p. 16-22.
- 53. Ready, L, J.(2023) Content and Form. In book: Immersion, Identification, and the Iliad (pp.221-238). https://www.researchgate.net/publication/372576703_Content_and_Form
- 54. Sasse, C., M. Trahan, R. T. (2007. Rethinking the new corporate philanthropy. In Business Horizons, Vol. 50, no. 1, p. 29-38.
- 55. Scherer, A. G. Palazzo, G. (2008). Handbook of Research on Corporate Citizenship. Cheltenham: Edward Elgar Publishing, 615 p.
- 56. Stewart, J. (2013). The Unity of Content and Form in Philosophical Writing. Bloomsbury Academic.
- 57. Ulrich, P. (2008). Integrative Economic Ethics: Foundations of a Civilized Market Economy. Cambridge: Cambridge University Press.
- 58. Ver Eecke, W. (2008). Ethical Dimensions of the Economy. Making Use of Hegel and the Concepts of Public and Merit Goods. New York: Springer Publishing.
- 59. Welford, R. (2013). Hijacking Environmentalism: Corporate Responses to Sustainable Development. New York: Routledge Publishing, (2013). .
- 60. Werther, Jr. W., B. Chandler, D. (2008). Strategic Corporate Social Responsibility: Stakeholders in a Global Environment. London: SAGE Publications.
- 61. Zamagni, S. Bruni, L. (2013). Handbook on the Economics of Philanthropy, Reciprocity and Social Enterprise. Cheltenham: Edward Elgar Publishing.

Usage of Virtual Reality in Slovakia in the education and healthcare sector and potential of its impact on business reputation

Martin Novysedlák 1 and Peter Dorčák 2

- ¹ Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia; martin.novysedlak@euba.sk
- ² Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia; peter.dorcak@euba.sk

Abstract: In recent years, Virtual Reality (VR) has emerged as a transformative technology, opening doors to innovative and immersive experiences across various domains. In the healthcare and education sectors, VR has rapidly gained recognition for its potential to revolutionize the way we learn, teach, and heal. By creating digital environments that simulate the real world or transport users to entirely new realms, VR is reshaping education and healthcare, offering enhanced training opportunities for professionals, immersive learning experiences for students, and innovative therapeutic solutions for patients. This article delves into the usage of VR technologies, with focus on education and healthcare sectors, describing in what ways VR is currently in use and proposing its potential impact on the reputation of the service provider. For this desk research was conducted, analyzing users and providers of VR technology services in the mentioned fields. The results shown a rather small number of organizations propagating VR usage in the field of education and healthcare in Slovakia, which are mostly in the tertiary level of education and private area, and geographically located in the western part of the country.

Keywords: virtual reality; healthcare; education; reputation.

Introduction

In recent years, Virtual Reality (VR) has emerged as a transformative technology, opening doors to innovative and immersive experiences across various domains. In the healthcare and education sectors, VR has rapidly gained recognition for its potential to revolutionize the way we learn, teach, and heal. By creating digital environments that simulate the real world or transport users to entirely new realms, VR is reshaping education and healthcare, offering enhanced training opportunities for professionals, immersive learning experiences for students, and innovative therapeutic solutions for patients. We consider it important to research whether the usage of VR technologies in aforementioned sectors increases user satisfaction and therefore could bring not only better results in the form of quicker learning or faster healing process, but also benefit the operator/provider with a competitive advantage stemming from their better reputation.

1. Theoretical background

As it was already suggested in the introduction, we believe, that there is a clear relationship between customer satisfaction and business reputation. This was confirmed by research of Helm et al. (2010) on a sample of 1681 consumers, which concluded that reputation not only influences a consumer's own experiences with the products of the firm. It also determines consumers' loyalty. Investing in reputation should therefore have positive effects on the bonding of customers although such investments usually aim at fostering the esteem the firm is held in by the general public, not at improving individual stakeholder relationships. The results also show that more than half of the effect of reputation on loyalty is mediated by satisfaction. In the absence of satisfaction, even the best reputation lacks most of its effect on loyalty.

This is further confirmed by research of Walsh et al. (2006) who researched customer defection based on corporate reputation. The research was done in the area of energetics on the sample of 462

cases. The research concludes that there is a negative relationship between corporate reputation and switching intention, meaning that good corporate reputation has a significant negative influence on customer switching intention. Satisfied customers of reputable companies will not switch supplier.

Our primary interest and target group of this paper is the healthcare sector, however, provision of VR services in this field is in most cases connected with requirement of proper training, where the field of educations steps in. In the field of education, a student is in the position of customer or client, while the university is in the position of business entity or, better said, service provider. Similarly, in the field of healthcare, the role of client is held by the patient and the role of service provider is held by a hospital or other institution providing healthcare services. It is only natural to believe, that a student or patient will praise the provider of services he received and was satisfied with, resulting in good peer-to-peer recommendations and other ways of experience sharing, thanks to which the reputation of providers institution will be increased.

This is also suggested by Hennig-Thurau et al. (2002) who demonstrated that customers who are satisfied with the performance of a company, are more likely to engage in positive word-of-mouth, thus positively reinforcing the company's reputation. However, Harrison-Walker (2001) makes the interesting and strategically important observation that the effect of service quality on word-of-mouth communication appears to be industry-dependent.

Both the Education and Healthcare sector are specific and differ from the typical consumer market in the are of customer retention. In a typical business setting, companies try to uphold their reputation to maintain relationship with their clients, in order to secure continuous and repeated purchase. This is not the case in Education or Healthcare, as in Education it is exactly known for how long the student should attend training and what challenges he needs to pass in order to finish his or her studies. It is in the best interest of the educator that the student finishes training up to the expectations of his own and of the environment where he will be using acquired skills, but also at the fastest possible pace, so that other students can be trained (due to capacity constraints).

In the area of healthcare, the situation is even more complex, as customer retention is both morally and realistically undesirable, the highest goal being full treatment with permanent resolution of patient's problem (we of course acknowledge, that some diagnoses are chronic and require life-long treatment). In both areas it therefore could be generally said that it is desirable that the recipient of services does not return. This could give impression and falsely lead to conclusion, that if the recipient is not returning, the aspect of reputation is not important.

While this logic could possibly be applicable in a typical business setting of purchasing goods, especially ones of lower value, the fields of Education and Healthcare are working with resources other than just money. The choice of service provider is important here since future quality of life is at stake here. Bad decision can lead to reduced possibilities when entering the job market or even to worsened quality of life and state of health. Another implication is, that decision about education or health provider is usually a long-term one.

Moving forward in the topic investigation, we have investigated the usage of Virtual Reality in teaching and healthcare applications. Gabajova et al. (2019) tested a part assembly within three groups, comparing fully manual, augmented, and virtual reality setting to complete the task. Out of the three, Virtual reality shown the fastest completion times.

Dávideková et al. (2017) suggests, that surgeries in health, aerial transport, production, and machinery were identified by literature as areas suitable for application of VR and simulations in education of employees to get used to new processes. However, in the questionnaire research conducted, the results show that that there is almost no VR applied in organizational education of employees in these fields.

Traditional teaching methods are perceived as too time consuming, boring, and lacking demonstrativeness that discourages from learning instead of supporting motivation. The application of innovative technologies allows better visualization supporting demonstrativeness and fostering development of creativity. The possibility of dynamic interaction with virtual artefacts is close to empirical and experimental handling in real physical world and provides the "learning by doing" effect. These factors are significantly contributing to the comprehension of taught content and accelerate the learning process on that way.

VR technology is currently used in a broad range of applications, the best-known being flight simulators, walkthroughs, video games, and medicine (virtual surgery). Applications that allow training of medicine students in performing endosurgery, operations of the eye and of the head were proposed in recent years (Novak-Marcincin, 2014).

It has been proven, that VR can provide benefits to various groups of users and ways, such as familiarizing students with the library, which proved beneficial especially with anxious or foreign students (Sample, 2020), allowing people with disabilities to use computers (Lamár and Neszveda, 2013), improve patient satisfaction and reduce anxiety (Maurice-Szamburski, 2018), enhance engagement with health screening and awareness (Mcgrath, 2018), reduce pain and fear during specific procedures (Coulter, 2020). It can also help improve nursing education, especially in psychiatric simulation and critical care (Kokol, 2023; Bayram and Caliskan, 2020) as one of the biggest challenges in health care is the high-risk related to practicing on patients.

Taking all the mentioned areas, the relationship between reputation and satisfaction, the possibilities and unexplored areas and the already made and implemented discoveries, the results of our theoretical background suggest that Slovakia as a country should be seeking technological research, innovation and implementation of new technologies into daily practice in both the education and healthcare sectors.

2. Methods and methodology

The research undertaken in this academic article primarily relies on desk research, also known as secondary research. Systematic review and analysis of existing literature, documents, scholarly articles, reports, and other publicly available sources related to the research topic has been realized with aim of preparation both the theoretical background and the practical part that consisted of data collection and screening of viable legal subjects that are actively using and promoting usage of Virtual Reality solutions in their typical activities. Data were extracted and synthetizes into tables.

3. Results

Based on the information collected in the Theoretical background chapter of this paper, we have decided that to help with identifying potential areas of innovation in the field of healthcare and education using VR, it is firstly necessary to assess the current level of usage. For this, secondary research was conducted during June and July of 2023, with aim of identifying online presence of subject that use VR technology in their daily operations. Out of the results, subjects that use VR for purely entertainment purposes (mostly focused on B2C operations) were removed.

3.1. Combined results – Organization type

Overall, 30 separate websites were identified that promoted usage of Virtual Reality. These were divided into separate categories, the main being the "organization type" where we differentiated between private companies, universities, hospitals and other organizations. It should be noted however, that in the universities category, faculties were also differentiated, as these could be using VR technology in specific ways, based on their focus of activity, education, and research; some faculties also promoted multiple work initiatives, such as Education and Software development activities.

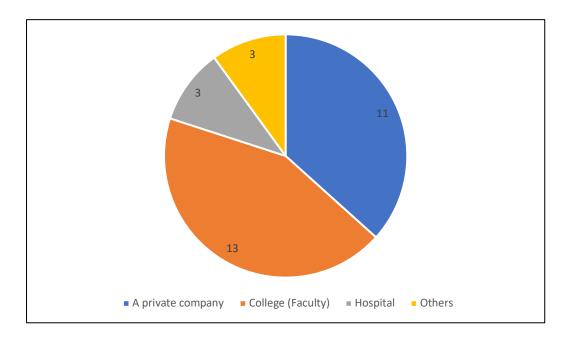


Figure 1. Combined results Source: own processing

3.1.1. Universities

When narrowing down the number of subjects by ignoring the Faculty differentiation and focusing only on the Universities as a whole, the final sample size in this field would be 7 subjects, namely Slovak University of Technology in Bratislava; Technical University of Košice; Comenius University Bratislava; Pavol Jozef Šafárik University in Košice; University of Žilina; Matej Bel University in Banská Bystrica; Pan-European University in Bratislava.

Most of the Universities/Faculties (10 cases) describe the usage of VR technologies for educational purposes of their students. Additional, in one case the information found describes usage in workers security training and operations for firefighter's emergency services. Three of the universities also offer software development services for VR hardware solutions. We would also like to note, that in case of universities it could be, that some of their activities are not fully publicly declared as they might be of research nature and only the final results are publicly promoted on the respective websites.

3.1.2. Private companies

As previously stated, there were 11 private companies identified, that promoted VR usage in various ways. Most represented (4 companies) were training activities, such as how to control specific machineries. Three companies offered software development for VR. Two companies promoted education courses, as an example here we could mention worker safety instructions. The final two companies offer services related to therapy or treatment, specifically eye treatment and cognitive behavioral therapies for phobia diagnoses.

3.1.3. Hospitals

Only three hospitals in Slovakia promote usage of VR technology in practice. Two of these are focusing on psychiatric treatment with focus on cognitive behavioral therapies. The third organization is a children hospital that uses VR for activation and mobility of patients, education but also as a prevention of psychological effects that long term exposure to hospital environment can have on child patients.

3.1.3. Others

Three subjects did not fall into any of our pre-determined categories of target groups. One is a civic association that uses VR for psychological therapy and treatment of cognitive behavioral issues. Second one is a non-profit organization that uses VR technology to promote help to disabled people by simulating their daily struggles to the user. The last organization is a private secondary school that has created a laboratory for technologies, including VR. Here we also have to express our surprise, that this was the only result found in the area of secondary education in Slovakia, despite the existence of a number of industrial secondary schools or gymnasiums that could be offering this type of education. However, we cannot surely conclude that this type of education is not offered, only that we did not find in our extensive research with various keywords related to VR technology.

3.2. Combined results – Geographical distribution

We have also decided to put the geographical distribution perception into this paper, as it is often prominent in Slovakia that the financially better performing western part of the country also attracts more investment in research and technology.

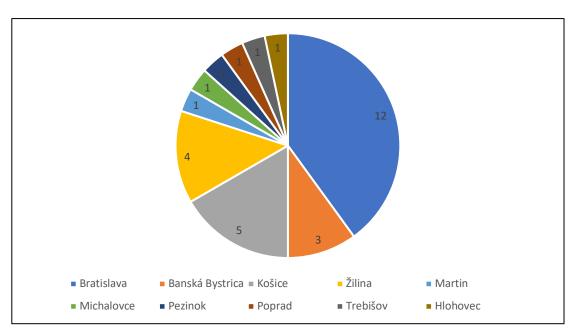


Figure 2. Geographical distribution

Source: own processing

As it can be seen in the graph above (Figure 2), geographically most of the organizations that use VR technologies are located in the capital – Bratislava, followed by Košice, the second largest city with huge presence of technological companies. Other notable cities are Žilina and Banská Bystrica as in all of the other cities there was only one organization that used VR technologies. However, as we have previously mentioned, in the case of universities, due to various faculties and/or initiatives, multiple samples could have been collected for the same organization. For this reason, we also provide the second amended version with all of these unified under their alma mater.

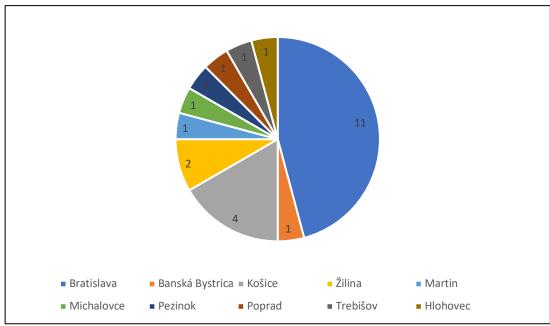


Figure 3. Geographical distribution – amended

Source: own processing

In the updated version (Figure 3) it is visible that the university in Banská Bystrica is the only organization in the city that promotes usage of VR for education nor healthcare. Some of the other cities were also amended. We will use this amended dataset also to create a simplified summary of the previously mentioned suggestion that the western part of the country might be in advantage when it comes to VR technologies in education and healthcare. Cities will be assigned into regional subcategories, Bratislava region, Western, Central and Eastern Slovakia, based on their geographical position according to NUTS 2.

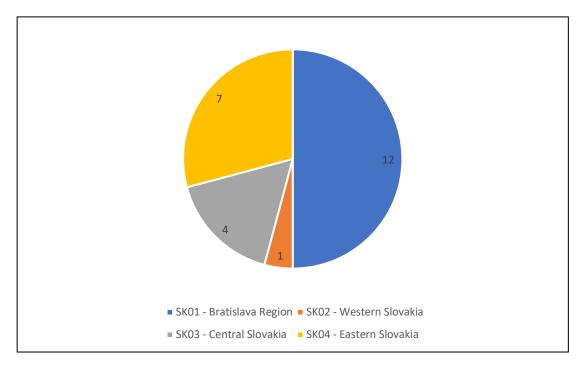


Figure 4. Regional distribution **Source:** own processing

As can be seen in the graph (Figure 4), half of the organizations are located in the Bratislava region, which is located on the westernmost side of the country, but has a specific position in the country, with Bratislava being the capital. Additionally, there is one organization in the Western Slovakia. This majority shows clear advantage of VR technology usage in the field of education and healthcare in the West of the country. In the second position is the Eastern Slovakia area, with 7 organizations – this could indeed suggest impact of the tech companies residing around Košice. Lastly, Central Slovakia shows 4 organizations, two of which are universities.

4. Discussion

Summarizing the results of the research, multiple conclusions can be drawn. Firstly, it is clear that the western parts of the country currently have advantage when it comes to Virtual Reality usage in the field of education and healthcare. The reason for this is probably both the presence of academic research but also the economic performance of the area when compared to the rest of the country – attracting more investment and business activities.

Secondly, the research shown that in the field of VR education and healthcare, universities can generally be considered the flag bearers. This is good news, that Slovakia is trying to keep up with the rest of the world when it comes to research in the field of VR, but at the same time it shows that VR has not yet found its way to typical usage in a larger number of companies, meaning there is still huge potential for improvement.

Thirdly, as we have also already mentioned, we were surprised that during research, there has been only one record of a secondary education level institution and even in that case it was a private school, not a public one. This shows clear lack of modern technology usage at this level of education in Slovakia.

Another takeaway could be a bit speculative conclusion, that subjects who use VR are either supported by research grants (universities), located in more rich parts of the country (Bratislava region, West) or are privately funded (lack of VR in public secondary or primary education).

At this point it is hard to conclude what is the impact of VR usage on organizational reputation in Slovakia, as VR usage is not prominent enough. However, the fact that it appears mostly in areas where there is a higher economic performance or activity suggests that VR could be seen as expensive or less available or not as beneficial for the organization to implement into typical operations, assuming the organization is well informed about the possibilities of VR. We also work with suggestion, that if an organization uses VR technology, it will actively promote it on its communication channels.

New attractive solutions for training and education of healthcare staff are also being researched and developed within the Interreg CENTRAL EUROPE project "VReduMED" in which University of Economics in Bratislava, Faculty of Business Management is one of two partners representing Slovakia. The project aims to develop a roadmap for virtual reality training products and services and will publish a handbook on the integration of virtual reality into health care education together with creation of three regional virtual reality labs to test different virtual reality use cases.



Figure 5. VReduMED

Source: Interreg CENTRAL EUROPE

Funding: This paper was supported by the scientific grant agency of Ministry of Education of Slovak Republic and Slovak Academy of Sciences (VEGA), grant number 1/0140/21.

References

- 1. Bayram, S. B., Caliskan, N., Bayram, S. B., & Caliskan, N. (2020). The Use of Virtual Reality Simulations in Nursing Education, and Patient Safety. V Contemporary Topics in Patient Safety—Volume 1. IntechOpen. https://doi.org/10.5772/intechopen.94108
- 2. Coulter, P. (2021). Virtual reality reduces pain and fear during intravenous cannulation in the emergency department. *Evidence Based Nursing*, 24(3), 107–107. https://doi.org/10.1136/ebnurs-2020-103253
- 3. Dahane, A., Bourhim, E. M., Benrahal, M., Labti, O., & Akhiate, A. (2022). How Can the Marketing Sector Benefit from Virtual Reality? A SWOT Analysis. 2022 13th International Conference on Computing Communication and Networking Technologies (ICCCNT), 1–6. https://doi.org/10.1109/ICCCNT54827.2022.9984532
- 4. Dávideková, M., Mjartan, M., & Greguš, M. (2017). Utilization of Virtual Reality in Education of Employees in Slovakia. *Procedia Computer Science*, 113, 253–260. https://doi.org/10.1016/j.procs.2017.08.365
- 5. Gabajová, G., Furmannová, B., Medvecká, I., Grznár, P., Krajčovič, M., & Furmann, R. (2019). Virtual Training Application by Use of Augmented and Virtual Reality under University Technology Enhanced Learning in Slovakia. Sustainability, 11(23), 6677. https://doi.org/10.3390/su11236677
- 6. Harrison-Walker, L. J. (2001). The Measurement of Word-of-Mouth Communication and an Investigation of Service Quality and Customer Commitment As Potential Antecedents. *Journal of Service Research*, 4(1), 60–75. https://doi.org/10.1177/109467050141006
- 7. Helm, S., Eggert, A., & Garnefeld, I. (2010). Modeling the Impact of Corporate Reputation on Customer Satisfaction and Loyalty Using Partial Least Squares. V V. Esposito Vinzi, W. W. Chin, J. Henseler, & H. Wang (Ed.), *Handbook of Partial Least Squares* (s. 515–534). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-540-32827-8 23
- 8. Hennig-Thurau, T., Gwinner, K., & Gremler, D. (2002). Understanding Relationship Marketing Outcomes: An Integration of Relational Benefits and Relationship Quality. *Journal of Service Research J SERV RES*, 4, 230–247. https://doi.org/10.1177/1094670502004003006
- 9. Chuang, L.-W., Chiu, S.-P., Tian, H.-W., & Wang, L.-S. (2020). INVESTIGATING CONSUMER BEHAVIORAL INTENTION IN SMART TECHNOLOGY CONTEXT. 2020 IEEE International Conference on Consumer Electronics Taiwan (ICCE-Taiwan), 1–2. https://doi.org/10.1109/ICCE-Taiwan49838.2020.9258165
- 10. Kokol, P. (2023). Simulations can improve nursing education in general, especially in psychiatric simulation and critical care. *Evidence-Based Nursing*, 26(1), 32–32. https://doi.org/10.1136/ebnurs-2022-103604
- 11. Lamar, K., & Neszveda, J. (2013). Average Probability of Failure of Aperiodically Operated Devices. *Acta Polytechnica Hungarica*, 10, 153–167.
- 12. Mariani, E., Kooijman, F. S. C., Shah, P., & Stoimenova, N. (2021). PROTOTYPING IN SOCIAL VR: ANTICI-PATE THE UNANTICIPATED OUTCOMES OF INTERACTIONS BETWEEN AI-POWERED SOLUTIONS AND USERS. *Proceedings of the Design Society*, *1*, 2491–2500. https://doi.org/10.1017/pds.2021.510
- 13. Maurice-Szamburski, A. (2018). Preoperative virtual reality experience may improve patient satisfaction and reduce anxiety. *Evidence Based Nursing*, 21(1), 14–14. https://doi.org/10.1136/eb-2017-102780
- 14. McGrath, L. (2019). Virtual reality can enhance men's engagement with health screening and awareness. *Evidence Based Nursing*, 22(3), 87–87. https://doi.org/10.1136/ebnurs-2018-103008
- 15. Novak-Marcincin, J., Janak, M., Barna, J., & Novakova-Marcincinova, L. (2014). Application of Virtual and Augmented Reality Technology in Education of Manufacturing Engineers. V Á. Rocha, A. M. Correia, F. . B. Tan, & K. . A. Stroetmann (Ed.), *New Perspectives in Information Systems and Technologies, Volume* 2 (Roč. 276, s. 439–446). Springer International Publishing. https://doi.org/10.1007/978-3-319-05948-8 42
- 16. Sample, A. (2020). Using Augmented and Virtual Reality in Information Literacy Instruction to Reduce Library Anxiety in Nontraditional and International Students. *Information Technology and Libraries*, 39(1). https://doi.org/10.6017/ital.v39i1.11723
- 17. Walsh, G., Dinnie, K., & Wiedmann, K. (2006). How do corporate reputation and customer satisfaction impact customer defection? A study of private energy customers in Germany. *Journal of Services Marketing*, 20(6), 412–420. https://doi.org/10.1108/08876040610691301

The development and current situation of mergers and acquisitions and their synergies

Anna Harumová *

Faculty of business management, University of Economics in Bratislava, Bratislava, Slovakia; anna.harumová@euba.sk *Correspondence: anna.harumová@euba.sk

Abstract: From an economic point of view, the merger represents a tool for the concentration of assets and liabilities of hitherto separate business companies or cooperatives. It can take place in two forms: merger or fusion. Acquisition is a process in which a smaller or economically weaker company is absorbed by a larger or stronger company. Business combinations mean an effective change in the economic and legal form of an existing entity, the purpose of which is to gain control over the net assets of another unit or effectively transfer or acquire assets with the aim of achieving a synergistic effect in their use, including tax optimization. Mergers and acquisitions (M&A) represent the transfer or combination of ownership of a company. Their development is significantly influenced by the phenomenon of globalization. Mergers and acquisitions have become an important part of corporate strategic management and strategies aimed at external growth. Moreover, cross-border mergers and acquisitions play an important role as one of the components of foreign direct investment. The aim of this paper is to provide an overview of the theoretical framework in the field of mergers and acquisitions, and to examine recent developments and the current situation of mergers and acquisitions and to analyze the emergence of synergistic effects.

Keywords: mergers, acquisitions, synergy, synergistic effects, international, development

Introduction

From an economic point of view, a merger represents a tool for the concentration of assets and liabilities of hitherto separate business companies or cooperatives. It can take place in two forms: merger or fusion. Acquisition is a process in which a smaller or economically weaker company is absorbed by a larger or stronger company. Business combinations mean an effective change in the economic and legal form of an existing entity, the purpose of which is to gain control over the net assets of another unit or effectively transfer or acquire assets with the aim of achieving a synergistic effect in their use, including tax optimization. Mergers and acquisitions (M&A) represent the transfer or combination of ownership of a company. Their development is significantly influenced by the phenomenon of globalization. Mergers and acquisitions have become an important part of corporate strategic management and strategies aimed at external growth (Beňo et al., 2014; Cartwright et al., 2006; Tampakoudis et al., 2021; Sha et al., 2020). Moreover, cross-border mergers and acquisitions play an important role as one of the components of foreign direct investment.

Globalization, growing competition, liberalization, and technological changes significantly supported corporate strategies aimed at external growth, strengthening competitiveness and the companies' own key positions on the market. Capital allocation within and between countries is becoming more and more complex. The desire of companies to increase competitiveness takes place in an environment of growing simultaneous fragmentation and globalization of markets, rapid pace of change and removal of customs barriers on a global scale - in an environment that is a natural driving force for the growth of large companies in various areas of business activities (Renneboog, et al., 2019; Borodin et al., 2020; Morellec et al., 2005; Kiessling et al., 2021). The concentration of business activities and production factors into increasingly large business units is a typical feature of globalization. This so-called phenomenon concentration is motivated by the growth of the value of the established entity, but understandably it cannot be the creation of an entity with a dominant market position. Mergers and acquisitions are forms of organizational concentration that are currently a common part of the growth strategies of companies all over the world.

From the point of view of history, it can be stated that the mutual takeover, absorption, purchase, and merger of companies has probably occurred continuously since the period of structured economic

relations and the existence of legally defined entities distinct from individuals. However, mergers and acquisitions are perceived in a modern sense only from the end of the 19th century. From a theoretical point of view, the goal of mergers and acquisitions is to increase the value of the company initiating the transaction or increasing value for its shareholders (Christofi et al., 2019; Chung et al., 2020; González et al., 2020; Feldman et al., 2022). Increasing the value of the company or an increase in the market value of its shares presupposes a perfectly functioning capital market, on which all positive synergistic effects are reflected in the share price. However, in practice this may not be the case, as empirical research shows that a large part of them did not achieve this goal. Assuming that the transaction is carried out based on an agreement between the seller and the buyer, the seller should receive a reasonable value, which should be higher than in the case of the unchanged functioning of the business as an independent entity. Since mostly businesses that have already encountered certain barriers and would not be able to survive in the competitive struggle on their own are sold, the value obtained is usually not high. However, its objective boundaries are difficult to determine. The aim of the contribution is to provide an upto-date overview of the development of mergers and acquisitions, and the importance of emerging synergistic effects.

1. Theoretical background

Merger of businesses, regardless of the form and tightness of the connection of two or of several entities, is gaining more and more importance in the world economy. The basic expectation associated with mergers and acquisitions is the achievement of a synergistic effect of a financial or operational nature. Many authors (Cartwright et al., 1990; Welch et al., 2020; Cumming et al., 2023; Cooper et al., 2023) mention several merger motives, which they divide into reasonable and doubtful. Among the dubious reasons for mergers from the point of view of economic sense or achieving synergy, the authors include diversification, increasing profit per share, or reducing financial costs. The form of mergers and acquisitions can be horizontal, vertical, and conglomerate. In the case of horizontal connection or takeover companies provide either the same products or services, or products and services that compete (e.g., in the case of a merger of car manufacturers). A vertical merger/acquisition occurs when a business acts as a potential or actual supplier of products or services to another business. In this case, the enterprise expands either towards the sources of raw materials (backward integration) or towards the final consumer (forward integration). In the case of a conglomerate, companies are not connected either horizontally or vertically - companies with an unrelated business object are connected. The analysis and valuation of the target company is based on the logical sorting and arrangement of the obtained information in the form of a list, which usually contains tax, legal, accounting, and financial issues, and is subject to constant updating.

The resulting report should evaluate the inside (historical background, products, markets, distribution, technology, organization, financial issues) and surroundings (competition analysis) of the target entity. Based on the outputs from other parts of the financial analysis, the analyst creates a financial model – a projection that is credible at a certain level of statistical reliability (Liu et al., 2023; Kiosses et al., 2023; Blann et al., 2023). Cross-border mergers and acquisitions are also important in relation to foreign direct investments. Foreign direct investments consist of investing more than 10% in the basic capital of the entity in the host country. Mergers and acquisitions belong to foreign direct investments from the point of view of the method of entry of the investor. From this point of view, foreign direct investments include not only mergers and acquisitions, but also joint ventures, greenfield investments, brownfield investments and privatization.

A model for evaluating the economic effects resulting from M&A can be built based on certain assumptions about the emergence of synergistic effects. First, it is necessary to create an evaluation model for the overall M&A effect, and then to identify and evaluate the individual synergistic effects from the resulting effect. The easiest method of evaluation can be tracking the price of the shares owned by the shareholders and the fact whether the value of the shares owned by the shareholders has increased or decreased. This method consists in comparing the price of the shares before the merger or acquisition and the price after the merger or acquisition. This comparison is often used by the public and especially by the mass media. However, this is an unreliable method, because the share price does not depend only on the success of the company change, but also on other factors common to the financial

market, such as the overall performance of the economy, alarming news, and general investor sentiment. A positive M&A effect would mean that:

Share price after M&A> Share price before M&A

A better method than a simple test is the comparison of the company with the chosen measure indicator (benchmark). A suitable measure can be a stock market index or an index of the given industry. Alternatively, a sample of companies of the same focus or size or one identical company or competitor, if available, can be chosen. The success of this method lies in the appropriate selection of the measure and the sample. Compared to the previous method, it is better primarily in that it eliminates other financial market factors that affect the price regardless of the success of the merger or acquisition. Again, we would find the positive effect using:

Profitability of the company after M&A> Profitability of scale

If we wanted to improve the method even further, we should also consider the costs of sacrificed opportunities. Their essence is to assess whether the shareholders are better off after the M&A than if the merger or acquisition had not taken place at all. Connecting with an important strategic partner, for example, can help a company with significant technological changes in the industry. Even if the company would not make a profit, it is better off after the M&A than if the merger had not happened at all. Like the previous case, we would detect the positive effect of M&A using:

Profitability of the company after M&A> profitability of the company without M&A

Since we need to evaluate the effects of M&A even before the actual M&A takes place, we must start from expected values. As a rule, companies estimate in advance the future amounts of sales or cash flow, which for them has the greatest informative value. To obtain the present value of the future M&A effects, we need to discount these values using investors' required return. This profitability is also often defined as the return that the investor could achieve on another opportunity with similar risk.

In general, we can say that an investment is successful if its value does not decrease. Therefore, in this chapter we will also focus on determining the value of companies before and after the merger. For these purposes, the most appropriate method is discounting the expected cash flows of the company, with the help of which we obtain the current value of the company. The essence of business combinations is the joining of two or more companies or joint ventures into one whole, based on which one company usually gains control over another or more companies. The largest mergers and acquisitions took place in the insurance and banking sectors. They concerned the public sector, such as health care, as well as the mass media - print, television, and radio, and to a large extent also film production. The main goal of this wave was the creation of strong multinational companies that would have at least a continental scope.

2. Methods and methodology

The development of the current situation will be processed based on UNCTAD data into tables, including graphic representation, with a selection of V4 countries, Europe, and the whole world. When analyzing the effects that affect the value of companies before and after a merger or acquisition, the individual economic indicators will be used to calculate the value of the company. From the balance sheet, these are mainly investments, current assets, liabilities, and debts. From the profit and loss statement, we obtain, above all, profit, sales, interest expense, depreciation, taxes, and other items. Based on these items, EBIT and EBIT after tax are calculated, which is adjusted by items such as depreciation, investments and working capital for the so-called Cash flow, which represents the drawable resources of the evaluated company. The depreciable resources are then discounted using a capitalization rate that we calculate based on weighted cost of capital (WACC) models. Using the business method, the value of the business is then determined by the capitalization of exhaustible resources for the evaluated time of the business, which is 5 to 7 years.

The general value of the enterprise determined by the business method is calculated as the sum of the value of depreciable resources and the continuing value. The sustainable growth rate of exhaustible resources is also used in the calculation, which expresses the percentage year-on-year change in the company's ability to create exhaustible resources, which depends on the state of the company as of the valuation date and on its development during the monitored period within its industry in the context of its history. The sustainable rate of growth is determined in accordance with the customary procedures of professional practice (geometric advice, arithmetic advice, etc.). When merging companies, we will follow Damodaran's model. Before determining the individual synergistic effects, we will estimate the value of the overall economic effect resulting from the M&A. To obtain its value, a model consisting of the following three steps can be used (Damodaran, 2023):

- 1. Both companies involved in the M & A process are evaluated separately using the method discounting of expected cash flows
- 2. The joint value of both companies is calculated, without any secondary effects from M & A through the combination of values obtained in the first step,
- 3. The joint value of both companies is calculated with the inclusion of the resulting synergies.

When evaluating the synergistic effect in functional companies, the method of expert estimation, which is based on an express analysis of the activity, has proven itself well. Several methods are used in theory and practice to calculate synergistic effects from mergers and acquisitions. In the article, we will use empirical and theoretical methods to process the given issue. We will use an analysis that would divide the issue into several parts. In singling out the essentials, we would use abstraction, with the help of which we disregarded the unimportant features. By comparison, we compared the results of the evaluation of the company by individual methods. Through synthesis, we combined the individual parts and the relationships between them into a whole to summarize the knowledge and results of the individual methods.

3. Results

According to the latest annual study on mergers and acquisitions in Europe by global law firm CMS, transaction activity in Europe has maintained a steady pace in 2023 despite a growing number of economic obstacles. In Slovakia, the total number of mergers and acquisitions (M&A) transactions fluctuated between 2013 and 2022. Graph 1 shows the development of the number of mergers in Slovakia for the period 2013 to 2022.



Figure 1 Number of M&A deals in Slovakia from 2013 to 2022

Source: own processing according to CMS data

Figure 1 shows the number of completed M&A deals. It is interesting that the most deals took place in 2019, 59, while the value of these deals was only 1.02 billion. EUR. The fewest trades took place in 2020, when 30 trades took place. In 2020, 1,705 deals were carried out in Europe through mergers and acquisitions with a total value of 60.80 billion. EUR, which is a year-on-year decrease of 12.9% and 16%. This is the lowest number of stores for this region. After a year characterized by the COVID-19 pandemic, in which deals were delayed, delayed, or simply abandoned, it is not as bad as many may have imagined. While Q4 deal numbers remained muted, the final quarter of the year saw the highest deal value since 2016.

After many years of decline, the annual flow of deals in Europe began to hover around the 2,000 USD in recent years. The region was expected to maintain its attractiveness for investors. Uncertainty over China-US trade relations, Brexit and the US presidential election may have had little impact on deal flow in the region. As 2020 has shown, global political uncertainty is no match for a pandemic when it comes to slowing M&A. However, business continued and compared to other global emerging markets such as developing Asia and Latin America, the region did quite well. A total of 41 M&A transactions were completed in 2022, a significant increase from the previous year when the total number of transactions reached 28. This trend reflects a situation where investors have retreated from acquisitions seeking post-pandemic consolidation of revenues and costs.

The year 2022 began with various challenges, including rising inflation and energy prices. Then the Russian invasion of Ukraine added another. Nevertheless, the M&A market in emerging European countries has proven extremely resilient. In the region, M&A activity maintained a steady pace, although transaction values were significantly lower. Differences can also be observed between territories and sectors. While 2022 brought a unique set of challenges, deal closings were largely favorable compared to pre-pandemic levels. (Renneboog, et al., 2019; Borodin et al., 2020; Morellec et al., 2005; Kiessling et al., 2021) as the average government bond yield, the sectoral beta coefficient, which represents the average figure for the industry in which the company operates and the risk premium, which is allocated to the Slovak Republic. The mentioned data can be found in the financial statements of the companies and on the Internet, on the website Damodaran online (Damodaran, 2023). Each of these components has an impact on the final value of the company. To determine the cost of equity capital, we will use the capital asset pricing model (CAPM - Capital Asset Pricing Model). The cost of borrowed capital is determined as the ratio of interest or other costs paid to the creditor to the principal of the loan or the form of the loan. Finally, we calculate the capitalization rate, which represents the tool by which the net income obtained in the future will be converted to the present value, expressed as a percentage and the growth rate after the merger.

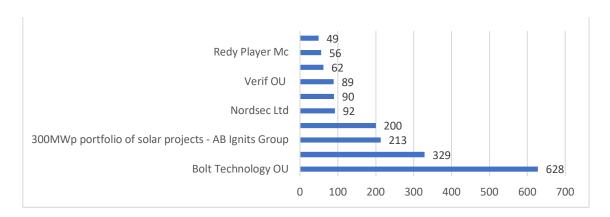


Figure 2 The largest mergers and acquisitions (M&A) in the Baltic States in 2022 by trade value (in millions of EUR)

Source: own processing according to statistical data

The largest merger and acquisition (M&A) in the Baltic States (Latvia, Lithuania, Estonia) in 2022 was the acquisition of Bolt Technology OU. Offers where the target company is a company based in the Baltic States are included. The highest value deal that took place was the acquisition of Bolt Technology OU by several different technologies, media, and telecommunications (TMT) companies for approximately 628 million of EUR.

Determining the value of the company is an important part of this process for evaluating M&A effects. Above all, it is important in the analysis to start from the target company, estimate its market value and determine the change in cash flows that this M&A will bring. Cash flows have a better reporting value than accounting profit. Economic theory states that even though profit is a very valuable indicator, it also contains certain risks of distortion.

Discounted Cash Flow in 5 years A+B without synergies A+B including synergies. 2023 1,807 2,957 4,764 5,479 4,570 2024 1,733 2,837 5,256 5,043 2025 2,722 4,385 1,663 2026 1,596 2,612 4,208 4,629 2027 1,612 2,638 4,250 4,888 17,927 25,293 Drawable resources in 5 years 8,411 13,766 Continuing value 32,535 53,252 85,787 98,655 Enterprise value 40,946 67,018 103,714 123,948 The value of the synergistic effect (123,948 - 103,714) 20,234

Table 1 Calculation of the value of the merger and the synergistic effect of the merged companies (in millions of EUR)

Source: own processing

The company's indicators are used for the calculation, such as the company's own capital and foreign capital, cost interest, the volume of borrowed capital and total capital, which is the sum of own and borrowed capital, and the tax rate. Furthermore, publicly available data such as the risk-free interest rate, which we can use, are used for the calculation.

4. Discussion

Transaction activity across Europe is captured by the European M&A Study (CMS). Transactions maintained a steady pace in 2022 despite increasing economic headwinds, according to this latest annual European M&A study. The study reveals that the main driver of transactions in 2022 was entering new markets (39%), down slightly from 43% in 2021. There was also a decline in deals involving the acquisition of a competitor from 32% in 2021 to 28% in in 2022. While there was a lot of M&A turbulence last year, there was still a strong desire to win deals across the board in all key economic sectors. So, it is reassuring that 2022 has turned out to be a good year for the industry. However, the upheavals of last year will continue until 2023. Investor confidence has started off weak this year, although it is expected to pick up in the second half of the year.

Nevertheless, there remains plenty of M&A opportunity in the CEE region and we hope that the appetite for dealmaking that we saw last year will continue in 2023. 2022 has started with a variety of challenges, including rising inflation and energy prices. Then the Russian invasion of Ukraine added another. Nevertheless, the M&A market in emerging European countries has proven extremely resilient. In the region, M&A activity maintained a steady pace, although transaction values were significantly lower. Differences can also be observed between territories and sectors. While 2022 brought a unique set of challenges, deal closings were largely favorable compared to pre-pandemic levels. Based on data from the World Investment Report for 2023 (UNCTAD), we reviewed the number and value of net cross-border M&A from both buyer and seller perspectives for the V4 countries, Europe, and the world in 2015-2022.

Table 2 shows the number of net cross-border M&As by buyer for V4 countries, Europe, and the world in the years 2015-2022. The highest number of net cross-border M&As from the point of view of buyers from V4 countries was recorded by the Czech Republic with 28 in 2021 and up to 30 in 2022. The second highest number of net cross-border M&A from the point of view of a buyer from V4 countries was recorded by the Republic of Poland with 28 for 2021, with the fact that only in 2022 there was a decrease compared to the previous period to 12. The third place was taken by the Republic of Hungary with 13 for the year 2021 with the fact that only in 2022 there was a decrease compared to the previous period to the 11th and last place among the V4 countries is Slovakia, where we do not see a downward trend, but in 2021 there were only 6 net cross-border M&A by buyer and in 2022 only 2.

The share of Slovakia in the number of European and global net cross-border M&A according to the buyer is insignificant. Development of the value of net cross-border M&A in millions USD, according to the buyer for Europe in 2022 it fell to 3,527 million. USD and for the world there was also a decrease in 2022 to 7,763 million. USD.

Country	2015	2016	2017	2018	2019	2020	2021	2022	
Czechia	18	18	14	17	32	17	28	30	
Hungary	2	1	7	2	17	- 1	13	11	
Poland	22	26	16	23	17	7	28	12	
Slovakia	5	10	3	4	3	7	6	2	
Total V4	47	55	40	46	69	30	75	55	
Euro 2	,353	2,495	2,553	2,672	2,889	2,364	3,847	3,527	
World 6	.364	6,607	6,967	6,821	7,118	6,201	8,846	7,763	

Table 2 Number of net cross-border M&As by region/economy of purchaser, 2015–2022

Source: own processing

Table 3 shows the number of net cross-border M&As by seller for the V4 countries, Europe, and the world in the years 2015-2022. The highest number of net cross-border M&As by seller from the V4 countries was recorded by the Czech Republic with 49 in 2021, and in 2022 there was an increase compared to the previous period to 50. The second highest number of net cross-border M&As from the point of view of the seller from the V4 countries was recorded by the Republic of Poland with 93 for 2021, with the fact that only in 2022 there was an increase compared to the previous period to 112. The third place was taken by the Republic of Hungary with the number of 20 for 2021 And only 12 for 2022. In the last place among the V4 countries is Slovakia, where we see an upward trend to 15 in 2021 and to 19 in 2022. net cross-border M&A by buyer.

Slovakia's share in the number of European and global net cross-border M&As according to the seller is also small. Development of the value of net cross-border M&A in millions USD, according to the buyer for Europe in 2022 fell to 4,336 million. USD and for the world there was also a decrease in 2022 to 7,763 million. USD.

Table 3 Value of net cross-border M&As by region/economy of seller, 1990–2022

Country	2015	2016	2017	2018	2019	2020	2021	2022	
Czechia	27	34	23	21	28	21	49	50	
Hungary	6	8	16	4	10	10	20	12	
Poland	105	101	63	69	106	42	93	112	
Slovakia	8	3	3	10	25	3	15	19	
Total V4	146	146	105	104	169	76	177	2 215	
Europe	3,079	3,384	3,133	3,362	3,587	2,971	4,574	4,336	
World	6,364	6,607	6,967	6,821	7,118	6,201	8,571	7,763	

Table 4 shows the value of net cross-border M&A in millions. USD, according to the buyer for the V4 countries, Europe, and the world in the years 2015-2022. The highest value of net cross-border M&A from the point of view of the buyer from the V4 countries was recorded by the Czech Republic with a value of 514.7 million. USD, for the year 2021, with the fact that for the year 2022 there was an increase compared to the previous period to 1,456.9 million. USD. The second highest number of net cross-border M&A from the point of view of a buyer from the V4 countries was recorded by the Republic of Poland with a value of 1017.7 million. USD, for the year 2021, with the fact that for the year 2022 there was an increase compared to the previous period to 1,249.3 million. USD. The third place was taken by the Republic of Hungary with a value of 406.8 million. USD for 2022 and in last place among the V4 countries is Slovakia, there were no net cross-border M&As according to the buyer between 2019 and 2022.

The share of Slovakia in the number of European and global net cross-border M&As according to the buyer is very small. Development of the value of net cross-border M&A in millions USD, according to the buyer for Europe in 2022 fell to 155,850 mil. USD and for the world the same decrease was recorded in 2022 to 706,527 million. USD.

Table 4 Value of net cross-border M&As by region/economy of purchaser, 1990–2022

Country	2015	2016	2017	2018	2019	2020	2021	2022
Czechia	- 6.9	26.1	43.8	153.8	245.6	301.8	514.7	1 456.9
Hungary	38.0	- 94.1	103.0	-	-	5.6	20.6	- 406.8
Poland	519.6	315.7	130.8	1,829.1	462.5	- 91.1	1,017.7	1,249.3
Slovakia	- 995.5	21.9	7.4	551.0	=	=	-	-
Total V4	- 445	270	285	2 534	708	216	1 553	2 299.4
Europe	316,944.0	435,150.4	210,783.6	342,728.0	181,627.6	208,747.8	284,586.7	155,850.0
World	735 125.7	886 901.4	693 962.0	815 725.7	507 396.1	474 864.0	727 880.0	706 572.0

Source: own processing

Table 5 shows the value of net cross-border M&A in millions. USD, by seller for V4 countries, Europe, and the world in 2015-2022.

Table 5 Value of net cross-border M&As by region/economy of seller, 1990–2022

Country 2015	2016	2017	2018	2019	2020	2021	2022
Czechia 2,252.6	1,362.2	- 10.1	1,750.7	- 652.6	- 443.4	136.3	1,097
Hungary 35.8	- 9.5	13.3	- 186.1	- 0.2	10.9	- 36.6	- 367
Poland 1,191.1	- 832.5	- 798.0	2,244.6	1,082.2	556.7	2,411.8	183
Slovakia 0.0	19.0	- 2.4	15.2	7.4	-	70.6	61
Total V4 3,480	539	- 797	3,824	437	124	2,582	974
Europe 308 372.5	389 824.7	236 040.2	381 101.6	200 233.5	259 595.9	257 586.1	706572,
World 735 125.7	886 901.4	693 962.0	815 725.7	507 396.1	474 864.0	727 880.0	356242.7

Source: own processing

The highest value of net cross-border M&A from the point of view of the seller from the V4 countries was recorded by the Czech Republic with a value of 136.3 million. USD, for the year 2021, with the fact that for the year 2022 there was a significant increase compared to the previous period to 1,097 million. USD. The second highest number of net cross-border M&A from the point of view of the seller from the V4 countries was recorded by the Republic of Poland with a value of 2,411.8 million. USD, for the year 2021, with the fact that in 2022 there was a high decrease compared to the previous period to 183 million. USD. The Slovak Republic took third place with a value of 61 million. USD and in last place among the V4 countries is Hungary, which in 2022 carried out net cross-border M&A according to the seller for - 367 mil. USD.

Slovakia's share in the number of European and global net cross-border M&A by buyer is also small. Development of the value of net cross-border M&A in millions USD, according to the buyer for Europe in 2022 fell to 155,850 mil. USD and for the world the same decrease was recorded in 2022 to 706,527 million. USD.

5. Conclusion

Business integration can take different forms. Businesses can be combined into one unit in terms of economics or law. In the first case, it loses its economic independence, or part of it, while in the second case it loses its legal personality. Mergers represent a connection not only from an economic point of view, but also from a legal point of view. It can take the form of a merger or connection. An acquisition represents the acquisition of ownership and management value of one company over another. In this case, the theory distinguishes between property acquisitions, which involve the acquisition of company assets, and capital acquisitions, which involve the acquisition of a decisive share of the company's voting rights. The reasons for mergers and acquisitions are gaining a larger market share, restructuring entities, improving the balance of payments, and the like. The success of the merger and acquisition confirms the emergence of a synergistic effect. The year 2022 began with various challenges, including rising inflation and energy prices. Then the Russian invasion of Ukraine added another. Nevertheless, the M&A market in emerging European countries has proven extremely resilient. In the region, M&A activity maintained a steady pace, although transaction values were significantly lower. Differences can

also be observed between territories and sectors. While 2022 brought a unique set of challenges, deal closings were largely favorable compared to pre-pandemic levels.

Funding: This paper is a partial output of research grant VEGA 1/0359/23.

References

1. Beňa, J., & Li, K. (2014). Corporate innovation and mergers and acquisitions. The Journal of Finance, 69 (5), 1923-1960.

https://doi.org/10.1111/jofi.12059.

- 2. Blann, JJ and Lamoreaux, PT (2023). The Economic Consequences of SEC Investigations: Evidence from M&A Transactions. Available at SSRN 4465319. http://dx.doi.org/10.2139/ssrn.4465319
- 3. Borodin, A., Sayabek, ZS, Islyam, G., & Panaedova, G. (2020). The impact of mergers and acquisitions on the financial performance of companies. Journal of International Studies, 13 (2). https://www.ceeol.com/search/article-detail?id=979600
- 4. Cartwright, S., & Schoenberg, R. (2006). Thirty years of mergers and acquisitions research: Recent advances and future opportunities. British Journal of Management, 17 (S1), S1-S5. https://doi.org/10.1111/j.1467-8551.2006.00475.x
- 5. Cartwright, S., & Cooper, CL (1990). The impact of mergers and acquisitions on people at work: Existing research and issues. British Journal of Management, 1 (2), 65-76. https://doi.org/10.1111/j.1467-8551.2006.00475.x
- 6. Cumming, D., Jindal, V., Kumar, S., & Pandey, N. (2023). Mergers and acquisitions research in finance and accounting: past, present, and future. European financial management. https://doi.org/10.1111/eufm.12417
- 7. Cooper, CL, & Finkelstein, S. (eds.). (2023). Advances in mergers and acquisitions. Emerald Publishing Limited. https://doi.org/10.1108/S1479-361X20230000022011
- 8. Damodaran Online Data (2023). https://pages.stern.nyu.edu/~adamodar/ (Accessed: September 18, 2023).
- 9. Feldman, ER and Hernandez, E. (2022). Synergy in mergers and acquisitions: Typology, life cycles and value. Academy of Management Review, 47 (4), 549-578. DOI: 10.5465/amr.2018.0345
- 10. González-Torres, T., Rodríguez-Sánchez, JL, Pelechano-Barahona, E., & García-Muiña, FE (2020). A systematic review of sustainability research in mergers and acquisitions. Sustainability, 12 (2), 513. https://doi.org/10.3390/su12020513
- 11. Christofi, M., Vrontis, D., Thrassou, A., & Shams, SR (2019). Triggering technological innovation through cross-border mergers and acquisitions: a microfoundations perspective. Technological forecasting and social change, 146, 148-166. https://doi.org/10.1016/j.techfore.2019.05.026
- 12. Chung, Y. and Kim, AJ (2020). Effects of mergers and acquisitions on brand loyalty in luxury brands: The moderating role of luxury class differences and social media. Journal of Business Research, 120, 434-442. https://doi.org/10.1016/j.jbusres.2019.11.030
- 13. Kiessling, T., Vlačić, B. and Dabić, M. (2021) Mapping the Future of Cross-Border Mergers and Acquisitions: A Review and Research Agenda, in IEEE Transactions on Engineering Management, vol. 68, no. 1, p. 212-222, February 2021, doi: 10.1109/TEM.2019.2954799.
- 14. Kiosses, N. (2023). US bank mergers and acquisitions (M&As): performance evaluation, shareholder value, and the impact of economic policy uncertainty on M&A outcomes. http://dspace.lib.uom.gr/handle/2159/28963 (Accessed: September 21, 2023).
- 15. Liu, K. (2023). Measuring corporate performance in mergers and acquisitions from a two-dimensional perspective of economic and social benefits. Amazonia Investiga, 12 (62), 124-131. https://doi.org/10.34069/AI/2023.62.02.10
- 16. Morellec, E., & Zhdanov, A. (2005). Dynamics of mergers and acquisitions. Journal of Financial Economics, 77 (3), 649-672. https://doi.org/10.1016/j.jfineco.2004.10.009.
- 17. Renneboog, L. and Vansteenkiste, C. (2019). Failure and success in mergers and acquisitions. Journal of Corporate Finance, 58, 650-699. https://doi.org/10.1016/j.jcorpfin.2019.07.010
- 18. Sha, Y., Kang, C., & Wang, Z. (2020). Economic Policy Uncertainty and M&A: Evidence from China. Economic Modelling, 89, 590-600. https://doi.org/10.1016/j.econmod.2020.03.029

- 19. Tampakoudis, I., Noulas, A., Kiosses, N., & Drogalas, G. (2021). The impact of ESG on value creation from mergers and acquisitions. What has changed during the COVID-19 pandemic? Corporate Governance: The International Journal of Business in Society, 21 (6), 1117-1141. https://doi.org/10.1108/CG-10-2020-0448
- 20. Welch, X., Pavićević, S., Keil, T., & Laamanen, T. (2020). M&A Pre-Deal Phase: Review and Research Program. Journal of Management, 46 (6), 843-878. https://doi.org/10.1177/0149206319886908

Business conditions in contemporary geopolitics

Alena Tóthová 1

¹ Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovak Republic; alena.tothova@euba.sk

Abstract: Today we live in a very dynamic world focused on growing consumption, which has its unpleasant consequences. The paper presents the basic characteristics of global movements and their resulting impacts. It mostly focuses on the economic situation of a selected sample of EU countries, which documents the business conditions in these countries. The economic situation is evaluated on the basis of several indicators. The choice and chosen order of indicators have the task of pointing out mutual tendencies. The main research methods for obtaining results are analysis, synthesis, comparison and induction. The center of attention is Slovakia and the conditions for doing business there. All analyzes and comparisons clearly demonstrate Slovakia's ability to cope with the demands and expected trends in world development compared to the other 12 EU countries.

Keywords: geopolitics; civilizations; macroeconomic statistics; summary indicators.

Introduction

Economic processes are the most important tool of geopolitics, therefore it is necessary to pay sufficient attention to the current development trends in this area. In the clash of civilizational models (cultures), the tensions between the economic interests of developed countries are beginning to deepen in parallel with the growing self-awareness of countries belonging to less developed regions of the world. One of the effects of globalization is the increase in the level of education, which was automatically reflected in the growing awareness of countries about their culture and the value of their civilizational model. In particular, Taiwan, Indonesia, China, India, and South Korea were able to use their historical roots very successfully in shaping their economies. In these changes, the governments of the named countries played an irreplaceable role in the way of administration and targeted support of business.

1. Theoretical background

We need to supplement the initial thoughts about the connection between economics and geopolitics with a brief description of the direction of the world over the last decades, in order to better understand the efforts presented in the paper to summarize the tendencies between business conditions and the financial situation of companies.

The ambition to create a perfectly free movement of goods, services, capital and labor has reached the stage of building a world without any regulation. Although the wealth of the countries and the income of the population have increased, at the same time the gap between high-income and low-income groups of the population has widened considerably. The polarization of society in the income area as well as in wealth leads to its radicalization. These tendencies became the underbelly of unleashing military conflicts that were not thought of at all. The current Western model of culture emphasizes the individual's full responsibility for himself. There was an enormous pressure on the individual to perform and excel. The basic value is everything that is done in the interest of human society, ie democracy, liberalism and pragmatism. The result is the reluctance of adults to start a family, which results in an aging population and a decline in population. The high proportion of the population in the older age category and the effort to at least maintain the social status of the population disproportionately increase state expenditures. The disposable incomes of the older population, due to the inflationary trend, do not allow to increase their consumption as originally calculated (Pauhofová, Páleník, 2013). The need to increase the financial support of the elderly threatens the model of solidarity that has been working so far. Eastern culture, in contrast to Western civilization, rather takes care of group interests, family members are used to supporting each other financially. The concern of the company and the state for its

citizens is adapted to this custom. Arab culture is defined by religion and the interests associated with it, i.e., first of all, a high birth rate. A rapidly growing population inevitably needs sufficient job opportunities corresponding to today's level of education of young people. Moreover, the current negative consequences of the changed climate have caused that the performance of the economy of some Islamic states is now far from sufficient to cover the needs of its population. We are witnessing a mass migration of the population to Europe for better living conditions. Europe has to face this and that onslaught and above all it has to look for means to preserve social harmony. Global crises and the war in Ukraine significantly complicate the situation in Europe from an economic point of view. The political leaders of the EU and the US are forced to reassess their geopolitical interests in order to manage the consequences of current movements in the world. The author Pecníková (2020) provides a comprehensive view of the issue of cultures.

Based on the given facts, questions such as: How can the civilizations named in the post react to current trends in society and the economy? What are the conditions for doing business today in individual regions of the world? How can the conditions for doing business be defined? What can we consider as the determinants of the development of the economy and society? The aim of this post is to provide brief answers to the questions asked.

Business conditions are determined to a significant extent by the institutional and legislative framework. The institutional and legislative framework affects entrepreneurs in the entire spectrum of phases of the business life cycle. We can state that the conditions of business define the possibilities and barriers of business. In general, we can understand business conditions as economic, legal, political, institutional, technological, ethical and cultural. The named conditions create rules for the establishment and development of businesses and their business activities (Friedmanová, 2020; Masovic, 2018; Toader, 2022; Cepel, 2019; Mendéz-Picazo, 2021).

The level of business conditions is represented by various indicators. Economic conditions are independently assessed by macroeconomic statistics. Economic, legal, political, institutional, technological, ethical and cultural conditions are jointly mapped by multi-criteria evaluations in the form of summary indexes. For all of them we can name the country competitiveness index (GCI and DBI), the business environment index (IPP), the corruption perception index (CPI - Corruption Perception Index), the tax burden index, the tax reliability index, the international tax competitiveness index, and the legal certainty index.

The Global Country Competitiveness Index (GCI) is published by the World Economic Forum (WEF). It identifies and evaluates the factors underlying the process of economic growth and human development. It is an assessment of the quality of public institutions, infrastructure, macroeconomics, health and basic education, higher education and practice, the efficiency of the goods market and the labor market, the development of the financial market, technological readiness, market size, maturity of business processes and innovation.

The International Institute for Management Development (IMD), based in Switzerland, improves knowledge about the competitiveness of countries in cooperation with 57 partner organizations from around the world. The global competitiveness ranking (IMD World Competitiveness Ranking) jointly evaluates four factors and each of them is divided into five sub-factors. The main factors are the performance of the economy, the efficiency of the government, the performance of the corporate sector and the infrastructure. The criteria are regularly revised based on the latest economic knowledge, the views of the academic community, international, national and regional sources and feedback from the business community and government agencies.

The World Bank index known as the Doing Business index (DBI) is the result of an assessment of the rules affecting business, from the very establishment of a business, through entrepreneurship, to the termination of business activity. In the phase of establishing a business, indicators such as the number of actions required to establish a business, the time required to perform the actions in question, the costs of these actions (% of income per capita), and the amount of the minimum capital contribution (% of income per capita) are evaluated. In the business phase, obtaining a building permit, obtaining electricity, property registration, access to credit sources, protection of minority investors, payment of taxes and levies, cross-border trading, law enforcement are monitored. At the end of the business, the insolvency solution is analyzed and evaluated (the time needed to solve the insolvency, the costs of debt

repayment, the rate of compensation of creditors, the result of the process and the index of the strength of the legal framework of the insolvency solution process).

The Corruption Perceptions Index (CPI) is prepared by Transparency International. It is calculated on the basis of several data sources and surveys among domestic and foreign analysts and managers.

The tax reliability index is the result of the fulfillment of the tax subject's obligations towards the financial administration. A tax entity can be assigned one of the following tax reliability indices: highly reliable, reliable and unreliable. The recalculation of the tax reliability index is defined by fifteen criteria. Specifically, arrears for the tax part and the customs part, arrears transferred to Slovenská konsolidáčná, a.s. for the tax and customs part, written off arrears due to unenforceability, failure to submit tax returns and audit reports within the statutory deadline, evaluation of the imposition of a fine in the administration of excise taxes, findings from tax office inspections, violation of selected provisions of laws related to the taxpayer's obligations. The index is intended to serve as a motivational tool. However, there are reservations about the legislation from practice. For example, to the evaluation period, to the publication of indexes, the retrospective effect of the criteria, or to the justification of the awarded index.

The International Tax Competitiveness Index (ITCI) is compiled by the Tax Foundation, an independent non-profit organization based in the US. The 2022 International Tax Competitiveness Index consists of an assessment of the tax burden of legal entities and individuals, an assessment of the burden of excise taxes, an assessment of the burden of property tax and an assessment of cross-border tax rules. The maximum total country score is set at 100.

The legal certainty index is compiled by the Slovak Bar Association with the aim of monitoring and evaluating the level of protection of legal certainty in the practice of law-making bodies and law enforcement bodies. Members of the Bar Association participate in the evaluation of a set of selected legal acts through an anonymous survey.

Based on the presented set of indices, we can confirm that the evaluation of countries using them is very diverse. However, we have to ask ourselves: How reliable are these indexes in their evaluations? The problem arises already when defining competitiveness. Competitiveness at the corporate level is understood as the ability to provide goods and services more efficiently than the competition in the market. Globalization processes brought about the involvement of national economies in "international competition" - which led to the formulation of many approaches and theories of competitiveness at the national level. The OECD definition reads: "national competitiveness is the degree to which a country can - under the conditions of a fair and free market - produce goods and services that stand the test of international markets, while simultaneously maintaining and increasing the income of its inhabitants in the long term" (Wolff et al., 2007). Ainginger argues that it is the ability of a country or locality to create well-being (Aiginger, 2006). The competitiveness of the country often appears in the vocabulary of politicians and journalists, because it emphasizes the competitive aspect of international business more than the possible mutually beneficial effect of international activities. Such an approach looks for winners and losers (Snowdon, 2007). However, there is still no generally accepted definition of national competitiveness. The second set of certain objections to the evaluation of the competitiveness of countries using indices is their concept and methodology. In the evaluations, indicators of different nature are mixed, which are usually supplemented with weights. In the evaluations, relatively great emphasis is placed on subjective evaluations, i.e. the statements of experts and representatives of practice. The most criticized is that they rather reflect the interests of global business circles (Šikula, 2007). Rather, it seems to be a tool for promoting the interests of multinational corporations. States are getting into the position of competing for the favor of foreign investors and at the same time being maximally accommodating to domestic entrepreneurs. Despite logical objections to country competitiveness rankings, it can be stated that, in principle, it is a rich source of information about countries. This reduces the rate of error in the assessment of states. However, governments must be careful not to focus too much on the results of the country's competitiveness assessment. Rather, they must seek competitive advantage by focusing on certain industries rather than the economy as a whole.

2. Methods and methodology

When writing this article, knowledge from scientific research by several authors and information from the websites of international institutions were used. The result of the selection of knowledge is a

processed basic characteristic of civilizations and their related movements in the world, as well as an overview of efforts to incorporate international and national characteristics into measurement and evaluation systems. The topic of the post, i.e. business conditions are given attention in connection with the processed categorization of basic conditions and the possibilities of their evaluation. The paper contains samples of the comparison of business conditions in individual countries through selected indicators. By examining the time series of such indicators, an assessment of business conditions in Slovakia in comparison with selected countries is developed. Time series of indicators are also used to identify trends in business and to draw conclusions from them. The basic research methods of this paper are analysis, synthesis, comparison and induction.

3. Results

Macroeconomic statistics are an important part of the index evaluation of countries. This is hard data that is harmonized across countries. Macro indicators provide variable statements about the economic conditions of business in the country. The economic sentiment indicator shows how important participants in national economies assess the conditions for doing business. The indicator is a composite indicator that shows the current state of expectations of all participants in the economic environment (see tables 1 and 2). It is the result of surveys in industry, services, construction, trade and consumer opinions on the current economic situation. The value of average moods in the economy is 100.

Table 1. The resulting ranking of the comparison of confidence in the economies of individual EU countries in September 2023.

Countries/ period	2023-09	2022-12	Countries	2023-09	2022-12
Malta	120,0	96,9	Slovakia	95,0	85,2
Greece	108,0	103,9	Hungary	93,6	90,3
Bulgaria	105,7	103,6	Netherlands	93,3	94,0
Croatia	105,0	107,9	Slovenia	93,2	97,4
Cyprus	104,9	102,7	Luxembourg	93,0	92,8
Romania	100,2	102,0	Germany	89,0	95,3
Spain	99,0	99,0	Denmark	89,0	78,3
Italy	97,9	100,9	Belgium	88,9	88,1
Latvia	96,2	92,6	Czechia	86,6	83,4
France	95,9	94,2	Sweden	82,9	83,9
Portugal	95,8	97,1	Estonia	79,5	81,3
Lithuania	95,8	92,2	Austria	78,9	86,6
Poland	95,5	90,2	Finland	78,8	82,7

¹ Own processing from DATAcube database.

Tables 1 and 2 do not contain data for Ireland as they are not published in the statistical database. The latest published data show that respondents have the most confidence in Malta's economic development, and the weakest expectations are in Finland. Slovakia is located in the middle of EU countries. Among the V4 countries, Slovakia is followed by Hungary and the Czech Republic. In 15 countries, compared to December 2022, the outlook for the future has improved, and in the case of the other 11 countries, it has worsened. Malta is an example of the most optimistic expectations. Malta is followed by Denmark and Slovakia. Austria, Germany and the already mentioned Finland were on the opposite side. The worst expectations are probably related to the movements in the world and the current geopolitics, which were briefly described in the opening part of this post.

Table 2 completes the picture of Slovakia, where the development of the opinions of the main groups of respondents on the future direction of the Slovak economy is presented.

Table 2. Development of expectations of economic subjects in Slovakia.

Period/confi- dence indicator	Industry	Construction	Retail	Services	Consumers
2023-09	-9,3	-10,0	-1,0	3,0	-19,7
2022-12	-15,7	-4,0	27,0	5,0	-34,1
2021-12	-3,3	-14,5	15,3	7,0	-25,9
2020-12	-0,3	-47,5	3,3	-16,7	-32,6
2019-12	-6,0	-9,0	27,0	7,0	-10,4
2018-12	1,3	-7,0	22,3	-7,0	-3,7
2017-12	5,3	-1,0	21,3	-0,7	-5,4
2016-12	5,0	-2,0	14,3	10,0	-5,0
2015-12	-5,3	-5,5	10,7	1,7	-9,9
2014-12	1,3	-16,5	14,7	13,0	-5,3
2013-12	-1,0	-43,5	4,3	7,7	-14,9
2012-12	-10,3	-57,0	5,7	11,3	-34,9
2011-12	0,0	-40,0	8,7	24,7	-39,6
2010-12	13,3	-36,5	18,0	27,0	-21,6
2009-12	-1,0	-42,5	-10,0	10,0	-28,4
2008-12	-21,3	-10,5	3,3	0,0	-29,2

¹ Own processing from DATAcube database.

Currently, consumers have the worst view of Slovakia's economic future, negative expectations are also seen in construction and industry. However, the industry has softened its pessimistic view, but the mood in the construction industry is only getting worse. Confidence in retail changed from positive to not slightly negative, and only services maintained their optimistic attitude. Interesting information is provided by the analysis of the entire monitored period. Consumers and respondents in the construction industry do not trust the development of the Slovak economy very much, they still have a negative attitude towards it. In the data, one can even see quite a lot of similarity between them, that is, in the worst periods for the construction industry, consumers also have low confidence in the Slovak economy, and vice versa. The attitudes of consumers in the distant past were somewhat milder, but today the situation is turning around. Conversely, retail and services largely trust the development in Slovakia. In all analyzed periods, there was mostly positive sentiment in these sectors. Retail looked unfavorably at its future only at the end of 2009, when the global crisis was going on, and it still perceives it with small questions today. In services, we can see more dissatisfaction in December 2018, and there was literally a very bad mood here exclusively during the covid period. The industry's comments on the economic situation are variable, good periods alternate with worse, although we can rather talk about the predominance of the worse ones. The clear winner of the confidence surveys is retail, as it is dominated by high expectations. The indicator of economic sentiment is a reflection of the condition of the external and internal environment of economies. The opinions of the survey respondents are a certain mirror of the perception of global events, applied geopolitics, especially of the USA and the EU, and the consequences arising from it.

Other macroeconomic indicators complete the mosaic of information on business conditions. First of all, we have to talk about the performance of economies, because only adequate performances make it possible to improve the conditions for entrepreneurs and vice versa. Gross domestic product (GDP) is a globally recognized and statistically reported indicator of the performance of countries, although its statement is also not completely accurate. It does not include the quality parameters of the life of society and individuals, the performance of the shadow economy, impacts on the environment and natural resources, etc. Nevertheless, we can list many reasons in favor of analyzing and monitoring this quantity of the economy (Baránik, 2003). A comparison of the performance of the Slovak economy with selected countries is shown in Table 3. The average performance of the EU for the year 2020 is equal to the index value of 100. The performances of the displayed countries are recalculated with respect to this average performance of the EU 27.

Table 3. GDP per capita in purchasing power parity (PPP).

Countries/ period	2008	2020	2021	2022	Performance change (2022/2008)
Czechia	85,0	93,0	92,0	91,0	1,07
Estonia	70,0	86,0	89,0	87,0	1,24
Finland	123,0	114,0	112,0	109,0	0,89
France	108,0	105,0	104,0	102,0	0,94
Luxembourg	266,0	261,0	268,0	261,0	0,98
Hungary	64,0	74,0	75,0	77,0	1,20
Germany	118,0	123,0	120,0	117,0	0,99
Norway	190,0	142,0	167,0	212,0	1,12
Poland	56,0	76,0	77,0	80,0	1,43
Austria	127,0	125,0	123,0	125,0	0,98
Romania	52,0	73,0	74,0	77,0	1,48
Slovakia	73,0	72,0	71,0	68,0	0,93
Switzerland	161,0	154,0	155,0	154,0	0,96

¹ Own processing from DATAcube database.

If we were to compile a success ranking for 2008 and 2022 from the selected 13 EU countries, we would find the following information. The performance of the national economy in 2008 places Slovakia in the 9th position, when the value of goods and services produced here represents 73% of the average performance of the EU 27. Luxembourg, Norway and Switzerland would appear on the first three rungs. The HDP of the first Luxembourg was approximately 3.6 times higher than the HDP of Slovakia. The order of the first three countries in the success ranking for 2022 has not changed, but Slovakia finds itself in the last 13th place with a performance at the level of 68% of the average performance of the EU 27. Table 3 does document a decline in the performance of 7 countries, which is more than half of the created group, but Slovakia fell to the bottom of the table due to the weakest starting position. The most dynamic performance growth among all was recorded by Romania (48% growth), Poland (43% growth) and Estonia (24% growth). What is the position of Slovakia among the V4 countries? Definitely the worst. Of the V4 countries, only Slovakia's performance decreased. Despite a weaker starting point compared to Slovakia, Poland has a higher GDP by approximately 17.6%, Hungary by 13.2%. The Czech Republic is an exception, because they already showed a higher performance at the beginning and are currently better than us by 33.8%. It is interesting that, based on economic sentiment, Slovakia came out somewhat more favorably in the evaluations. The presented data are clear evidence that Slovakia will face global events and impacts the most weakened and with the weakest condition from the selected sample of countries. The seriousness of Slovakia's current position is evidenced by the following tables 4, 5 and 6, where a comparison of household expenditures, public administration and investments in long-term assets is shown.

Table 4. Expenditures on household consumption (in % of GDP).

Countries/ period	2008	2020	2021	2022	Performance change (2022/2008)
Czechia	47,4	45,3	45,4	46,6	0,98
Estonia	53,3	49,8	49,8	51,4	0,96
Finland	49,3	51,1	51,1	51,5	1,05
France	54,5	53,1	52,6	53,9	0,99
Luxembourg	34,2	30,2	30,4	30,6	0,90
Hungary	53,5	49,5	48,2	49,9	0,94
Germany	54,2	50,2	49,4	51,1	0,94
Norway	38,4	43,4	38,4	32,4	0,84

Poland	62,0	56,5	56,2	56,8	0,92
Austria	51,8	50,2	49,9	51,4	0,99
Romania	63,9	61,1	62,4	63,4	0,99
Slovakia	55,8	57,5	56,8	61,5	1,10
Switzerland	53,1	51,9	49,6	50,4	0,95

¹ Own processing from DATAcube database.

In 2008, Luxembourg, Norway and the Czech Republic had the lowest household consumption expenditures relative to GDP. Slovakia, on the other hand, was among the first three countries with the highest share of these expenses. It was characteristic of the V4 countries that their consumption in households, unlike Slovakia, represented a significantly lower percentage of GDP (with the exception of Poland). Over time, this difference with Slovakia is increasing even more, although Poland is the least distant from us. In the next step, we should analyze the reasons for higher household consumption in relation to the performance of Slovakia's economy, but the scope of the contribution does not allow such an analysis. Over the past 15 years, the share of household consumption in GDP has decreased in almost all countries. Only Finland and Slovakia recorded the opposite development. It was even confirmed that household consumption had the most dynamic development in Slovakia. The data from 2022 did not change the ranking of the countries in the first and last positions. On the one hand, high household consumption drives the performance of the economy, but on the other hand, it can ultimately result in huge differences in the living standards of the population. Very wide gaps between population groups can cause frustration and disruption of social harmony. If we add to this the problem of escalating immigration, a literally explosive situation arises in society. Under the given conditions, the state and its political leadership play an important role.

In addition to household consumption, it makes sense to reevaluate public administration spending. State spending is another impetus for GDP growth, but it must be appropriately addressed. The data from Table 5 show how successful Slovakia is in this regard.

Table 5. Public administration expenditures (in % of GDP).

Countries/ period	2008	2020	2021	2022	Performance change (2022/2008)
Czechia	19,1	21,8	21,4	20,2	1,06
Estonia	18,7	20,8	20,0	19,5	1,04
Finland	21,6	24,3	24,6	24,1	1,12
France	22,6	24,9	24,2	23,7	1,05
Luxembourg	15,7	18,5	17,5	17,6	1,12
Hungary	21,4	21,3	20,8	20,2	0,94
Germany	18,3	22,0	22,0	21,9	1,20
Norway	18,5	26,1	23,1	18,6	1,01
Poland	18,7	19,1	18,7	17,9	0,96
Austria	19,3	21,1	21,7	20,7	1,07
Romania	15,9	18,7	17,7	16,8	1,06
Slovakia	17,5	20,9	21,1	20,6	1,18
Switzerland	11,0	12,1	11,9	11,4	1,04

¹ Own processing from DATAcube database.

In 2008, France, Finland and Hungary were at the top of the countries evaluated according to the share of public administration expenditures in GDP. These countries had more than 20% share of public administration expenditure. Slovakia was in 10th place during this period. Similar to household expenses, in this case too it is necessary to analyze where these expenses went. Over the past 15 years, all countries have increased the share of public administration expenditures in GDP, except for Hungary and Poland. Slovakia even almost increased the share of these expenses the most (their development index is 1.18). Only Germany has increased public administration expenditures more intensively,

immediately behind Slovakia are Luxembourg and Finland. With its approach in this direction, Slovakia has overtaken the other V4 countries. Our declining economic performance, combined with government spending, has easily manifested itself as an increasing share of GDP. All the facts clearly point to the need to reevaluate the justification and structure of public expenditures. Disproportionate and wrongly targeted growth of public expenditures with insufficient revenues to the state budget leads to growing state indebtedness. As a side effect, public debt becomes more expensive and unnecessary draining of other state resources for various purposes, but not for the much-needed development. The most significant expenses from the point of view of the development of the country's economy are indicated by the data shown in Table 6.

Table 6. Investments in fixed assets (% of GDP).

Countries/ period	2008	2020	2021	2022	Performance change (2022/2008)
Czechia	29,2	26,5	26,0	26,8	1,11
Estonia	31,1	29,8	29,2	27,5	0,88
Finland	24,5	24,0	23,6	24,2	0,99
France	23,6	22,9	24,2	24,8	1,05
Luxembourg	20,3	16,7	18,2	17,5	0,86
Hungary	23,4	26,5	27,4	28,4	1,21
Germany	20,3	21,5	21,3	22,1	1,09
Norway	22,6	27,4	23,2	19,7	0,87
Poland	23,1	18,3	16,8	16,7	0,72
Austria	23,3	25,0	26,5	25,9	1,11
Romania	37,3	23,5	23,7	24,9	0,67
Slovakia	24,8	19,5	19,2	20,4	0,82
Switzerland	24,1	27,0	26,3	26,3	1,09

¹ Own processing from DATAcube database.

In 2008, we were among the 4 countries with the highest share of investments in long-term assets to GDP. At the top of the ranking was Romania, followed by Estonia, the Czech Republic and the aforementioned 4th place. The remaining V4 countries, Poland and Hungary invested less (Poland by 1.7 p.p. and Hungary by 1.4 p.p.). Over time, only 6 countries, out of a total of 13 monitored, increased the share of expenditure on investments in long-term assets. Hungary literally became a prizewinner, because it rose from the initial 8th position to the top of the presented ranking. Long-term investments have become the main impetus for the growth of the Hungarian economy. Among the V4 countries, the Czech Republic is also a successful country in this regard, because it retained the 3rd place in the ranking and also increased the share of long-term investments in GDP. We can evaluate Poland more critically. Its overall performance is mostly supported by domestic consumption. His spending tendencies are not exactly ideal, especially in relation to investments in long-term assets. The performance of the Slovak economy is mostly driven by public administration expenditures, then household expenditures. However, investments in long-term assets recede into the background over time (their development index is 0.82, i.e. they decreased by 4.4 p.p.). The decreasing share of long-term investments in parallel with the decreasing GDP of the country is a very bad trend. We can state that this trend does not correspond to rational efforts to grow the economy. Of all the V4 countries, we probably have the weakest potential to handle world events and their changing consequences.

In the last part of the contribution, we reflect on the projection of the outlined facts and contexts in the world rankings, which evaluate countries from the point of view of competitiveness, corruption and tax issues. From all the multi-criteria indicators cited in the post, we will look at the IMD World Competitiveness Ranking. Tables 7 and 8 present the results of the evaluation of the countries analyzed in the paper.

Countries/ period	2020	2021	2022	2023
Czechia	33	34	26	18
Estonia	28	26	22	26
Finland	13	11	8	11
France	17	15	15	22
Luxembourg	15	12	13	20
Hungary	47	42	39	46
Germany	17	15	15	22
Norway	7	6	9	14
Poland	39	47	50	43
Austria	16	19	20	24
Romania	51	48	51	48
Slovakia	57	50	49	53
Switzerland	3	1	2	3

Table 7. The overall position of countries in the IMD global competitiveness ranking.

The countries in Table 7 are a sample selected by us from the overall assessed set of 64 countries for the year 2023, which is regularly published by the IMD World Competitiveness Center. The IMD world ranking of competitiveness emphasizes the long-term trend in building the competitiveness of countries. In 2020, the best positions in this ranking were achieved by Switzerland, Norway and Finland. Switzerland recently competed for the championship with Denmark and Ireland. In the end, Denmark repeatedly became the overall winner. The least successful countries from our selection are Hungary, Romania and Slovakia, which reached 57th position. The differences in the position of the V4 countries change over the years shown. Slovakia is the closest to the positions of Poland, it is a bit further away from Hungary and the farthest from the Czech Republic. Between the Czech Republic and Slovakia, there are up to 35 cities in 2023. The Czech Republic even moved to 18th place overall in the ranking of 64 countries. Among the first three countries remained the same states as in 2020. Slovakia did not manage to move up, it still remains in 53rd place at the bottom of our table. Table 8 indicates why this is so.

Criteria/period	2020	2021	2022	2023
The performance of the economy	49	47	52	56
Government efficiency The performance of the	60	51	51	48
corporate sphere	61	55	54	52
Infrastructure	46	44	42	44

¹ Own processing from data provided at https://www.imd.org/centers/wcc/world-competitiveness-center/rankings/world-competitiveness-ranking/2023/

In 2020, our biggest weaknesses were the performance of the corporate economy and the efficiency of government. In 2023, the situation is fundamentally different in some respects. The brake for Slovakia is the performance of the economy and the performance of the business sphere. In conclusion, we can state that Slovakia's weakest condition among the 13 monitored countries was also confirmed by the last presented result of the evaluation of 336 competitiveness criteria (both hard and soft). Slovak

¹ Own processing from data provided at https://www.imd.org/centers/wcc/world-competitiveness-center/rankings/world-competitiveness-ranking/2023/

entrepreneurs must prepare for the fact that by adjusting the social, subsidy, levy and especially tax policy, the demands placed on them will most likely increase. The paper indicates the links between the individual indicators of the countries and names the consequences arising from them. In order to increase the information about the conditions of doing business in Slovakia, it is necessary to expand the research by looking for connections between indicators of the country, companies, movements in the world and current geopolitics.

4. Discussion

The paper began with the idea that economic processes are the most important tool of geopolitics, and geopolitics affects various spheres of our lives. Globalization has brought many positives, but also quite a few negatives. The increased level of education across the world has caused increased demands on the standard of living. Young people prefer different types of entertainment than we were used to until recently. Society's pressure for perfection, computer games and communication on social networks close the young generation to the virtual world. The result is a growing trend in the occurrence of psychological problems in the population. Demands on healthcare and financial security of this sector are increasing. Changes in the thinking of young people are causing populations to age, literally at a leaping pace. Countries with a high proportion of the older generation will have a huge problem keeping government spending at an acceptable level. Consumption goes hand in hand with the rising standard of living of the population. The dictates of ever-increasing consumption are beginning to have a devastating effect. The consumption of natural resources is literally rampant, which negatively affects our environment. The changing climate causes noticeable changes in the fauna and flora, causing considerable financial damage. Poor living conditions drive millions of people from their homes. Immigration is becoming an increasingly pressing problem in Europe, but also in the USA. The growing awareness of countries about their culture and the value of their civilizational model has fueled the competition in the world even more. The world of digital technologies is the scene of progressive and very rapid changes. Entrepreneurs are trying to replace the labor force with very advanced technology and succeed in this way in the fight for their share of the global market. Multinational corporations capitalized on these trends and brought the political elites of countries into the fight for investors. The differences between the wealth and income of individual population groups are increasing fundamentally. Tension arises in the population and there is a threat of disruption of social harmony. New and new war conflicts are emerging, which stem from the too uneven distribution of the population between the poor and the rich. At the same time, we cannot forget the clash of different concepts of religions in this context. All the named characteristics are not able to exhaustively describe what is happening in the world, but they indicate the importance of the times. Politicians and top economists must look for a recipe for how we can get out of this situation. Economists must look for connections between global movements and their associated consequences in order to identify options for responding to these phenomena.

Funding: "This research was funded by Scientific grant agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic and the Slovak Academy of Sciences (VEGA), grant number VEGA 1/0140/21" and "The APC was funded by VEGA grant number 1/0140/21/ Research on economically important factors of corporate reputation in the context of sustainable industry and low carbon economy".

References

- 1. Aiginger, K. (2006): Competitiveness: From a Dangerous Obsession to a Welfare Creating Ability with Positive Externalities. *Journal of Industry*, Competition and Trade, Volume 6/ Number 2, June 2006, ISSN 1573-7012, s. 161 177. Retrieved September 30, 2023, from: https://link.springer.com/article/10.1007/s10842-006-9475-6
- 2. Baránik, M. (2003). Teória a prax hospodárskej politiky. Trenčín: TC TECH.
- 3. Bris, A. (2019). *IMD world competitiveness center*. Retrieved September 30, 2023, from: https://www.imd.org/wcc/world-competitiveness-center-mission/Overview/
- 4. Cepel, M. (2019). Social and Cultural Factors and Their Impact On The Quality Of Business Environment In the SME Segment. *International Journal of Entrepreneurial Knowledge* 7(1):65-73. 10.2478/ijek-2019-0005.
- 5. Hvozdíková, V. (2023). *Národná konkurencieschopnosť mýtus alebo realita?* Retrieved September 30, 2023, from: https://ekonom.sav.sk/uploads/projects/Hvozd01.pdf
- 6. Eurostat (2023). *Economic sentiment indicator*. Retrieved September 30, 2023, from: https://ec.europa.eu/eurostat/databrowser/view/TEIBS010/default/table?lang=en

- 7. Friedmannová, D., Hamuľák, J., Matejka, O. & Minčič, V. (2020). Smart podnikateľské prostredie v podmienkach SR, ako podporná infraštruktúra pre podniky počas jednotlivých fáz ich životného cyklu. *AZZZ SR*, 225 s., ISBN 978-80-8273-013-8. Retrieved October 15, 2023, from: https://www.ia.gov.sk/data/files/np_PKSD/Analyzy/AZZZ/SMART_podnikatelske_prostredie_v_podmienkach_SR.pdf
- 8. Malpass, D. (2020). Who we are. Retrieved September 30, 2023, from: https://www.worldbank.org/en/who-we-are
- 9. Masovic, A. (2018). Socio-cultural factors and their impact on the performance of multinational companies. *ECOFORUM*, vol. 7, Issue 1(14), 2018. Retrieved October 15, 2023, from: https://core.ac.uk/download/pdf/236086764.pdf
- 10. Mendéz-Picazo, M.T., Galindo-Martín, M. G. & Castaño-Martínez, M. S. (2021). Effects of sociocultural and economic factors on social entrepreneurship and sustainable development. *Journal of Innovation & Knowledge*. 10.1016/j.jik.2020.06.001
- 11. Pauhofová, I., & Páleník, M. (2013). Súvislosti realizácie koncepcie striebornej ekonomiky v krajinách Európskej únie. *Ekonomický časopis*, roč. 61, č. 8, s. 861 876. Retrieved September 30, 2023, from: https://www.sav.sk/journals/uploads/0621142108%2013%20Pauhofova-Palenik%20RS.pdf
- 12. Pauhofová, I., a Staněk, P. (2016). *Adaptačné procesy a pulzujúca ekonomika*. Bratislava: Ekonomický ústav SAV. 165 s., ISBN 978-80-7144-267-7. Retrieved September 30, 2023, from: https://ekonom.sav.sk/uploads/journals/343_adaptacne-procesy-a-pulzujúca-ekonomika-2016.pdf
- 13. Pecníková, J. (2020). Úvod do štúdia kultúr(y). *Banská Bystrica: DALI-BB s.r.o.*, 2020, 79 s., ISBN 978-80-8141-241-7 Retrieved October 15, 2023, from: https://www.ff.umb.sk/app/cmsSiteAttachment.php?ID=7742
- 14. Snowdon, B. (2007) *Globalisation, Development and Transition.* Cheltenham: EE, 2007, 537 s., ISBN 978-1-84542-850-1. Retrieved September 30, 2023, from: https://ideas.repec.org/b/elg/eebook/4183.html
- 15. Šikula, M. (2007): *Konkurenčná schopnosť SR*. Európska konferencia produktivity EPC 2007, Žilina: Slovenské centrum produktivity, 2007.
- 16. Toader, C. I. (2022). The Impact of Socio-Cultural Factors on the Business Environment, CECCAR Business Review, vol. 3(6), pages 3-11, June. Retrieved October 15, 2023, from: https://ideas.repec.org/a/ahd/journl/v3y2022i6p3-11.html
- 17. Wolff, F., Schmitt, K., & Hochfeld, Ch. (2007): Competitiveness, innovation and sustainability clarifying the concepts and their interrelations. Berlín: Öko-Institut e.V., Retrieved September 30, 2023, from: https://www.oeko.de/oekodoc/596/2007-142-en.pdf

Functioning Ethical Management Presented on the Basis of the Credible University

Gabiela Dubcová 1, Ľubica Foltínová 2*

- ¹ FBM, University of Economics in Bratislava, Slovakia; gabriela.dubcova@euba.sk
- ² FBM, University of Economics in Bratislava, Slovakia; lubica.foltinova@euba.sk
- * Correspondence: Gabiela Dubcová, gabriela.dubcova@euba.sk

Abstract: This contribution is focused on the structure of ethical behaviour and it is a continuing our project article focused on the research of ethical behaviour alternatives: "Phenomenal Forms of Ethical Behaviour of Economics Entities", in which we analysed and explained the phenomenal forms of ethical behaviour: alternatives and derivates of ethical behaviour. On this basis for each ethical management of the economics entity is the most important, the real ethical behaviour - as the essential content of management and economics of each economic entity. The partial goals: to define of general principles of the ethical management, to summarize core specifics attributes of the ethical management generally, to analyse of instruments and the structure of the ethical management at the credible university and to present of critical consideration of the ethical management.

Keywords: ethical management, ethical behaviour, compliance program

Introduction

At present, we are in the first period of CSRD (Corporate Sustainability Reporting Directive) reporting usage in the bank companies in the form of SFDR (Sustainable Finance Disclosures Regulation) and the intensive phase of a preparation reporting data for large companies:

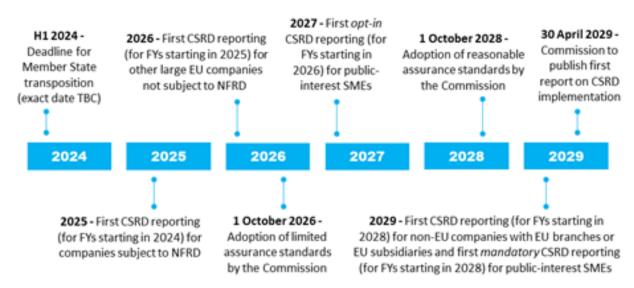


Figure 1. Timeline of the EU's Corporate Sustainability Reporting Regulations.

Source: https://www.unpri.org/pri-blog/csrd-and-esrs-how-eu-corporate-sustainability-reporting-is-evolving/10539.article.

On this basis is the most important, the real ethical behaviour - as the essential content of management and economics of each economic entity. This contribution is focused on the structure of ethical behaviour and it is a continuing our project article focused on the research of to ethical behaviour alternatives: "Phenomenal Forms of Ethical Behaviour of Economics Entities", in which we analysed and explained the phenomenal forms of ethical behaviour: alternatives and derivates of ethical behaviour.

1. Theoretical background

Ethics in management can be defined as a set of moral principles. Principles that govern the actions of a person or a group. It is a norm of behaviour that guides leaders and managers in their day-to-day actions. Company core values shape business ethics. And the establishment of an ethical culture relies on leadership. It is particularly true of leaders who display integrity, unity, and respect. (Susmita, S.2020)

The ethical management is defined as institutionalization of organizational values to create an rules and standards that are supportive of ethically sound behaviour, leading to a strong ethics culture in organisation. (Bishop , 2019, Nuseir & Ghandour, 2019, Certo, 2019)

The ethical management we can identify in resources focused on evaluation of functioning ethical conduct after successful institutionalisation of the sustainability strategy or strategy of the ethical conduct. (Remišová & Trenčianská, 2012, Nelson & Stout, 2022, Trevino & Nelson, 2021).

The ethical management focused on ESG policy and implementation of ESG principles into organisation with usage of adequate instruments (including of the measurement system), we can find in bibliography related to the applying ESG approach. (Dathe, 2023, Câmara & Morais, 2023, Read, 2023).

Ethical management is the process of accounting for morals while overseeing an organization. This practice allows managers to prioritize the well-being of employees, customers, the community and all stakeholders while considering the company's bottom line. By adhering to the company's core values and making challenging decisions on a case-by-case basis, an ethical management team promotes principles like responsibility, transparency, honesty, fairness, etc. (Krosel, et al., 2022.)

Ethical Management System in enterprises: Enterprises according to their strategies of corporate governance respond to social demands emphasizing corporate transparency and morality beyond legislation and its adaptation as compliance program, but also establish standards of conduct and value judgement that enable them to implement and actualize sustainability/ESG management related to all stakeholders, eg Slovenska Sporitelna, SKC Corporation, Whirlpool Corporation, ESET, etc.

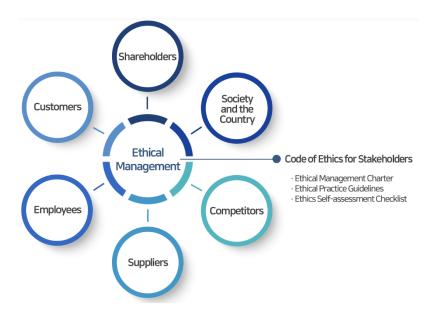


Figure 2. Ethical Management System.

Source: https://www.kccglass.co.kr/eng/esgManagement/transparentManagement/ethic.do.

Ethical management is focused first of all to all organizational stakeholders but internally is created by 3 relevant levels:

Adaptation of the country legislation in the enterprise Country legislation ETHICS PROGRAMME Country legislation ETHICS MINIMUM

Figure 3. Functioning Ethical Management.

Source: Self elaboration.

This 3 relevant levels presents: ethics minimum – legislation system, compliance program – adapted legislation in the company and ethics program: code of conduct, ethics committee, reporting of the ethical behaviour, etc. All information in relevant resources are focused on enterprises or organization, but we have marked deficit of related information about ethical management at universities. This is the first motivation to our research.

2. Methods and Methodology

All research activities during the whole period were carried out based on the application of the three-dimensional perspective logic of the research process:



Figure 4. Three-Dimensional Perspective of the Research Process.

Source: Self elaboration.

2.1 Research Aims

It is the evaluation of specific attributes of the ethical management at university entity, with partial goals:

- To define of general principles of the ethical management,
- To present of critical consideration of the ethical management,
- To summarize core specifics attributes of the ethical management generally,
- To analyse of instruments and the structure of the ethical management at the credible university.
- To disseminate the EUBA ethics management for positive motivation.

2.2 Object of the Research

This article takes big importance in the providing of real information with a real view on the object of this research. The central part of our research is focused on specific attributes of instruments and the structure of the ethical management at the credible university

2.3 Methodology of the Research

Considering the complexity of the problem regarding the economical and managerial activities of the organization in the area of specific attributes of instruments and the structure of the ethical management generally and at the credible university, such a combination of methods was applied which was appropriate to accomplish the exacting goals (due to saving of space, only the outline is stated here in Figure 5.):

APPLICATION OF METHOD COMBINATION FOR RESEARCH PURPOSES			
General methods	Specific methods		
A/ Logical methods	questionnaire		
■ analysis – synthesis	■ benchmarking		
■ induction – deduction	■ structured interview		
■ abstraction – concretization	 direct and indirect diagnosticities (via indicators) 		
	■ mathematical methods		
B/ Empirical methods	■ statistical methods		
observation	■ graphical methods		
■ measurement	■ simulation		
experiment	 application of information and communication technologies 		
Synergy (interaction)			

Figure 5. Particular Scientific Methods in our Co-author Tandem.

Source: Self elaboration.

3. Results

Next part is focused on description and explanation of the practical functioning ethical management the University of Economics in Bratislava (EUBA). These results we achieved from comparison of our he EUBA system he functioning Ethical management with universities of the SR (Dubcová, Šimonová, 2022) and from our comparison with functioning ethical management at V4 universities with membership in UN Global Compact (https://unglobalcompact.org/, 2023).

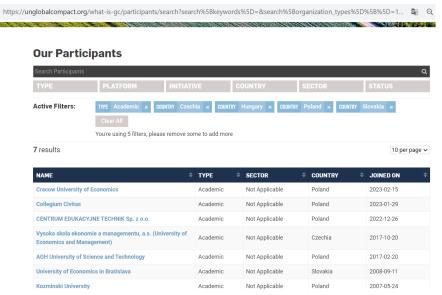


Figure 6. University members of the UN Global Compact.

Source: https://unglobalcompact.org/.

3.1 Attributes of Institutionalization of Ethics into Internal Organization of the EUBA

3.1.1 Dominant Focusing on Quality and Excellence

The EUBA strategic goal is to profile the University internationally as an institution that meets international standards in all areas of its activities. We are focused on continuous quality improvement in Science and Education through TQM (Total Quality Management) with three dimensions:

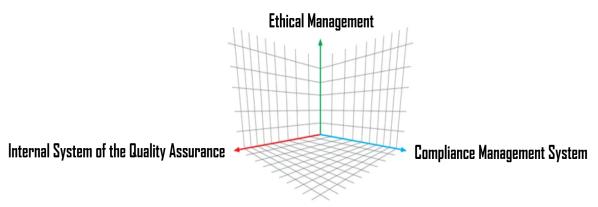


Figure 7. Ethical Management Implemented via TQM.

Source: Self elaboration.

A/ Compliance Management System - adapts the relevant general legislation of the Slovak Republic for university activities into the content and form of the internal regulations of EUBA, which is also governed by them in its daily activities:



Figure 8. Compliance Management System.

Source: https://euba.sk/en/university/documents.

B/ Internal System of the Quality Assurance - deals with the monitoring, evaluation and improvement of quality in the activities of EUBA:



Figure 9. Internal System of the Quality Assurance.

Source: https://euba.sk/en/univerzita/organizacna-struktura-a-pracoviska/utvary-riadene-prorektorom-premanazovanie-akademickych-projektov/centre-of-quality-assurance-and-support.

C/ Ethical Management - by implementing an ethical programme, it ensures responsible behaviour of all EUBA stakeholders:



Figure 10. Ethical Management.

Source: https://euba.sk/en/university/university-management/ethics-committee.

The most important relevant documents for our responsible conduct are:

Code of Ethics

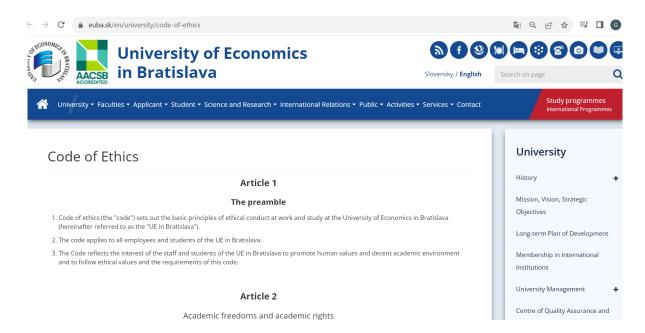


Figure 11. Code of Ethics.

Source: https://euba.sk/en/university/code-of-ethics.

The Code of Ethics regulates ethics behaviour at the EUBA according to the rules for:

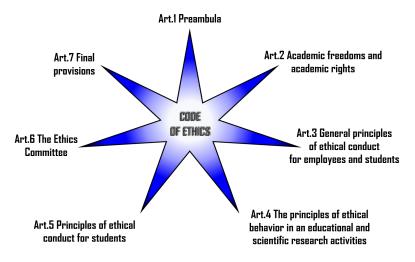


Figure 12. Regulations in the Code of Ethics.

Source: Self elaboration.

- Sustainable Development Plan ESG activities for the current year, which are evaluated after implementationhttps://euba.sk/univerzita/plan-udrzatelneho-rozvoja,
- Catalog of the Activities system of all activities declaring and disseminating ethical behavior for
 each academic year (https://euba.sk/www_write/files/SK/univerzita/organy-univerzity/eticka-komisia/2023/katalog_aktivit_ek_euba.pdf, 2023),
- Sustainability Conduct Report Regularly reports about the ESG activities of the EUBA according to the 10 UN Global Principles (https://euba.sk/en/university/university-management/ethics-committee#relevant-documents-for-our-responsible-conduct, 2023).

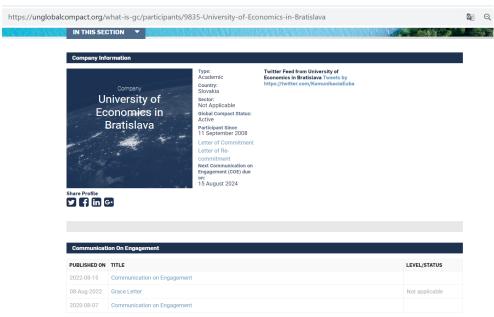


Figure 13. Sustainability Conduct Reports.

Source: https://unglobalcompact.org/what-is-gc/participants/9835-University-of-Economics-in-Bratislava.

Through superior activities in the field of ESG and sustainable development, EUBA supports and implements TQM and thus the implementation of the 10 principles of the UN Global Compact in everyday practice, making us a natural leader of competing universities in the Slovak Republic and V4:



Figure 14. SDGs and ESG Principles of the EUBA Ethical Management.

Source: https://euba.sk/www_write/files/SK/univerzita/organy-univerzity/eticka-komisia/engagement21.pdf.

3.1.2 Supportive Accreditation by AACSB International

Synergistically, by fulfilling the mission of membership and accreditation by AACSB International (The Association to Advance Collegiate Schools of Business), EUBA implements a goal-oriented system of quality and excellence for the benefit of all stakeholders (https://euba.sk/en/science-and-research/access-to-databases/eurostat-microdata?view=article&id=81:standardy-aacsb, 2021) .

3.2 Attributes of external acceptance of ethics conduct of the EUBA

3.2.1 Membership and cooperation in these associations/initiatives

Membership and primarily active cooperation in the Slovak and in the International associations/initiatives dealing with ethical, social or environmental issues:

- UN Global Compact
- RI4SK National working group for ethics and integrity in research
- BLF Business Leader Forum

- Slovak Diversity Charter
- AACSB Association to Advance Collegiate Schools of Business
- ACCA –Association of Chartered Certified Accountants
- AmCham American Chambers of Commerce
- AUF Agence Universitaire de la Francophonie
- CCFS Chambre de Commerce Franco Slovaque
- EUA European University Association
- EDAMBA European Doctoral Association for Master and Business Administration
- ERSA European Regional Science Association
- CIDD Consortium of International Double Degrees
- CIMA Chartered Institute of Management Accountants
- CRANET
- DAAD Deutscher Akademischer Austauschdienst
- EFMD European Foundation for Management Development
- HERMES The University Network HERMES Higher Education and Research in Management of European Universities
- Magna Charta Universitatum
- OeAD Agency for Education and Internationalisation
- SFUI Slovak-French University Institute

Membership and cooperation in these associations/initiatives inherently presupposes the implementation of relationships based on the principle of goal-oriented, educational and sustainable development and ethics, especially equality, justice, inclusion, tolerance, diversity and respect for human dignity. In the short term, EUBA staff and students carry out their scientific research and publication activities within the Association in project teams (national and international), generated by the conditions of the European Commission's strategy, principled with integrated ethical standards (https://euba.sk/www_write/files/SK/univerzita/organy-univerzity/eticka-komisia/engagement21.pdf, 2023).

3.2.2 Awards

The Ombudsman Award in 2016 for active participation in the Centre for Research on Ethnicity and Culture (CVEK) educational support programme: "You have a chance too", thanks to which Roma students have the opportunity to receive a quality education. It is very challenging for a public university to be a full participant in an available credible competition focused on the complexity of CSR or at least one of the pillars of CSR. For EUBA, the following is also a valuable award – unique excellent partnership (no other university in the SR (https://euba.sk/en/university/university-management/eth-ics-committee#memberships-and-initiatives-supporting-our-responsible-conduct, 2023):

- a) Membership of reputable organisations/associations focused on ESG and SDGs:
- UN Global Compact
- Slovak Diversity Charter
- BLF Business Leader Forum
 - b) Participation of the EUBA Ethics Committee:
- Co-authorship of the National Declaration on Strengthening Research Integrity in Slovakia, signed by 37 universities (https://euba.sk/www_write/files/SK/univerzita/organy-univerzity/eticka-komisia/deklaracia_12102021.pdf, 2021)

• Membership of Via Bona, national award for CSR (https://www.nadaciapontis.sk/en/projekty/viabona-slovakia/about-via-bona/, 2023).

All ESG activities implemented within the framework of the EUBA Ethics Management are coordinated by the EUBA Ethics Committee with the RI4SK PS (https://euba.sk/univerzita/eticky-manazment#clenstva-a-iniciativy-podporujuce-nase-zodpovedne-spravanie, 2023) as an implementation of the National Declaration on Strengthening Research Integrity in Slovakia, to which EUBA is a signatory as of 12 October 2021 (+ 36 other universities in the Slovak Republic) and cooperation during preparation of the new binding code of scientific integrity and ethics for Slovak universities and research institutions (https://www.minedu.sk/m-fedak-slovensko-bude-mat-po-prvykrat-zavazny-ko-dex-vedeckej-integrity-a-etiky/, 2023).

4. Discussion

According to the presented system of the functioning the Ethical management at the University of Economics in Bratislava, the EUBA system is the most effective and really functioning in the SR (Dubcová, Šimonová, 2022) and from our comparison with functioning ethical managements at V4 universities with membership in UN Global Compact (https://unglobalcompact.org/, 2023). The most comparable ethical management is functioning at the Kozminski university (https://www.kozminski.edu.pl/en/about-university/sustainable-development, 2023).

We can assert, the functioning ethical management is generated with intensive and effective membership of the EUBA in all organization focused on ethical conduct (ESG and SDGs) with regularly duty to report:

- UN Global Compact
- Slovak Diversity Charter
- BLF Business Leader Forum
- PS RI4SK

The most frequently, the EUBA disseminate its ethical conduct (ESG and SDGs) in the form of Catalogue of the Activities per year (https://euba.sk/www_write/files/SK/univerzita/organy-univerzity/eticka-komisia/2023/katalog_aktivit_ek_euba.pdf, 2023):

PERFORMED ACTIVITIES OF THE ETHICS COMMITTEE OF THE EUBA PERIOD: FROM 1/9/2022 TO 16/6/2023					
I. Memberships and Initiatives Supporting our Responsible Behaviour	III. Trainings	V. Dealing with Stimuli and Complaints			
External nature (accepted activity): Coordination/consultation activities and communication (at a representative level): *PS2 RMSK *UN Global Compact *BLF Slovakia *Naše Mesto (Our city) *Diversity Charter	Realisation of the training: * on research and scientific ethics and integrity * at all EUBA faculties * for teaching staff and workers * in the form of discussion tables * with the aim of interactively revealing latent ethical dilemmas and problems, and proactively preventing stimuli and suggestions				
II. Relevant Documents for our Responsible Behaviour	IV. Realisation of Popularization Activities and Initiatives	VI. Advisory and Consulting Activities			
Sustainable Conduct Report 2021 "Communication of Engagement" for the UN Global Compact (2-year cycle) Sustainable Development Plan 2023 Report on the activities of the EC EUBA 2022 Catalogue of EUBA activities for the Diversity Charter Catalogue of the EC EUBA Activities 2023	European Researchers' Night 2022 (in cooperation with ethically behaving partners and confirmations of voluntary activity) Naše Mesto (Our city) 2023 Sustainability Festival 2023	A/ Provided by: Advisory activity on ethical problems for teachers are students: • Discrimination • Bullying • Plagiarism/Self-plagiarism • Slander Certificates on project ethical behaviour Certificates of voluntary activity B/ Received: • Are related to each consulted problem separately (lawyers, psychologists, computer scientifists) • On research and scientific ethics and integrity training • Non-financial reporting for the EUBA C/ Setting up a post box for questions, dilemmas an suggestions (near to the EUBA post office in the Rector building)			

Figure 15. Catalogue of the Activities.

Source: https://euba.sk/www_write/files/SK/univerzita/organy-univerzity/eticka-komisia/2023/katalog_aktivit_ek_euba.pdf.

5. Conclusions

Our research and presented functioning ethical management of the University of Economics in Bratislava declare not only an individual system of the successful and effective system of the functioning ethical conduct (from the sustainability strategy into the quality credible reporting of the real ethical behaviour) but in the abstracted form disseminate the general model of the functioning ethical management of an university. It can be a pattern and a positive motivation for future development of the ethical conduct requested from legislation focused on universities and research institutions.

Funding: This research was funded by VEGA 1/0836/21 "Creation of a Flexible ESG Controlling Model for Typologically Heterogeneous Enterprise Systems with Specific Conditions and Institutionalization Attributes for Standardized Functioning and Optimization and Creation of the Adequate Model of Ethics and Integrity Conduct of Institutions in the Area of Scientific-Research Activities on the Basis International Comparison and Setup of Related Determining Attributes for its Effective Implementation and Functioning" (50%) and KEGA 019EU-4/2022 "Strengthening the Position of Institutionalized Sustainable Development and Inclusion by Supporting Agenda 2030 Research and education and Inclusive Diversity Behaviour" (50%).

References

- 1. AACSB Business Accreditation Standards. (2023, October 10). https://euba.sk/en/science-and-re-search/access-to-databases/eurostat-microdata?view=article&id=81:standardy-aacsb.
- 2. Bishop, P. (2019). Management, Organisation, and Ethics in the Public Sector. Routledge.
- 3. Câmara, P, Morais, F. (2023). The Palgrave Handbook of ESG and Corporate Governance. Springer Berlin.
- Centre of Quality Assurance and Support. (2023, October 10). https://euba.sk/en/univerzita/organizacnastruktura-a-pracoviska/utvary-riadene-prorektorom-pre-manazovanie-akademickych-projektov/centre-of-quality-assurance-and-support.
- 5. Certo S. (2019). Modern Management: Concepts and Skills, Global Edition. Pearson.
- 6. Dathe, T. (2023). Corporate Social Responsibility (CSR), Sustainability and Environmental Social Governance (ESG): Approaches to Ethical Management. Springer Nature.
- 7. Documents. (2023, October 10). https://euba.sk/en/university/documents.
- 8. ESET Socially Responsible. (2023, October 10). https://www.eset.com/int/about/socially-responsible/.
- 9. Ethical Management System. (2023, October 10). https://www.kccglass.co.kr/eng/esgManagement/transparentManagement/ethic.do.
- 10. Ethical Management System. (2023, October 10). https://www.skc.kr/m/eng/corporation/intro/corp.do?menuCd=001001001.
- 11. Ethics Committee. (2023, October 10). https://euba.sk/en/university/university-management/ethics-committee.
- 12. Fei, S., Kwon, Ch. & Jin, Ch. (2021). The Role of Corporate Ethical Management on Trade Relationship Trust and Commitment, Sustainability, 13(9), 5290; https://doi.org/10.3390/su13095290.
- 13. Krosel, A et al. (2022). What Is Ethical Management? (Plus Benefits and Examples) https://www.in-deed.com/career-advice/career-development/what-is-ethical-management
- 14. Nelson, J.S. & Stout, L.A. (2022). Business Ethics: What Everyone Needs to Know. Oxford University Press.
- 15. Nuseir, T.M. & Ghandour, A. (2019). Ethical Issues in Modern Business Management. International Journal of Procurement 2019, 12 (5), pp.592–605. DOI: 10.1504/IJPM.2019.10018652.
- 16. Our ESG Approach. (2023, October 10). https://whirlpoolcorp.com/2021SustainabilityReport/our-approach/esg-approach.php.
- 17. Participants. (2023, October 10). https://unglobalcompact.org/
- 18. Ransome. H. (2023, October 10). CSRD and ESRS: How EU Corporate Sustainability Reporting is Evolving. https://www.unpri.org/pri-blog/csrd-and-esrs-how-eu-corporate-sustainability-reporting-is-evolving/10539.article
- 19. Read, C. (2023). Understanding Sustainability Principles and ESG Policies. Springer Berlin.
- 20. Remišová, A. & Trenčianská, E. (2012) Etika a morálka. Sprint 2.
- 21. Susmita, S. (2020). Ethics in Management: Different Approaches, Types and Benefits. https://www.makingbusinessmatter.co.uk/ethics-in-management/.
- 22. Sustainability/ESG. (2023, October 10). https://www.erstegroup.com/en/about-us/sustainability-esg/
- 23. Sustainable Development. (2023, October 10). https://www.kozminski.edu.pl/en/about-university/sustainable-development

- 24. Šimonová, J. & Dubcová, G. (2022). Comparative Analyses of the Process of Detecting and Investigating a Breach of Ethical Rules of Research Integrity. Creating an Appropriate Model of the Behaviour for Ethics and Integrity of Institutions in the Area of Scientific Research Activities Based on International Comparison and Setting a System of Determining Attributes for Its Effective Implementation and Functioning: Proceedings of Scientific Papers: NO.II. Brno: Masaryk University.
- 25. Trevino, L.K. & Nelson, A. (2022). Managing Business Ethics: Straight Talk about How to Do It Right. Wiley.

The influence of perceived value factors on overall consumer satisfaction

Dana Hrušovská 1*

- Affiliation 1 (Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovak republic); dana.hrusovska@euba.sk
- * Correspondence: dana.hrusovska@euba.sk;

Abstract: This study aimed to explore the factors contributing to consumer satisfaction, focusing specifically on the interplay between satisfaction and elements of perceived value, within the context of the food products industry in the Slovak Republic. The underlying hypothesis posited a tangible relationship between consumer satisfaction and perceived value factors. A comprehensive questionnaire survey was deployed to gauge consumer satisfaction levels with food products. The results were analysed using regression analysis to determine the statistical significance of any observed relationships. A structured questionnaire was circulated across various demographics within the Slovak Republic, aiming to capture a diverse and representative sample of the population. The main focus of the inquiry was to assess consumer satisfaction levels concerning food products, with a particular emphasis on evaluating the perceived value and its constituent factors, including perceived quality and consumer expectations. The study uncovered statistically significant relationships between perceived value factors and consumer satisfaction. Specifically, perceived quality emerged as the pivotal factor influencing overall satisfaction levels among participants. Furthermore, it was discerned that consumer expectations and perceived value predominantly shaped the perceptions of quality The findings of this research highlight the crucial role of perceived quality in determining consumer satisfaction with food products in the Slovak Republic.

Keywords: consumer satisfaction; perceived value; food products, regression analysis

Introduction

Consumer satisfaction is a pivotal component in the success of products and services in the marketplace. It is determined by the degree to which a consumer's expectations are met or exceeded by their experiences with a product or service (Marína & Miroslava, 2020). Satisfied consumers are more likely to be loyal, repeat customers and to recommend the product or service to others, thereby contributing to the longevity and profitability of a business (Oliver & Swan, 1989; Sweeney & Soutar, 2001). Perceived value is a key factor that influences consumer satisfaction (Nagyová et al., n.d.). It is the consumer's overall assessment of the utility of a product or service based on their perceptions of what is received and what is given. In simple terms, it refers to the consumer's evaluation of the benefits and costs of using a particular product or service (Kita et al., 2021). The circular economy and customer satisfaction can be closely linked (Oliver, 1980). The circular economy seeks to maximize the value of products, services and waste, minimize waste production and keep resources in the economy as long as possible. This model can bring several benefits to customers and can their satisfaction. The circular economy supports the production of quality and long-lasting products, which can increase customer satisfaction. Greater sustainability may be relevant in that customers who value environmental awareness and sustainability will be more satisfied with a product or service. Businesses that embrace the circular economy are often more transparent about their supply chains and production processes, which can increase trust and customer satisfaction. A circular economy can reduce the cost of production and thereby eliminate more competitive prices, which can benefit customers. A circular economy can provide more flexibility and more opportunities. Confounding customer satisfaction can be done by conducting satisfaction surveys, product ratings, reviews and other ways of collecting customer feedback (Oliver & Swan, 1989; Westbrook & Oliver, 1991). Analyzing this data can help companies optimize their products and services to better meet customer needs and increase customer satisfaction.

1. Theoretical background

Customer satisfaction is defined as a measurement that determines how products or services supplied by a company meet or surpass customer expectation. Marketers focus on maximizing consumer satisfaction. Many competitors recognize that the collection and analysis of consumer satisfaction data is a key step for their future survival and prosperity in a competitive environment (Marína & Miroslava, 2020). Achieving consumer satisfaction can be the basis for evaluating a company's performance and employee compensation system (Anton & Perkins, 1997). Consumer satisfaction has been a pivotal subject of research in the domains of consumer behaviour and marketing since the 1970s, predominantly in developed nations. Seminal studies by researchers like (Oliver, 1997), (Churchill & Surprenant, 1982), and (Spreng & Olshavsky, 1993) have contributed significant insights into the dynamics of consumer satisfaction. The inception of systematic consumer satisfaction measurement can be attributed to Fornell in 1989, who introduced the Swedish Customer Satisfaction Barometer (SCSB) at the University of Michigan in Sweden (Fornell, 1992). Subsequently, the American Customer Satisfaction Index (ACSI) was conceptualized and established in 1994 (Fornell et al., 1996), offering a more refined and comprehensive approach to measuring consumer satisfaction. The Customer Satisfaction Index (CSI) (Hsu, 2008) serves as a multifaceted tool, enabling the evaluation of consumer contentment with products, services, or the organization as a whole. Several nations, including Sweden (SCSB), Norway (NCSB), Switzerland (SWICS), Korea (KCSI), and Malaysia (MCSI), have institutionalized CSIs at the national level. The Swiss Customer Satisfaction Index (SWICS) (Bruhn & Grund, 2010) was unveiled in 1998, incorporating findings from 7,400 telephonic interactions with around 3,800 consumers. It delineates consumer satisfaction across 20 sectors and examines the interplay between latent variables within individual sectors. Various countries and regions, including Brazil, Argentina, Mexico, Canada, Australia, Hong Kong, and Taiwan, are in the process of formulating their respective CSI systems. These indices essentially pursue analogous measurement objectives but exhibit conspicuous disparities in model structure and variable selection, rendering comparative analysis impractical due to inherent methodological differences. While these Customer Satisfaction Indices (CSIs) share a common objective of measuring customer satisfaction, the inherent variations in their methodological frameworks and variable specifications underscore the lack of uniformity in their structural compositions. Consequently, this heterogeneity in model structures impedes the ability to make comparative assessments among the various national CSIs. The advent of Consumer Satisfaction Indices globally has provided invaluable insights and methodologies to gauge consumer satisfaction across various sectors.

Defining the Problem: The problem of this study is the intricate relationship between perceived value and consumer satisfaction, and how different facets of perceived value impact the overall consumer experience. Understanding this relationship is crucial as it can shape consumer behaviour and influence their purchasing decisions. However, the multifaceted nature of perceived value, which includes functional, economic, emotional, and social components, makes it a complex variable to study and understand fully. Additionally, consumer satisfaction is subjective and can vary widely among individuals, further complicating the analysis (Homburg & Giering, 2001; Oliver & Swan, 1989).

Problem statement: How do different factors of perceived value influence overall consumer satisfaction, and what are the implications of this relationship for businesses seeking to optimize their products or services to meet consumer needs and preferences.

2. Methods and methodology

The evaluation of the research is based on a quantitative methodology. We carried out a question-naire survey on the territory of the Slovak Republic and examined the assessment of consumer satisfaction with food products. The aim of this research was to identify factors affecting satisfaction, to find out if there is a relationship between satisfaction and factors of perceived value. We described the evaluation of statistical significance with a regression analysis for the Horalka biscuit product. By testing the null hypothesis, we determined the values of Significance F. The analysis of the dependence between satisfaction and factors of perceived value was determined for 129 consumers. The objective of this discussion is to explore how these perceived value factors impact overall consumer satisfaction.

Objectives of the Study: To address the problem stated above, the study aims to achieve the following objectives. In our research, we focused on five perceived value factors.

- a. Assessment of overall quality compared to price (PVx1),
- b. Evaluation of product characteristics compared to price (PVx2),
- c. Evaluation of functionality compared to price (PVx3),
- d. Evaluation of cost compared to durability (PVx4),
- e. Evaluation of overall quality with total costs (PVx5). Figure 1.

Customer-perceived consumer added value is a decisive factor. It may significantly influence the consumer's decision to purchase the goods. The lower the price for the enterprise, the higher the perceived consumer added value and the higher the incentive for the consumer to opt for this product. Following the defined problem and objectives, we formulated the following research question:

Research question : We assume that there is a relationship between consumer satisfaction and perceived value factors.

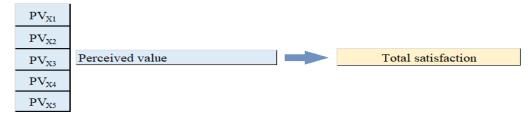


Figure 1: Impact of perceived value factors according to overall consumer satisfaction and behaviour.

Source: Own processing.

3. Results

The evaluation of statistical significance is described by regression analysis for the product of horalka biscuit. The multiple R (correlation coefficient) value is equal to 0.64692, indicating a high degree of tightness of the relationship between consumer satisfaction and perceived value factors. An analysis of the dependence between satisfaction and perceived value factors was measured in 129 consumers. By testing a zero hypothesis, we determine the values of Signifikance F = 3.46233E-13 < 0.05 (α – level of significance), i.e. H0 is rejected, which means that the model was selected correctly. Linear dependence exists at a level of significance 99 %. The regression function for the horalka biscuit product is in the form of:

$$y = 2.63273 + 0.12894 PV_{x1} - 0.17323 PV_{x2} + 0.22024 PV_{x3} - 0.35181 PV_{x4} + 0.20189 PV_{x5}$$
 (1)

At Intercept = 2.63273 if the overall quality rating compared to the price was zero, consumer satisfaction would reach 2.63273 points out of 10. By increasing the overall quality of the product compared to the price of the product by 1 unit of measure (1b.), satisfaction will increase by 0.12894 points. By increasing the rating of product characteristics compared to the price of the product by 1 unit of measure (1b.), satisfaction decreases by 0.17323 points. By increasing the evaluation of product functionality compared to the price of the product by 1 unit of measure (1b.), satisfaction will increase by 0.22024 points. Increasing the appreciation of the costs you incurred on the product (its acquisition, product not available, storage, disposal and price of the product) compared to the shelf life, its duration of consumption, use, freshness by 1 unit of measure (1 b.) increases satisfaction by 0.35181 points. By increasing the appreciation of the overall quality, i.e. characteristics and functionality compared to the total cost of the product (includes the price of the product, the cost of product maintenance, disposal, time costs related to, for example, opening or closing the packaging, the time cost of "looking for" a product that is not always available, etc.) by 1 unit of measure (1 b.), satisfaction will be increased by 0.20189 points.

Table 1. Output of regression and correlation analysis for Horalky according to perceived value factors

SUMMARY OUTPU	Т					
5						
Regression St	tatistics					
Multiple R	0.64691					
R Square	0.41850					
Adjusted R Square	0.39486					
Standard Error	1.60295					
Observations	129					
ANOVA						
	df	SS	MS	F	Significance F	
Regression	5	227.45827	45.49165	17.70464	3.46233E-13	
Residual	123	316.04559	2.56947			
Total	128	543.50387				
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	2.63272	0.65775	4.00258	0.00010	1.33073	3.93471
PVx1	0.12894	0.10263	1.25630	0.21138	- 0.07422	0.33210
PVx2	-0.17323	0.11775	- 1.47117	0.14379	- 0.40631	0.05984
PVx3	0.22024	0.09992	2.20409	0.02937	0.02244	0.41804
PVx4	0.35181	0.08312	4.23237	0.00004	0.18727	0.51635
PVx5	0.20189	0.09459	2.13420	0.03481	0.01464	0.38913

Source: Own processing.

From the output of regression and correlation analysis, we monitor P-value. The locating constant and the regression coefficient Multiple R are statistically significant, the constant reaches 3.46233E-13 < 0.05. The P-value for the regression coefficient is 0.00011 < 0.05. The increase in the overall quality assessment compared to the price by 1 b. represents an increase in satisfaction in the range of 0.07 to 0.33. Detailed results are given in Table 1.

Based on the defined problem: How different factors of product value perception affect consumer satisfaction and what are the implications of this relationship for those who try to optimize their businesses or services to meet the needs and preferences of consumers, we investigated the relationships between different quantitative variables. Tables 2 and 3 show the summary results of individual regressions of individual selected products, where we compared the significance of selected factors. We investigated the association between the dependent variable (Y) and several independent variables (PVX1, PVX2, PVX3, PVX4, PVX5). The products were selected in order to cover the area of soft drinks (Kofola, Rio), fresh food (Yogurt), snacks (Horalky - biscuits, chocolate) and healthy food (Nuts, TOFU).

Table 2 Regression and correlation analysis output values for selected product of Multiple R and Significance F factors according to perceived value and consumer satisfaction

PV - Perceived value	Multiple R	Significance F
Kofola	0.61225	9.32041E-14
Rio	0.65810	3.40501E-12
Yogurt	0.76303	8.75099E-20
Horalky - Biscuits	0.64692	3.46233E-13
Chocolate	0.65554	1.21792E-12
Nuts	0.78801	7.76045E-19
Tofu	0.73185	1 69511F-15

Source: Own processing.

Table 2 presents the results of the summary of the regression model and the ANOVA model of perceived value factors for selected products. Multiple R is statistically significant for all products. It reaches a minimum of 0.61 and a maximum of 0.78. The Significance F ratio shows whether the overall regression model is appropriate for the data. The outputs indicate that independent variables statistically significantly predict a dependent variable for all selected products. We can then examine the statistical significance of each of the independent variables. Table 3 shows the p-value points for selected products. For the PV_{x5} factor, statistical significance is highest for six products out of seven.

Table 3 P-value from regression and correlation output analysis for selected products according to perceived value and consumer satisfaction factors

PV	The assessment of overall qua-	Evaluation of product charac-	Evaluation of the funkciona-	Evaluation of cost compared	Evaluation of overall quality
	lity compared	teristics com-	lity compared	to durability	with total costs
	to price	pared to price	to price		
	PV_{x1}	PV_{x2}	PV_{x3}	PV_{x4}	PV_{x5}
Kofola	0.55155	0.67632	0.00038	0.00150	0.00605
Rio	0.19080	0.00800	0.27628	0.13979	1.73335E-06
Yogurt	0.00597	0.94702	0.07574	0.72155	1.32116E-05
Biscuits	0.21139	0.14380	0.02938	0.00004	0.03481
Chocolate	0.04875	0.06064	0.27335	0.11160	0.00165
Nuts	0.00810	0.71091	0.00000	0.46520	3.08815E-05
Tofu	0.00084	0.54877	0.09539	0.76409	0.05535

Source: Own processing.

From the results of the research, we can conclude that the group of factors of perceived value for overall satisfaction (assessment of overall quality compared to price, evaluation of product characteristics compared to price, evaluation of functionality compared to price, evaluation of costs compared to durability and evaluation of overall quality with total costs) is the third most important group. The first most important group is perceived quality, the second is consumer expectations and the fourth is knowledge of the product.

Table 4 Statistical significance in terms of frequency, in % and order of significance

Groups of factors	Statistical signifi- cance (number)	Statistical sig- nificance (%)	Order of signifi- cance
CC — general characteristics	2/21	9.5	5.
of the consumer			
CP – consumer personality profile	3/35	8.6	6.
PK – product knowledge	14/35	40.0	4.
CE - consumer expectations	15/28	53.3	2.
PQ – perceived quality	19/35	54.28	1.
PV – perceived value	15/35	42.85	3.
CE - consumer expectations PQ – perceived quality	15/28 19/35	53.3 54.28	2. 1.

Source: Own processing.

We rate the groups of factors of general consumer characteristics and the consumer's personality profile as statistically insignificant. Detailed results are given in Table 4.

4. Discussion

The study investigated the complex relationship between perceived value factors and overall consumer satisfaction. The analysis revealed several key findings: Perceived Value Factors Influence Consumer Satisfaction: The research confirmed that perceived value factors significantly influence consumer satisfaction. Specifically, the assessment of overall quality compared to price, evaluation of product characteristics compared to price, evaluation of functionality compared to price, evaluation of costs compared to durability, and evaluation of overall quality with total costs all play a significant role in

shaping consumer satisfaction. Statistical Significance: The study identified statistical significance in the relationship between perceived value factors and consumer satisfaction for a range of consumer products, including Kofola, Rio, Yogurt, Biscuits, Chocolate, Nuts, and Tofu. These findings underscore the general applicability of the perceived value-consumer satisfaction relationship across diverse product categories. Hierarchy of Influential Factors: The research categorized different groups of factors, including consumer characteristics, consumer personality profile, product knowledge, consumer expectations, perceived quality, and perceived value. Perceived quality was found to be the most influential factor, followed by consumer expectations and perceived value. This hierarchy highlights the importance of not only delivering quality products but also aligning them with consumer expectations and perceived value to drive satisfaction. Future Research Directions, while this study sheds light on the relationship between perceived value and consumer satisfaction, there are several avenues for future research: Segmentation Analysis: Future research could explore whether the impact of perceived value factors on consumer satisfaction varies among different consumer segments, such as age groups, income levels, or cultural backgrounds. Longitudinal Studies: Conducting longitudinal studies could provide insights into how the relationship between perceived value and consumer satisfaction evolves over time and whether it is influenced by external factors like economic conditions or technological advancements. Product-Specific Investigations: Deeper investigations into specific products or industries could reveal nuances in the perceived value-consumer satisfaction relationship. For example, studying high-involvement products like automobiles or healthcare services may yield different insights than low-involvement products like fast food. Qualitative Research: Qualitative research methods, such as in-depth interviews or focus groups, can complement quantitative findings by uncovering the underlying motivations and emotions that drive perceived value perceptions and satisfaction. Cross-Cultural Studies: Exploring how perceived value and its impact on consumer satisfaction vary across different cultural contexts can provide valuable insights for businesses operating in global markets.

5. Conclusions

The findings of this research highlight the crucial role of perceived quality in determining consumer satisfaction with food products in the Slovak Republic. The nuanced interrelation between consumer expectations, perceived value, and perceived quality is elucidated, establishing perceived quality as the linchpin for overall satisfaction. This study not only validates the hypothesis positing a relationship between consumer satisfaction and perceived value factors but also underscores the importance of aligning consumer expectations and perceived value to enhance perceived quality and, by extension, consumer satisfaction. Recommendations for Future Research: Given the significant implications of perceived value factors on consumer satisfaction revealed in this study, future research endeavours could benefit from delving deeper into these dynamics across different consumer segments. This would entail exploring the variability in the impact of perceived value factors on consumer satisfaction among diverse consumer groups, which could offer more granular insights and facilitate the development of more targeted and effective strategies for enhancing consumer satisfaction in the food products industry.

Funding: This research was funded by the scientific grant VEGA No 1/0462/23 Circular economy in the context of social requirements and market restrictions (100 %).

References

- 1. Anton, J., & Perkins, D. S. (1997). Listening tu the Voice of the Customer: 16 steps to a successful customer satisfaction measurement program. Customer Service Group.
- 2. Bruhn, M., & Grund, M. A. (2010). Theory, development and implementation of national customer satisfaction indices: The Swiss Index of Customer Satisfaction (SWICS). *Total Quality Management*, 11(7), 1017–1028. https://doi.org/10.1080/09544120050135542
- 3. Fornell, C. (1992). A National Customer Satisfaction Barometer: The Swedish Experience. *Journal of Marketing*, 56(1), 6–21. https://doi.org/10.2307/1252129
- 4. Fornell, C., Johnson, M. D., Anderson, E. W., Cha, J., & Bryant, B. E. (1996). The American Customer Satisfaction Index: Nature, Purpose, and Findings. *Journal of Marketing*, 60(4), 7–18. https://doi.org/10.2307/1251898

- 5. Homburg, C., & Giering, A. (2001). Personal characteristics as moderators of the relationship between customer satisfaction and loyalty—An empirical analysis. *Psychology and Marketing*, 18, 43–66. https://doi.org/10.1002/1520-6793(200101)18:1<43::AID-MAR3>3.0.CO;2-I
- 6. Hsu, S.-H. (2008). Developing an index for online customer satisfaction: Adaptation of American Customer Satisfaction Index. *Expert Systems with Applications*, 34(4), 3033–3042. https://doi.org/10.1016/j.eswa.2007.06.036
- 7. Churchill, G. A., & Surprenant, C. (1982). An Investigation into the Determinants of Customer Satisfaction. *Journal of Marketing Research*, 19(4), 491–504. https://doi.org/10.1177/002224378201900410
- 8. Kita, P., Žambochová, M., Strelinger, J., & Kitová Mazalánová, V. (2021). Consumer Behaviour of Slovak Households in the Sphere of Organic Food in the Context of Sustainable Consumption. *Central European Business Review*, 10(1), 1–17. https://doi.org/10.18267/j.cebr.256
- 9. Marína, K., & Miroslava, L. (2020). Consumer Behaviour and Attitudes by Purchasing of Selected Food Products. *Studia Commercialia Bratislavensia*, 13(45), 200–214.
- Nagyová, Ľ., Géci, A., Krivošíková, A., & Horská, E. (n.d.). The impact of consumer personality on purchasing behavior in the dairy market in terms of psychological factors | Potravinarstvo Slovak Journal of Food Sciences. Cit 28. september 2023, z https://potravinarstvo.com/journal1/index.php/potravinarstvo/article/view/1556/1762
- 11. Oliver, R. L. (1980). A Cognitive Model of the Antecedents and Consequences of Satisfaction Decisions. *Journal of Marketing Research*, 17(4), 460–469. https://doi.org/10.2307/3150499
- 12. Oliver, R. L. (1997). Satisfaction: A Behavioral Perspective on the Consumer. McGraw Hill.
- 13. Oliver, R. L., & Swan, J. E. (1989). Consumer Perceptions of Interpersonal Equity and Satisfaction in Transactions: A Field Survey Approach. *Journal of Marketing*, 53(2), 21–35. https://doi.org/10.2307/1251411
- 14. Spreng, R. A., & Olshavsky, R. W. (1993). A desires congruency model of consumer satisfaction. *Journal of the Academy of Marketing Science*, 21(3), 169–177. https://doi.org/10.1177/0092070393213001
- 15. Sweeney, J., & Soutar, G. (2001). Consumer Perceived Value: The Development of a Multiple Item Scale. *Journal of Retailing*, 77, 203–220. https://doi.org/10.1016/S0022-4359(01)00041-0
- 16. Westbrook, R., & Oliver, R. (1991). The Dimensionality of Consumption Emotion Patterns and Consumer Satisfaction. *Journal of Consumer Research*, 18, 84–91. https://doi.org/10.1086/209243

Culture and Creative Industry. Potential and Growth, Innovation, Sustainability

Natália Tarišková

¹ Faculty of Business Management, EUBA, Slovakia; natalia.tariskova@euba.sk

Abstract: The aim of the work is to summarize key documents about the cultural and creative industry in relation to the development of society in an informative and overview way. Innovative and interdisciplinary responses to global and local challenges, whether economic or social, are a mirror of potential, growth, and creativity in a creative society, which represents the achievement of a certain degree of maturity of the country in the technological, social, and cultural environment that affects economic growth. Connecting the creative world with the world of technology, production or research is the future of their sustainable development.

Keywords: strategic documents, cultural economics, growth and innovation, creativity index, sustainability

Introduction

EU competences in the fields of culture and social affairs is defined according to Article 167 of the Treaty on the Functioning of the European Union (TFEU): "The Union shall contribute to the flowering of the cultures of the Member States, while respecting their national and regional diversity and at the same time bringing the common cultural heritage to the fore. Action by the Union shall be aimed at encouraging cooperation between Member States". According to the same article, only "incentive measures, excluding any harmonisation of the laws and regulations of the Member States," can be adopted at EU level. Despite limited EU competences in the fields of culture and social security, there seems to be political will and a historic opportunity to tackle the challenges of working conditions of artists together at EU level, to compare notes, learn from good practice in other countries and see how to best move forward for the benefit of all (Regulation, 2004).

For many years, EU cultural policy action has been guided by the priorities defined in the Commission's European Agendas for Culture, the European Framework for Action on Cultural Heritage and the Joint Communication 'Towards an EU strategy for international cultural relations', on the one hand, and the multiannual Work Plans for Culture, on the other. The cultural and creative sectors and industries have been identified as one of the 14 industrial ecosystems in the 2020 New Industrial Strategy.

Over the past sixty of last century cultural economics has established itself as a field of study that is relevant to arts organisations, creative industries, cultural policy and, increasingly, to economic policy for growth and sustainable development (Towse, 2020).

In the European Union, cultural and creative industries (CCI) employ 6.7 million people and contribute 4% to its economy, a figure comparable to the value of information and communication technologies (ICT) or accommodation and food services. It is interesting that CCI exceeds the above-mentioned sectors by the number of companies on the market and brings more value to the economy than the accommodation and catering services sector (SBA, 2023).

Cultural and creative industries correspond to industries producing and distributing goods or services that, at the time they are developed, are considered to have a specific attribute, use or purpose that embodies or conveys cultural expressions, irrespective of the commercial value they may have. Besides the traditional arts sectors, they include film, DVD and video, television and radio, video games, new

media, music, books and press" as well as "those industries that use culture as an input and have a cultural dimension, although their outputs are mainly functional. They include architecture and design, which integrate creative elements into wider processes, as well as sub-sectors such as graphic design, fashion design, or advertising.

It began modestly with an interest in the economic analysis of the finance of museums and the live performing arts, and has spread and evolved into a broader analysis of the cultural or creative industries and their role in the creative economy - representatives of manufacturing and technological companies, designers and creatives, scientists, researchers and start-ups.

The development of the creative and cultural sector is linked to the Cohesion Policy 2014 –2020. The Europe 2020 Strategy, the Horizon 2020 program and the Research and Innovation Strategy for Smart Specialization (RIS3). Creative industry is also included in the six perspective industries presented in RIS3 (1 - Automation, robotics and digital technologies, 2 - Processing and evaluation of light metals and their alloys, 3 - Production and processing of polymers and progressive chemical substances; including smart fertilizations, 4 - Creative industry, 5 - Valorization of the domestic raw material base, 6 - Support of intelligent technologies in the field of processing raw materials and waste in the region of occurrence). Within the framework of strategic objectives, under objective no. 3: "To create a dynamic, open and inclusive innovative society as one of the prerequisites for improving the quality of life" in point b) with the sub-goal "to increase the share of the creative industry in the creation of GDP", measure 3.1: "stimulation of knowledge-intensive business services (KIBS) and creative industry" (RIS3, p. 67).

1. Theoretical background

In the current period, there are several aspects of economic change that increase the importance of localities, cities and regions as important platforms for production, distribution, and innovation. The main paradox of the present time is the fact that while economic processes are moving more and more to the global scale of functioning, the local function is getting stronger. The social character of the locality, its social qualities presented by the creative human potential, its talent, and cultural environment, which make the locality attractive, are the factors behind the revival of the importance of the local in the global economy.

The first country of the European Union, which came up with a support policy in the late 1990s creative industry, it was Great Britain that introduced many concepts in this field. Currently, it has very well-thought-out investment schemes in the creative industry and developed strategies to support it, down to the local level.

Several international organizations deal with creative sector mapping. In 2003, the OECD published a study entitled "International Measurement of the Economic and Social Importance of Culture" focused primarily on the English-speaking environment. In the same year, WIPO (World Intellectual Property Organization) published the "Guide on Surveying the Economic Contribution of the Copyright-Based Industries", in which it applied its own methodology. According to her, several countries have established their own statistics databases. UNCTAD (United Nations Conference on Trade and Development) included the creative industry among its key activities in developing countries, but UNCTAD's global reports also include data from European countries.

There are three non-economic areas in which creativity and culture contribute to economic development:

1. as a manifestation of culture (individual and collective) it gives impetus to social groups, especially marginal ones, and provides platforms for stimulating their social and civic activities,

- 2. as cultural heritage, tangible and intangible, provides people with cultural memory, knowledge, and skills to establish sustainable relationships with culture, natural resources and the ecosystem,
- 3. as urban planning and architecture to create living and living environments.

The influence of creativity on the economy is also monitored by the consulting company KEA European Affairs, established at the European Commission, which prepares studies that serve as a basis for the decision-making activities of the European Commission bodies. In 2006, the KEA commission prepared its own study entitled "The Economy of Culture", giving the definition of the creative industry and its division into the cultural sector and the creative sector. The cultural sector included the area of traditional art (visual and theater arts, cultural heritage) and the area of cultural industry (film, audiovisual, television and radio broadcasting, computer games, music, publishing). It included the creative industry (design, architecture and advertising) and related areas (e.g. software development, hardware production) in the creative sector. It created the European Creativity Index as a new statistical framework for the representation and measurement of the various interacting factors contributing to the growth of creativity in the European Union.

Dr Neiva Ganga is developing a research and knowledge exchange programme addressing the value of arts and culture at an individual – e.g., mental health and wellbeing – and at a societal level – e.g., social and health inequalities. She is researching the value of cultural mega-events in the UK and Europe, and the effectiveness of arts and innovation in tackling health inequalities. Her works aim to answer the research question: What is the social value of place-based arts and culture interventions at an individual and community level in the UK and Europe? (Ganga, 2023). Her research focuses on evidence of the social value of arts interventions to improve wellbeing outcomes across 20 indicators of the UK's National Wellbeing Framework; ii) the mechanisms of change of place-based art, culture and heritage interventions; iii) discussion of the value of place-based heritage in improving wellbeing; and iv) the role of inequalities in shaping cultural access and participation, and the contribution of place-based art, culture and heritage interventions in mitigating social and health inequalities.

Different views on defining and measuring creativity are based on different historical developments and the given cultural-economic environment, which documents a significant difference in the American and European approach to its measurement. The issue of creative economy and creative industry is dealt with by several studies that monitor various factors associated with creativity and their impact on the economy. The creativity moment, as Kačírková (2016) summarizes, is factor that was investigated by Throsby (2001), the cultural product communicability factor by Hesmondhalgh (2007), the information and communication technology factor by Harley (2004), the intellectual property factor by Howkins (2001), the creative class factor and the occupation factor by Florida (2002), social factors and networking Potts (2008).

As Kačírková (2016) continues - some authors (Nathan, 2005) consider Florida's approach of creative cities as an application applicable to American cities rather than European environments. This is due to the different environment of Europe – cultural, economic, labor market mobility, etc., as well as the problem of availability of compatible data. To measure creativity within Europe, Florida and Tinagli (2004) adapted the mentioned index into the form of the Euro-Creativity index, which is composed of sub-variables, namely the Euro-Talent index, the Euro-Technology index and the Euro-Tolerance index. Currently, the given index is one of the most sophisticated approaches to the quantification of a creative society and is often used abroad in Europe, in the USA, or in Australia.

The CCI Creative City Index (CCI-CCI) is a new approach to the measurement and ranking of creative global cities. It is constructed over eight principal dimensions, each with multiple distinct elements. Some of these dimensions are familiar from other global city indexes, such as the MORI or GaWC indexes, which account for the size of creative industries, the scale of cultural amenities, or the flows of creative people and global connectedness. In addition to these indicators, the CCI-CCI contributes

several new dimensions. These measure the demand side of creative participation, the attention economy, user-created content, and the productivity of socially networked consumers.

The European Capitals of Culture Policy Group was funded by the European Commission's Culture Programme for twelve months in the period 2009 to 2010. The Policy Group set itself the goal of sharing good practice in relation to the delivery process of the European Capital of Culture (ECoC) title and developing a common research framework to assess the impact of a title year. The ECoC programme has developed significantly in delivery and profile. It has become one of the most coveted awards for European cities which aspire to position themselves as cultural and creative hubs and aim to demonstrate the value of culture to the revitalization of their urban economies and in affecting social change. In this context, the programme is becoming increasingly competitive, with calls sometimes attracting more than ten candidate cities from a designated hosting country.

The European Capitals of Culture (ECoC) were created in 1985 as an intergovernmental initiative and transformed into a European Union action in 1999. The rules were renewed from 2007, developing the effectiveness of the action further. In accordance with these rules, the European Commission ensures the external and independent evaluation of all 2007-2019 ECoC. In addition, a number of ECoC so far have initiated and carried out their own evaluations of the title year, following different models and approaches. Decision No 445/2014/EU (the "Decision") lays down new procedures for the implementation of the ECoC action for the period 2020 to 2033. Regarding evaluation, the Decision introduces a new obligation for all ECoCs 2020-2033 to carry out their own evaluations of the results of the title-year. As part of this new obligation, cities bidding for the title have to indicate in their application their plans for monitoring and evaluating the impact of the title on the city as well as for disseminating the results of such evaluation.

UNESCO's efforts to advocate for the role of culture for sustainable development over the last decade resulted in three milestone Resolutions adopted by the United Nations General Assembly (2010, 2011 and 2013), which acknowledge the role of culture as an enabler and a driver of sustainable development. This process culminated in culture being integrated in the 2030 Agenda for Sustainable Development adopted in 2015. Culture is explicitly referenced in SDG 11 Target 4, 'Strengthen efforts to protect and safeguard the world's cultural and natural heritage', for which the globally agreed upon indicator 11.4.1 will be elaborated and reported by the UNESCO Institute of Statistics (UIS). Beyond Target 11.4, culture contributes to development both as a sector of activity transversally across and other sectors. tion of culture to sustainable development is also clearly recognized in other major interna-Urban Agenda adopted at the United Naframeworks, including the New tions Conference on Housing and Sustainable Urban Development (Habitat III) in Quito, Ecuador, in October 2016 (UNESCO, 2019).

2. Methods and methodology

The main goal of the work is to clarify - art and culture are an integral part of our societies and enrich the quality of our lives in many ways. The ability of art to imagine, to connect, to innovate and to bring people from different backgrounds and cultures together is becoming increasingly recognised at EU and Member State levels – not only because of the intrinsic value of culture, but also because of its proven social and economic impacts (EU, 2023).

Cities holding the ECoC title are invited to use the common core indicators presented below when carrying out their respective evaluation. These indicators correspond to the general and specific objectives of the ECoC action. They are also based on the criteria laid down in the Decision for the assessment of the applications of the cities bidding for the ECoC title. The core indicators suggested below reflect this hierarchy of objectives and are intended to capture their essence whenever possible in a quantified form.

	General Objectives							
they sha	Safeguard and promote the diversity of cultures in Europe, highlight the common features they share, increase citizens' sense of belonging to a common cultural space (GO1), and foster the contribution of culture to the long-term development of cities (GO2)							
			Specific Ob	jectives	(SO)			
diversity a dimension of offering in o	SO1: Enhance the range, diversity and European dimension of the cultural offering in cities, including through transnational cooperation SO2: Widen access to and participation in culture SO3: Strengthen the capacity of the cultural sector and its links with other sectors							
			Operation	al Objec	tives			
Stimulate extensive cultural programm es of high artistic quality	Ensure cultural programm es feature a strong European dimension and transnatio nal co- operation	Involve a wide range of citizens and stakeholde rs in preparing and implement ing the cultural programm e	Create new opportunit ies for a wide range of citizens to attend or participat e in cultural events	Impro ve cultura I infra- structu re	Develop the skills, capacity and governan ce of the cultural sector	Stimulat e partners hip and co- operatio n with other sectors	Promot e the city and its cultural pro- gramm e	Improve the inter- national outlook of residents

Figure 1. Hierarchy of ECoC objectives

Source: European Comission (2018)

Objectives	Type of indicator	Indicative indicators	Possible sources of data collection
General objective 2: To foster the contribution of culture to the long-term development of cities	Impact	National / international recognition of cities as being culturally vibrant and having improved image Increase in GDP and employment in cities' cultural and creative sectors Increase in the availability of affordable space for cultural production (studios etc.) Quality and quantity of post-ECoC and long-term strategic documents and policies prepared New use of unused spaces, new public space development Civic sector reference bodies working with the municipality – number, number of meetings, number of organisations participating Development of the city's cultural strategy and implementation plans Number of decisions Municipality took in consultation with the cultural and civic sector and the increased budget for cultural activities	Surveys of tourists and visitors to host cities; international surveys of tourist opinions; opinion of national or international cultural experts; other authoritative published sources. Statistical data provided by municipalities, national statistical offices, sector bodies, etc. Documents analysis GPS data, big data etc. Reports, number of new civic initiatives, new organisations, creative start-ups, partnerships etc. Reference groups' work programmes and reports Analysis of city budgets -expenditure on culture

Figure 2. Overview of ECoC objectives and criteria with corresponding indicative indicators and possible sources of data collection

Source: European Comission (2018)

3. Results

The long-term strategy of Trenčín 2026 is very ambitious and paves the way for legacy. For example, the Creative Cluster Platform, the CIT organisation or the Institute for Participation Trenčín (IPT) as a new Department in the City administration will be important legacies of Trenčín 2026. In addition, the renewed cultural centre and the Fiesta Bridge (a key element of the ECoC bid and the programme for the titleyear) are expected to have a strong long-term impact. The team is continuously adjusting their objectives to match the possible changes, but they are convinced that the main legacy projects can be realised.

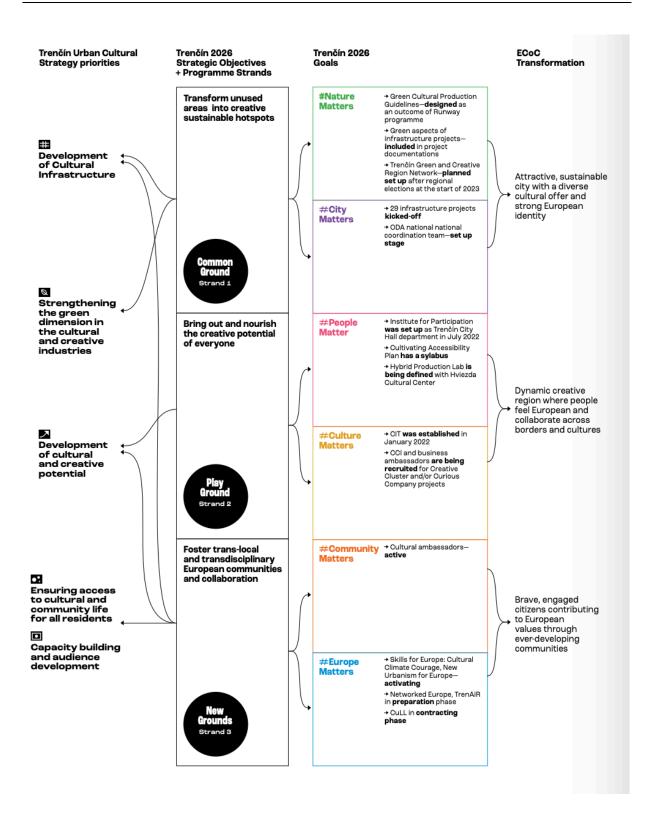


Figure 3. Long Term Strategy Trenčín 2026 ECoC

Source: CIT (2022)

It is expected that some indicators are further developed in the light of evolving circumstances, lessons learned from other ECoCs, unexpected developments, new types of data being created and new methodologies available to capture them.

Quantitative data should take account of baselines (i.e. data at application stage, start of title year, end of title-year), regional or national comparators when available and the cultural, social, educational and infrastructure context of the city.

Data should also be analysed and contextualised, to understand what contribution the ECoC is likely to have made, and identify other influential factors. On top of these common indicators, Trenčín should also define any additional indicators needed in the light of its own context, priorities and activities and reflecting its own performance targets. These indicators could be considered relevant for future cities and integrated in the common ECoC indicators.

BROI	Co-creative methods	: Ethnography : (new cultural	Google Analytics	Primary & Secondary quantitative data
iOI	Arts-based research	infrastructures, non-	: · Netnography	: analysis
	(new cultural	engaged audiences,	(online events)	(e.q. statistical data
ity cultural strategy	infrastructures, non-	: co-created events,	:	on GDP employment,
Trencin, 2026	engaged audiences.	: mass- observation with	· Qualitative analysis	environment, CCI,
rogramme analysis	co- created events)	citizens'-researchers)	(media and social media)	: tourism, cultural
nterview with		:	:	institutions box offic
takeholders, policy	Living Lab workshops	: Residents' survey	Sentiment analysis	quality of life, wellbei
nalysis)	(all areas of research)	& focus group	· (media and social media)	cultural participation
		(sociodemographic,	• '	: census, volunteers)
isitors' survey	Trencin, 2026	cultural practice,		
focus group	programme &	: standardise measures		Social network analy
sociodemographic,	Governance analysis	of wellbeing, quality of		(CCI, Trencin, 2026
ultural practice,	(interview with	life, ECOC awareness,		: programme)
tandardise measures	stakeholders, policy	citizenship)		:
f wellbeing, quality	analysis) Carbon	. CCI Survey &		Geographical mapping (events audiences)
f life, ECOC wareness, citizenship,	footprint analysis Trencin, 2026 & CCI	Focus group		· (everits addiences)
pend, satisfaction.	Trendin, 2026 & CCI	(sociodemographic,		: Culture and Creative
xpectations)		: cultural practice.		City Monitor
.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		standardise measures		. Only mornion
rencin, 2026 & City		of wellbeing, quality		
ultural strategy		of life, ECOC		
overnance analysis		: awareness, network,		
nterview with		: skills development,		
takeholders, policy		internationalisation)		
nalvsis)		:		
		: Volunteers' survey		
		& focus group		
		(sociodemographic, cultural practice.		
		standardise measures		
		of wellbeing, quality		
		of life, ECOC		
		· awareness, network,		
		skills development,		
		internationalisation)		

Figure 4. Hierarchy of ECoC objectives

Source: CIT (2022)

In many cities and regions of Slovakia, cultural and creative industries create an important part of the potential for economic growth, therefore culture and creativity should become a central part of economic and regional development strategies. As describes figure below, there are challenges for mitigation strategies, too. High traffic density √ Efficient public transport √ Compact city design High amount of waste √ Recycling Urban warming √ Increasing green space, √ Using reflective materials Increasing Air pollution √CO₂ capture, √ Filtering exhaust gases, ✓ Increasing efficiency of industrial processes/vehicles Increasing energy consumption/sinking √ Using renewable sources, resources √ Achieving low energy buildings, ✓ Increasing efficiency of devices/processes Lack of biodiversity/natural habitat √ Increasing green space, ✓ Developing animal/plant protection areas Sinking water resources √ Water purification √ Desalination √ Rainwater harvesting Rising food demand/poverty √ Vertical farming √ Artificial food production √ Greening the deserts Land shortage for housing √ Constructing multifunctional buildings, √ Creative architectural designs Weak Social cohesion √ Improving sociocultural environment √ Increasing the number of organisations-events that bring people together

Figure 3. Impacts of global urbanisation and mitigation strategies.

Source: Riffad (2016)

4. Discussion

A new model of sustainability is needed, including greater incentives to save energy, reduce consumption and protect the environment while also increasing levels of citizen wellbeing. Cities of the future should be a socially diverse environment where economic and social activities overlap and where communities are focused around themselves. They must be developed or adapted to enable their citizens to be socioeconomically creative and productive (Rifad, 2016).

In line with the existing state of research and the database of statistical data in the field of culture and creative industry, which does not yet allow consistent knowledge of the state or the setting of continuous monitoring and subsequent comparison of developments in this field, it will be necessary to

proceed to a complex change in cultural statistics and take into account Eurostat's recommendations resulting from the ESS net Final Report - culture, as well as the specifics of the Slovak reality. It will be necessary to stimulate activities contributing to the development of the creative industry through direct and indirect support tools enabling better access of subjects to financial resources, especially regarding small and medium-sized enterprises, but also in terms of activities of memory and fund institutions on the field of creative industry. To fulfill the above-mentioned intention, it is necessary to equally activate public and private resources and develop and implement a system of support for business education and the development of creativity in the educational process.

The cultural and creative industry is one of the prospective drivers of growth in the European Union, creativity and its projection into localities, cities, regions, industrial and cultural sectors, and society will bring economic development of the 21st century. The importance of creativity in the development of the economy and society is proven by significant worldwide surveys and conferences.

The phenomenon of the creative and cultural industry is not only a topic of Europe or the USA, but Eastern countries such as China, Singapore, and Australia are also heavily involved in this issue. At the same time, each country is characterized by a special approach to defining and selecting individual industries included in statistics, mainly to economic indicators.

The Culture 2030 Indicators are intended for implementation at both national and urban level by voluntary countries and cities. The terms 'urban' and 'local' are used interchangeably in the context of the Culture 2030 Indicators to refer to city-level implementation, with the understanding that the notion of urban is defined by each country according to its specific criteria. In addition, local data collection requires a certain level of organisation which should be provided by municipal authorities. The urban indicators are closely aligned with the national level indicators but are adapted to fit urban concerns, allowing for independent evaluation of the role of culture in urban areas and in sustainable urban development. In some cases, cities may also wish to position themselves within the overall national position. These city-level indicators will encourage further synergies with UNESCO's existing cities-related programmes and networks, in particular the UNESCO Creative Cities Network and the World Heritage Cities Programme.

5. Conclusions

To develop a research and knowledge exchange addressing the value of culture at an individual level, e.g., mental health and wellbeing, and at a societal level, e.g., urban development is extraordinary challenge of contemporary methodological innovation. To design interdisciplinary research on culture and health in Slovakia is one of the sustainable cornerstones how to attract and disseminate the benefit of the findings based on the fusion of culture and management as the core priority of the innovation for cultural economics. The educational philosophy of one generation will be the governing philosophy of the next across academia, health, business, third sector, and policymaking ranging from central to local government.

The Ministry of Culture of the Slovak Republic pursuant to Act No. 540/2001 Coll. about the state statistics as amended (hereinafter Act No. 540/2001 Coll.) performs annual long-term state statistical survey in the field of culture, but not any Culture and Creative Indices or contemporary methodological innovations. Culture statistics include data on theaters, music ensembles, audiovisual, radio and television broadcasting, libraries, periodicals, museums, galleries, observatories and planetariums, zoological and botanical gardens, protection of the monument fund, caves, and selected indicators of churches.

According to the current state statistical survey program, relevant data can be extracted from the statistical survey for the field of culture which is carried out by the Ministry of Culture of the Slovak Republic, from the statistical survey of the Ministry of Education, Science, Research and Sport of the Slovak Republic (university libraries and botanical gardens) and Ministry of the Environment of the Slovak Republic (zoological gardens) as well as from the administrative resources of the Administration of Slovak Caves and the Slovak Museum of Nature Conservation and Caving. Summary results of the state of statistical surveys for individual partial areas of culture are published in statistical yearbooks

for the Slovak Republic and individual self-governing regions are provided European and international institutions for the purposes of comparison and analysis development trends in individual areas of culture are used in the creation of strategies and concepts of cultural development in Slovakia (NOS, 2022).

Funding

This research was 50% funded by VEGA 1/0006/22 "Acceleration of growth of innovative enterprises scaling of scale-ups and enterprises based on new technologies (NTBFs)" and 50% funded by VEGA 1/0836/21 "Creating an appropriate model of behavior for the ethics and integrity of institutions in the field of scientific research activities based on international comparison and setting a system of determining attributes for its effective implementation and functioning".

References

- 1. Butler-Kisber, L. (2018). Qualitative Inquiry: Thematic, Narrative and Arts-Based Perspectives. ISBN 978-1-4739-6690-1.
- 2. European Comission. (2018). *Guidelines for the cities' own evaluations of the results of their ECOC.* https://culture.ec.europa.eu/sites/default/files/2021-04/ecoc-guidelines-for-cities-own-evaluations-2020-2033.pdf
- 3. ECoC 2013 Košice. 2010. https://culture.ec.europa.eu/sites/default/files/files/ecoc-2013-first-monitoring_en.pdf
- 4. KIT. (2022). https://culture.ec.europa.eu/sites/default/files/2022-10/ecoc-2026-slovakia-first-monitoring-re-port.pdf
- 5. EU (2023). Workplan for culture 2019-2022: *The status and working conditions of artists and cultural and creative professionals*. Luxembourg: Publications Office of the European Union. https://cultureactioneurope.org/knowledge/work-plan-for-culture-2019-22.
- 6. Ganga, R., Davies, L. & Wilson., K. (2023). Arts & Wellbeing. *A review of the social value of place-based arts inter- ventions*. Liverpool: Institute of Cultural Capital.
- 7. Hartley, John, Potts, Jason, MacDonald, Trent, Erkunt, Chris and Kufleitner, Carl. "(C²I)² = CCI-CCI The CCI Creative City Index 2012" Cultural Science Journal, vol.5, no.1, 2012, pp.1-138. https://doi.org/10.5334/csci.41
- 8. Kačírková, M. (2017). Kreativita v kontexte znalostnej spoločnosti. Bratislava: EÚSAV. ISSN 1337-5598
- 9. KEA. (2020). Cultural Industries in Slovakia. Analysis and recommendations to boost growth in Cultural Industries in Slovakia N° SRSS/SC2018/097.
- 10. NOS. (2022). *Správa o štátnom štatistickom zisťovaní v oblasti kultúry* 2021. Bratislava: Oddelenie vzdelávania, výskumu a štatistiky. https://www.culture.gov.sk/wp-content/uploads/2022/10/sprava o SSZ 2021.pdf
- 11. Leavy, P. (2018). Handbook of Arts-Based Research. New York: The Guilford Press. ISBN 978-1-4625-2195-1.
- 12. Leavy, P. (2020). Method Meets Art. *Arts-Based Research Practice*. New York: Guilford Press. ISBN 978-1-4625-3897-3.
- MK SR, (2020). Revízia výdavkov na kultúru. Bratislava: Inštitút kultúrnej politiky. https://www.mfsr.sk/files/sk/financie/hodnota-za-peniaze/revizia-vydavkov/kultura/revizia-vydavkov-kulturu-final-20200714.pdf.
- 14. MK SR. (2023). *Metodika tvorby strategických dokumentov v kultúre a kreatívnom priemysle na lokálnej a regionálnej úrovni*. Bratislava: oddelenie kreativity a vzdelávania. ISBN 978-80-974527-0-4.
- 15. Potts, Jason D. (2009). Why creative industries matter to economic evolution. *Economics of Innovation and New Technology*, 18(7-8). pp. 663-673. https://doi.org/10.1080/10438590802564592.
- Regulation (EC). (2004). No 883/2004 of the European Parliament and of the Council of 29 April 2004 on the coordination of social security systems. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX %3A02004R0883-20140101).
- 17. Riffad, S., Powell, R., Aydin, D. (2016). Future cities and environmental sustainability. <u>DOI: 10.1186/s40984-016-0014-2</u>.
- 18. Slovak Business Agency. (2023). https://www.sbagency.sk/inspirativne-spoluprace-kreativneho-avyrobneho-priemyslu-na-slovensku.
- 19. Towse R., Hernández, T.N. (2020). *Handbook of Cultural Economics* (3rd edition). Cheltenham, UK: Edward Edgar Publishing. https://doi.org/10.4337/9781788975803.
- 20. UNESCO (2019). Culture. 2030 indicators. ISBN 978-92-3-100355-4. Published in 2019 by the United Nations Educational, Scientific and Cultural Organization, 7, place de Fontenoy, 75352 Paris 07 SP, France© UNESCO, 2019ISBN 978-92-3-100355-4This publication is available in Open Access under the Attribution-NoDerivs 3.0 IGO (CC-BY-ND 3.0 IGO) license (http://creativecommons.org/licenses/by-nd/3.0/igo/).

Small and medium-sized enterprises in the digital decade

Anikó Töröková

Faculty of Business Management, University of Economics in Bratislava, Bratislava, aniko.torokova@euba.sk

Abstract: The European Union aims to empower businesses and individuals in the coming era of digitalisation, people-centeredness, sustainability and prosperity. The Digital Decade program is especially designed to support the digital transformation of businesses through the deployment of innovative technologies, promoting innovation and helping small and medium-sized enterprises (SMEs) to acquire a basic level of digital skills. This paper focuses on the assessment of the use of specific digital technologies, the scope and objectives of their implementation, and the attitudes of SMEs in Slovakia towards the competencies and digital competence of their employees. We used publicly available data from the Statistical Office of the Slovak Republic and Eurostat in our research, applying common scientific research methodologies. Our findings suggest that SMEs are indeed exploiting the opportunities offered by selected digital technologies, albeit to a limited extent. They place significant emphasis on the skills and digital literacy of their employees; however, they face difficulties in both recruiting and retaining individuals with these competences in their organizations.

Keywords: small and medium-sized enterprises, digitization, digital transformation

Introduction

The importance of small and medium-sized enterprises (SMEs) in the national economy is indisputable. They are an important part of the national economy and serve as an essential catalyst for the progressive development of countries. This stems from their natural adaptability and ability to respond quickly to different market needs, to adapt to modest orders and to cope with demand fluctuations, as well as other characteristics. In addition, SMEs have a significant impact on employment and are more responsive to changes in economic conditions. In comparison with employees in larger enterprises, where specialization in specific functions is more prevalent, their employees show a higher degree of versatility.

Fundamental changes in their lives are being brought about by advanced computerization and new digital technologies, which are triggers for change and offer the potential to do things with more precision, speed and quality. In addition, the new infrastructure uses mobile technologies, cloud solutions, sensing, 3D printing, artificial intelligence, advanced robotics, biotechnology, nanotechnology, and neurotechnology, among others. They process, evaluate and analyze large volumes of data collected by cyber-physical systems distributed over the Internet. All these technologies provide companies with the opportunity to radically change business models and create new products and services. Advanced digital technologies are taking root in all sectors of the economy and are helping companies to streamline selected business processes, increase productivity and thus their competitiveness. Indeed, the COVID-19 pandemic and mandated anti-epidemic measures have significantly affected the day-to-day running of businesses and highlighted the pitfalls of doing business in a changing economy. It has exposed the gap between digitally equipped businesses and businesses that are yet to adopt digital solutions. By the time the measures were introduced, normal operating practices had to change and consumer behavior also changed overnight. Businesses that could not adapt to the new situation had to close their doors and production stagnated. Those businesses that were able to flexibly adapt their business and operational processes to the new situation were at an advantage.

There are no one-size-fits-all tools to ensure operational efficiency in emergency situations, however, companies that have thrived during pandemics have made extensive use of digital technology to respond appropriately and quickly to change. IT tools tailored to an organisation's operations impact

business performance by improving customer engagement, supply chain efficiency and financial information. One of the fundamental requirements is the availability of real-time information. In fact, flexibility and the ability to innovate are becoming the new criteria for competitiveness, which means identifying the right business solutions that can grow with the enterprise. In the future, it is expected that more and more businesses will take advantage of the opportunities offered by technological advances.

This paper focuses on mapping the use of cloud computing, Internet of Things, artificial intelligence technologies, the extent and purpose of their deployment in small and medium enterprises in Slovakia.

1. Theoretical background

We are living in an era of highly advanced digitalization, which translates into the everyday life of businesses. More broadly, the changes associated with the application of digital technologies are affecting all areas of human society and are changing the way businesses operate. Based on a review of existing literature, Khan (2016) identified six main characteristics of digitalization: interconnectedness, time saving and information reduction, increased transparency and complexity, removal of hierarchy and personal barriers, enabling decision making for all and enhancing integrity, humanizing effect. Through new technologies, new production processes are becoming essential and the management concepts resulting from digitalization ensure a high level of efficiency and optimization of operating costs that would be unattainable with conventional machines. Proven technological and strategic models are becoming less relevant. To maintain production, increase competitiveness and create added value, companies need to take a more flexible approach to business process innovation.

The concept of digital transformation has moved from early definitions focusing mainly on the technical aspects of using digital technologies to radically improve the performance or impact of businesses (Westerman et al., 2011), to being understood as an opportunity for business development, a change in corporate strategy that uses technology as a means to create new business models (Fitzgerald et al., 2013; Singh &Hess, 2017), to incorporating an implementation dimension (IDC, 2019). Digital transformation closes the gap between what digital customers already expect and what analogue businesses deliver (Verdino, 2015).

Digital transformation brings the integration of digital technologies into all areas of business, leading to fundamental changes in the way businesses operate and the value they deliver to customers. Modern corporate data culture and data infrastructure are being transformed and entirely new, previously unused processes are being integrated into the company. This is creating a new socio-technological business model in which the perception of the role and position of IT in the enterprise is fundamentally changing. The way a company organizes itself, motivates, encourages and challenges its employees, invests in training and promotes a workplace culture is also important. Together, these aspects play an important role in successfully implementing change to take advantage of the opportunities provided by new technologies.

We are in the era of smart industry, which is a digital manufacturing system that successfully integrates information systems into manufacturing processes (Ahuett-Garza & Kurfess, 2018). Several authors highlight the application of new digital and exponential technologies (Fragapane et al., 2020; Chiarini, 2021) and consider them as a driving force for the digital transformation of enterprises and the development of smart industry (Krafft et al., 2020).

The digital transformation is also affecting the global economy (Business environment monitoring, 2023). It not only creates enormous opportunities, but also generates new demands and requirements for changes in education, employment, motivating people, evaluating, and rewarding work. Enterprises have started to apply modern technologies, to replace human labor with machines in the production process, to collect information about individual processes through chips and sensors, to process and evaluate the collected data using special software, etc.

On 19 February 2020, the European Commission presented as one of its priorities an agenda for shaping Europe's digital future that embraces digital solutions, puts people first, opens new opportunities for businesses and supports the development of trusted technologies. It declares that if used in a meaningful way, digital technologies will benefit citizens and businesses in many ways over the next five years, focusing on three key digital objectives: technology at the service of people, a fair and competitive economy, and an open, democratic, and sustainable society. The Digital Economy and Society

Index (DESI) measures and assesses EU Member States' progress towards a digital economy and society on an annual basis.

The environment of small and medium-sized enterprises has been undergoing rapid and dynamic changes in recent years due to the intensive development of new modern digital technologies. The aim of our paper was to find out to what extent and for what purposes small and medium-sized enterprises in Slovakia use selected digital technologies: cloud computing, Internet of Things and artificial intelligence technologies and the pitfalls of their implementation. At the same time, we mapped the importance of employee qualifications, digital skills, and the degree of difficulty in finding and retaining qualified employees. As a result of our research, we found that SMEs do take advantage of the opportunities provided by selected digital technologies, but to a limited extent. They consider the skills and digital literacy of employees to be very important but have difficulty finding and retaining them.

2. Methods and methodology

Standard methods of scientific investigation were used in the paper. A content analysis of professional and scientific literature from renowned databases Web of Science, Scopus, official documents issued by European authorities, the Government of the Slovak Republic, Eurostat surveys, data published by the European Commission and the Statistical Office of the Slovak Republic was carried out. Furthermore, the methods of selection, comparison, induction, deduction, synthesis were used.

Statistical functions were used to work with the data. Data related to the use of selected digital technology tools were selected from public databases and the website of the Statistical Office collected by the annual data collection on ICT use in enterprises. In 2021, the sample consisted of 1611 small enterprises out of a total of 11486 small enterprises and 487 medium-sized enterprises out of a total of 2506 medium-sized enterprises. The sample included 128 small and 44 medium-sized enterprises in the ICT sector.

The shares were calculated in relation to the following values: the number of enterprises using cloud computing, IoT and individual AI tools to the total number of enterprises connected to the Internet; the purpose of using cloud computing to the total number of cloud computing users; the purpose of using IoT to the total number of IoT users.

The human resources data were selected and summarized from Eurobarometer 529 conducted in March 2023. 537 respondents from Slovakia participated in the survey, including 150 small enterprises and 83 medium-sized enterprises.

3. Results

Small and medium-sized enterprises (SMEs) are a key element of any national economy and their role in promoting dynamic development in individual countries is indisputable. According to data for 2021 available from the Slovak Statistical Office portal, these entities represent a staggering 99.9% of all business entities in Slovakia. In addition, they employ 74.3% of the active workforce within the corporate economy, contributing to a significant 59.0% of total employment in the economy. Small and medium-sized enterprises are most represented in key sectors such as business services, trade, construction, and industry, at 76.2%. Their significant economic impact is reflected in their share of total value added, which reaches up to 55%.

3.1. Slovakia in the Digital Economy and Society Index

At the outset, we present a table with an overview of Slovakia's DESI ranking and score for 2018-2022. In 2021, the Commission adapted the DESI to reflect two major policy initiatives that will have an impact on digital transformation in the EU in the coming years: the Recovery and Resilience Mechanism and the Digital Decade Compass.

Year	Rank SK	Score SK	Score EU
2022	23	43.4	52.3
2021	22	43.2	50.7
2020	22	45.2	52.0
2019	21	42.9	49.4
2018	20	41.9	46.5

Table 1. Slovakia's performance in DESI 2018-2022 compared to the EU average.

Source: Own processing from the data DESI

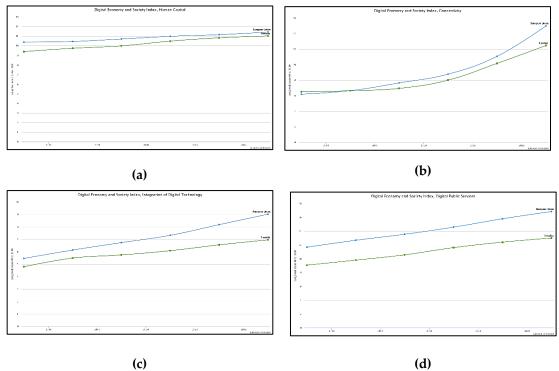


Figure 1. DESI - Compare countries progress; (a) Human capital; (b) Connectivity; (c) Integration of digital technology; (d) Digital public services.

Source: https://digital-decade-desi.digital-strategy.ec.europa.eu/datasets/desi-2022/charts

As can be seen in Figure 1, Slovakia is making progress in all four dimensions, but remains below the EU average. In May 2021, the government approved a strategy and action plan to improve Slovakia's DESI ranking by 2025. The main objective of the strategy is to move Slovakia from the last third of the DESI ranking to the middle of the DESI ranking within five years and thus reach at least the EU average. The strategy declares to support the introduction of innovations also at the level of small and medium-sized enterprises, to promote education on the possibilities of using digital technologies and to build digital skills specifically among entrepreneurs.

3.2. Use of selected digital technologies in SMEs 2021

As per the data from the Slovak Statistical Office's survey on the utilization of information and communication technologies in enterprises in Slovakia, it is apparent that a substantial proportion of employees in both small and medium-sized enterprises have access to the Internet while at work. Specifically, 93.8% of small enterprise employees and 99.2% of medium-sized enterprise employees enjoy this privilege. Among these, 90.4% of small enterprise employees and 95.3% of medium-sized enterprise employees utilize broadband connections. In addition, mobile networks are employed by 71.3% of small enterprise employees and 81.6% of their counterparts in medium-sized enterprises.

Up to 77% of small businesses and 86.7% of medium-sized businesses connected to the internet have their own website, which they use most often for the description of goods or services, price in-

formation. The Possibility for visitors to customize or design online goods or services was the least offered option (9.4% of small and 7.9% of medium-sized enterprises.

Cloud computing service providers were used by 34.7% of small and 47.5% of internet-connected medium-sized enterprises in 2021. The predominant use was for accessing software, storage, and data processing. We see reserves among SMEs in the use of cloud computing in the sharing of information within the enterprise, both around enterprise resource management by sharing information between different functional areas (ERP systems) and customer information management applications (CRM systems). More detailed results are shown in Table 2.

Table 2. Use of cloud computing services

Use of cloud computing services	Small enter- prises [%]	Medium-sized enterprises [%]
E-mail	89.5	82.7
Office software	63.6	65.6
Hosting the enterprise's databases	41.1	31.7
Storage of files	57.8	66.0
Finance or accounting software applications	55.6	44.4
Customer Relationship Management (CRM)	29.5	23.2
Computing power to run software	24.5	23.9
Software applications (ERP)	13.8	17.5
Security software applications (e.g. antivirus program, network access control)	70.4	66.3
computing platform providing a hosted environment for application development, testing or deployment	15.6	19.5
Use of the ERP software package	25.4	49.7
Use of the CRM - the collection, storing and making available information on customers to various business functions	17.1	29.4
Use of the CRM - the analysis of information on customers for marketing purposes	13.1	22.7

Source: Own processing from the data of the statistical survey of the Statistical Office of the Slovak Republic on the use of information and communication technologies in enterprises in Slovakia.

It can be stated that cloud services are mostly used for routine activities that a business cannot do without and were previously handled by locating them on company computers and servers. More demanding applications, such as the use of CRM and ERP systems to share information within the enterprise, are not even reached by 20% of users on average in small enterprises using cloud computing. Slightly better figures are reported by medium-sized enterprises, which use cloud computing services to a higher extent than small enterprises, but their average is also around 34%.

Remotely monitored smart devices and systems capable of collecting and exchanging data with each other via the Internet (IoT) are used by 23.8% of small and 39.4% of medium-sized internet-connected enterprises. The share of their use in each area is shown in Table 3. As can be seen, their use for securing premises is significantly predominant.

Table 3. Use of Internet of Thing

Use of Internet of Things	Small enter- prises [%]	Medium-sized enterprises [%]
Energy consumption management (e.g. smart -meters, -thermostats	29.6	36.1
Premises' security (e.g. smart -alarm systems, -smoke detectors, -door locks, - security cameras)	84.8	88.6
Production processes (e.g. sensors or RFID tags that are used to monitored or automate the process)	14.4	34.2
Logistics management (e.g. sensors for tracking products or vehicles in ware- house management)	27.8	36.1

For condition-based maintenance (e.g. sensors that are to monitored maintenance nance needs of machines or vehicles)	23.2	25.3
Customer service (e.g. smart cameras or sensors to monitored customers' activities)	11.5	15.4
Other purposes	14.0	16.4

Source: Own processing from the data of the statistical survey of the Statistical Office of the Slovak Republic on the use of information and communication technologies in enterprises in Slovakia.

The use of IoT in SMEs is skewed by their use for asset security purposes, which is over 80%. Other uses range from 11.4% to 36.1%. IoT is used for process automation (Production processes, Logistics management) in 21% of SMEs and 35% of medium-sized enterprises.

The uptake of AI technology in internet-connected SMEs is still very low. The most used is the simulation of human conversations using chatbots integrated into a website for marketing and sales purposes. In Table 4 we present the processed data for each AI technology for SMEs using at least one AI technology.

Table 4. Use of Artificial Intelligence technologies

Use of Artificial Intelligence technologies	Small enter- prises [%]	Medium-sized enterprises [%]
Performing analysis of written language	2.2	2.2
Converting spoken language into machine-readable format	0.9	1.5
Generating written or spoken language	0.6	0.6
Identifying objects or persons based on images	1.3	2.8
Machine learning for data analysis	0.7	1.0
Automating different workflows or assisting in decision making	0.8	3.5
Enabling physical movement of machines via autonomous decisions	0.0	1.1
Marketing or sales	41.0	11.6
Production processes	13.4	22.6
Organization of business administration processes	21.1	13.7
Management of enterprises	4.1	5.9
Logistics	2.0	17.5
ICT security	19.0	12.2
Human resources management or recruiting	1.4	0.0

Source: Own processing from the data of the statistical survey of the Statistical Office of the Slovak Republic on the use of information and communication technologies in enterprises in Slovakia.

The most common reasons for not using AI tools are the costs seem too high, lack of relevant expertise in the enterprise, incompatibility with existing equipment, software or systems, difficulties with availability or quality of the necessary data.

According to DESI 2022, 55% of the population in Slovakia has basic and 21% advanced digital skills, but businesses are struggling to recruit quality and digitally skilled employees. How important is it for the business model of your company to have workers with the right skills? Over 80% of small businesses and over 95% of medium-sized businesses consider it very important to moderately important (Figure 2).

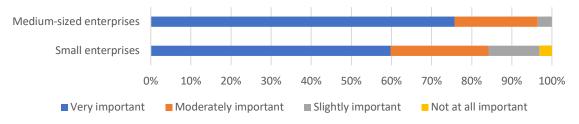


Figure 2. How important is it for the business model of your company to have workers with the right skills?

Source: Own processing Eurobarometer 527

The extent to which digital skills are becoming important for businesses is expressed in Figure 3. The responses show that for 61.3% of small and 72.1% of medium-sized enterprises, employees' digital skills are becoming more important than before.

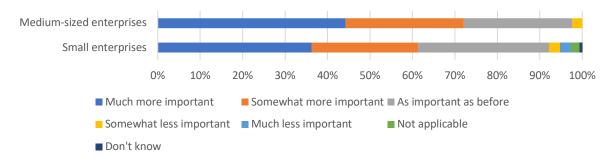


Figure 3. To what extent are the digital skills (e.g. skills required for adopting and/or using digital technologies) becoming more or less important for your company?

Source: Own processing Eurobarometer 527

Finding and retaining skilled staff is proving to be a problem. As many as 68.4% of small and 66.5% of medium-sized enterprises (Figure 4) said that it was very difficult for them to find and 44.4% of small and 33.8% of medium-sized enterprises (Figure 5) said that it was very difficult for them to retain qualified employees.

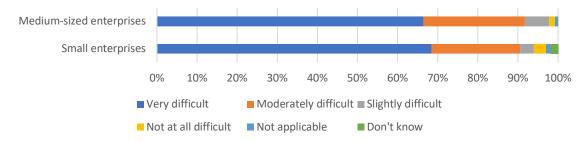


Figure 4. How difficult is it for your company to: Find workers with the right skills?

Source: Own processing Eurobarometer 527

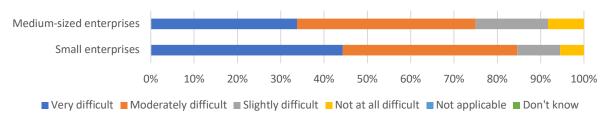


Figure 5. How difficult is it for your company to: Retain skilled workers.

Source: Own processing Eurobarometer 527

The digital economy requires the development of the digital skills of the population. Only qualified and digitally skilled employees are a prerequisite for the successful digitization and digital transformation of businesses. Their absence has a significant impact on the performance and modernization of businesses, and their lack slows down innovation and business growth.

4. Discussion

Even though smart industry is starting to have a very good foundation in Slovakia, even small and medium-sized enterprises have very high connectivity, we are lagging compared to EU member states. The Digital Economy and Society Index (DESI) clearly shows that Slovakia is making progress but remains below the EU average. The importance of the index has increased with the publication of the Union's new Digital Strategy in March 2021, entitled "Digital Compass 2030: A Digital Decade the European Way". To improve the situation, the Slovak government adopted a strategic document "Strategy and Action Plan to improve Slovakia's position in the DESI by 2025" (May 2021) with the aim of bringing Slovakia at least to the EU average in all DESI indicators. Regarding SMEs, it declares their support in introducing innovations, educating them about the possibilities of using digital technologies and building digital skills specifically for entrepreneurs.

SMEs have also started to apply modern technologies, but they lack the knowledge and skills needed to apply digital solutions. Finding and retaining skilled employees is proving to be a challenge. As many as 68.4% of SMEs and 66.5% of medium-sized enterprises said that it was very difficult for them to find and 44.4% of SMEs and 33.8% of medium-sized enterprises found it very difficult to retain skilled employees.

The slow pace of digitalization within enterprises is corroborated by findings from surveys and analyses conducted by the Slovak Business Agency. A prevalent challenge faced by most small and medium-sized enterprises is their unpreparedness and lack of managerial experience in formulating digital business strategies. This challenge is deeply rooted in communication within the organizational system, encompassing both horizontal and vertical dimensions, which must align with the continuous influx of information, necessitating digital systems to devise solutions. Concerning the utilization of CRM and ERP systems for information sharing across the enterprise, small businesses, on average, exhibit a rather low adoption rate, falling below 20% of users. Medium-sized enterprises perform slightly better, with an approximate adoption rate of 34%. Effective management should demonstrate the capability to respond both vertically (involving employees and middle management) and horizontally (involving clients, suppliers, and collaborating companies). The introduction of digitalization necessitates the emergence of integration processes in both these dimensions. Vertical integration entails the interconnection of decision-making processes, the development of digital applications, and data analysis throughout the entire value chain, encompassing procurement, production, and sales. Horizontal integration, on the other hand, involves the linkage of production processes from sourcing materials, energy, and information to customer communication. Notably, digital technologies have infiltrated production processes. Approximately 21% of small businesses and 35% of medium-sized enterprises have adopted remotely monitored intelligent devices and systems capable of collecting and exchanging data via the Internet (IoT) to automate and streamline production and logistics processes.

The uptake of AI technology in internet-connected SMEs is still very low, at 1%-2%. Internet-connected SMEs. In addition to financial aspects, their deployment is hampered by a lack of relevant expertise in the enterprise, incompatibility with existing equipment, software or systems, difficulties with the availability or quality of the necessary data.

Digitalization will require a complete restructuring of processes and corporate organization at almost all levels. This must be accompanied by the definition and adoption of clear qualifications for employees that will be necessary for the successful operation of the company, as well as a business strategy that will adjust the business model and open to new markets abroad. The pace of transformation is hampered by rising inflation, increasing prices of materials, energy, and fuels, as well as uncertainty linked to the war conflict in Ukraine.

The "Action Plan of Digital Transformation of Slovakia for 2023-2026" approved on 14 December 2022, which contains, among other things, 5 measures in building a digital ecosystem, 8 measures serving the digital transformation of enterprises, 12 measures to support the potential of artificial intelligence, should also help. Each of the measures is elaborated in detail with a specific deadline for implementation.

Funding: This research was funded by VEGA No. 1/0662/23 Digital transformation of companies and their readiness to integrate the elements of Industry 5.0 – proportion 100 %.

References

- 1. Ahuett-Garza, H. & Kurfess, T. (2018). A brief discussion on the trends of habilitating technologies for Industry 4.0 and Smart manufacturing. *Manufacturing Letters*, 15, 60–63. doi:10.1016/j.mfglet.2018.02.011
- 2. Chiarini, A. (2021). Industry 4.0 technologies in the manufacturing sector: Are we sure they are all relevant for environmental performance? *Business Strategy and the Environment*. doi:10.1002/bse.2797
- 3. European Commission. (2023a). Flash Eurobarometer FL529: European Year of Skills Skills shortages, recruitment and retention strategies in small and medium-sized enterprises
- 4. European Commission. (2023b). Shaping Europe's digital future. Digital Economy and Society Index (DESI). https://digital-strategy.ec.europa.eu/en/policies/desi
- 5. European Commission. (2023c). Shaping Europe's digital future. Slovakia in the Digital Economy and Society Index. https://digital-strategy.ec.europa.eu/en/policies/desi-slovakia
- 6. European Commission. (2023d). Shaping Europe's digital future. DESI Compare countries progress. https://digital-strategy.ec.europa.eu/en/policies/desi-slovakia
- 7. European Commission. (2023e). Shaping Europe's digital future. Digital Economy and Society Index (until 2022). https://digital-decade-desi.digital-strategy.ec.europa.eu/datasets/desi-2022/charts
- 8. European Commission. (2023f). Europe's Digital Decade: digital targets for 2030 https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_sk
- 9. European Union. (2023). Special Eurobarometer SP532 : The digital decade. https://data.europa.eu/data/datasets/s2959_99_1_sp532_eng?locale=en
- 10. Fitzgerald, B. M., Kruschwitz, N., Bonnet, D. & Welch, M. (2013). Embracing Digital Technology A New Strategic Imperative. https://www.capgemini.com/wp-content/uploads/2017/07/embracing_digital_technology_a_new_strategic_imperative.pdf
- 11. Fragapane, G., Ivanov, D., Peron, M., Sgarbossa, F. & Strandhagen, J. O. (2020). Increasing flexibility and productivity in Industry 4.0 production networks with autonomous mobile robots and smart intralogistics. *Annals of Operations Research*. doi:10.1007/s10479-020-03526-7
- 12. IDC. (2015). Digital Transformation (DX): An Opportunity and an Imperative Benefits. https://www.idc.com/prodserv/decisionscapes/RESOURCES/ATTACHMENTS/IDC_254721_ExecBrief_Digital_Transformation.
- 13. Khan, S. (2016). Leadership in the digital age: A study on the effects of digitalisation on top management leadership. https://su.diva-portal.org/smash/get/diva2:971518/FULLTEXT02.pdf
- 14. Krafft, M., Sajtos, L., & Haenlein, M. (2020). Challenges and Opportunities for Marketing Scholars in Times of the Fourth Industrial Revolution. *Journal of Interactive Marketing*, 51, 1–8. doi:10.1016/j.intmar.2020.06.001
- 15. MIRRI SR. (2022a). Akčný plán digitálnej transformácie Slovenska na roky 2023-2026. https://mirri.gov.sk/sekcie/informatizacia/digitalna-transformacia/akcny-plan-digitalnej-transformacie-slovenska-na-roky-2023-2026/
- MIRRI SR. (2022b.) Národná stratégia digitálnych zručností Slovenskej republiky. https://mirri.gov.sk/sekcie/informatizacia/digitalna-transformacia/narodna-strategia-digitalnych-zrucnosti-slovenskej-republiky/
- 17. MIRRI SR. (2023). Stratégia digitálnej transformácie Slovenska 2030. https://mirri.gov.sk/sekcie/informatizacia/digitalna-transformacia/strategia-digitalnej-transformacie-slovenska-2030/
- 18. Monitoring podnikateľského prostredia. (2023). Digitálne technológie a MSP. https://monitoringmsp.sk/2020/03/26/digitalne-technologie-a-msp/
- 19. PwC. (2016). Industry 4.0: Budovanie digitálneho podniku. https://www.pwc.com/sk/sk/publikacie/assets/2016/ceo-prieskum/industry-4-0-budovanie-digitalneho-podniku.pdf
- 20. Pwc. (2017). The way we work in 2025 and beyond. https://www.pwc.ch/en/publications/2017/the-way-wework-hr-today_pwc-en_2017.pdf
- 21. Singh, A. & Hess, T. (2017). How Chief Digital Officers Promote the Digital Transformation of their Companies. https://pdfs.semanticscholar.org/100e/616568ea2edcc558300 b30d61ebe1fe8ece3.pdf
- 22. Štatistický úrad SR. (2022). Využívanie informačných a komunikačných technológií v podnikoch 2022.
- 23. Štatistický úrad SR. (2023) IKT v podnikoch. https://datacube.statistics.sk/#!/view/sk/VBD_SK_WIN/is1003rs/v_is1003rs_00_00_sk
- 24. Verdino, G. (2015). What is digital transformation, really? https://www.gregverdino.com/digital-transformation-definition/

25. Westerman, G., Calméjane, C., Bonnet, D., Ferraris, P. & McAfee, A. (2011) Digital transformation: a road-map for billion-dollar organizations. https://www.capgemini.com/wp-content/uploads/2017/07/Digital_Transformation__A_Road-Map_for_Billion-Dollar_Organizations.pdf) MIT Center for Digital Business and Capgemini Consulting)

Stratified Landscapes of Waste Management in the European Union: An Empirical Analysis

Peter Štetka ¹ and Nora Grisáková ²

- ¹ University of Economics in Bratislava, Faculty of Business Management, Slovakia; peter.stetka@euba.sk
- ² University of Economics in Bratislava, Faculty of Business Management, Slovakia; nora.grisakova@euba.sk
- * Correspondence: peter.stetka@euba.sk

Abstract: In the context of escalating environmental challenges, the effective management of waste assumes critical importance. This study aims to provide a nuanced understanding of waste management practices across 27 European Union countries by employing a cluster analysis approach. Utilizing a confluence of statistical fit, managerial relevance, and targetability as criteria, a four-segment solution was determined through hierarchical clustering and corroborated by Principal Component Analysis (PCA). The segments were labeled as Eco-Progressive Leaders, Balanced Recyclers, Underperforming Outlier, and Recycling Laggards, each distinguished by their waste management profiles across four key variables: plastic, metallic, paper/cardboard, and wooden packaging. The empirical findings reveal divergent paradigms in waste management among the segments, thereby offering targeted insights for policymakers and industry stakeholders. The study concludes by emphasizing the segments' utility in formulating targeted waste management policies and recommends a multi-dimensional approach for future research to capture additional variances not accounted for in the current study. The analysis serves as a robust platform for harmonizing waste management practices across a diverse European landscape.

Keywords: Waste Management; Cluster Analysis; European Union; Hierarchical Clustering; Principal Component Analysis; Environmental Policy; Recycling; Sustainability; Segment Characterization; Policy Implications

Introduction

Waste management remains a critical challenge for modern societies, especially in the context of sustainable development and environmental conservation. The European Union (EU), with its diverse member states, presents a particularly complex landscape for waste management strategies. Given the EU's commitment to sustainability, evidenced by initiatives like the European Green Deal, there is an exigent need to understand the heterogeneous waste management practices across its member countries. This heterogeneity poses both challenges and opportunities for harmonizing waste management strategies and policy interventions at a supra-national level.

The primary purpose of this empirical research is to stratify waste management practices across 27 European countries into distinct segments based on key variables such as recycling rates of various materials—plastic, metallic, paper/cardboard, and wooden packaging. By employing advanced clustering techniques, this study aims to offer a nuanced understanding of these practices, thereby contributing to the existing literature on waste management in the European Union.

The significance of this work lies in its methodological rigor and its potential policy implications. Utilizing hierarchical clustering and Principal Component Analysis (PCA), the study offers a robust statistical framework to understand the divergence in waste management practices across Europe. The identified segments serve as a useful lens for both policymakers and industry stakeholders, offering actionable insights for targeted interventions. Furthermore, the study adds empirical depth to the theoretical discourse on waste management, serving as a cornerstone for future research in this domain.

The ensuing sections provide a detailed account of the methodology, results, and discussions, followed by policy implications specific to the European Union and concluding remarks. The paper aims to furnish an empirically robust platform for harmonizing waste management practices across the diverse European landscape.

By demystifying the complexities inherent in European waste management practices, this study aspires to contribute meaningfully to both academic and policy-oriented dialogues on sustainable development within the European Union.

1. Theoretical background

This literature review aims to provide an in-depth analysis of waste management across various sectors, including Municipal Solid Waste Management (MSWM), Electronic Waste (E-waste), Textile-Apparel Manufacturing, and Construction and Demolition (C&D) waste. It further delves into the policy implications of waste management within the framework of a circular economy, with a specific focus on the European Union. Drawing upon seminal research studies, the review explores the complexities involved in waste management, emphasizing the need for a multi-faceted approach that integrates technological innovations, policy frameworks, and social awareness. The review also scrutinizes the role of regulatory choices, public perception, economic considerations, and geographical context in shaping effective waste management practices. By synthesizing these diverse perspectives, the review aims to offer valuable insights for policymakers, academics, and industry practitioners, thereby contributing to a more comprehensive understanding of how policy can effectively shape waste management practices and facilitate the transition to a more sustainable and circular economy.

1.1. Waste management in different sectors: An in-depth analysis

Municipal Solid Waste Management (MSWM) has been a focal point of research, particularly in the context of transitioning from a linear to a circular economic model. Zhang et al. (2010). conducted an exhaustive study on the progress of MSWM in China. Their research underscores the necessity for a paradigm shift towards a circular economy, emphasizing the role of digitalization as a catalyst for low-carbon development strategies. Similarly, a comprehensive study by Hafidi et al. (2022) on MSWM in the MENA region advocates for a transition from the traditional linear economy model to a circular economy model. Both studies collectively argue that effective MSWM is contingent upon the integration of innovative technologies and policy frameworks that align with the principles of a circular economy.

The management of electronic waste (E-waste) is another critical area that has garnered attention in literature. Shabuddin et al. (2023) provide an in-depth analysis of global best practices in E-waste management. Their research emphasizes three pivotal components for a sustainable circular economy: policy implementation, technological requirements, and social awareness. The study suggests that the confluence of these elements is essential for the effective management of E-waste, thereby contributing to the broader goals of a circular economy.

The textile and apparel manufacturing sector also presents unique challenges and opportunities in waste management. A seminal study by Akter et al. (2022) focuses on this sector in Bangladesh. The researchers identify various types of material waste across different production stages and estimate an economic loss of approximately 0.70 USD for every piece of apparel export. To mitigate this, they propose a conceptual waste management model grounded in the principles of a circular economy. The study serves as a blueprint for other developing nations with burgeoning textile industries to adopt sustainable waste management practices.

Construction and Demolition (C&D) waste management is another sector that has been the subject of rigorous academic inquiry. A study by Huang et al. (2018) evaluates the effectiveness of C&D waste management policies in key cities in China's Yangtze River Delta region. The research provides scientific-based decision support for local and central governments, advocating for the strengthening of construction waste management policies. The study underscores the importance of policy interventions in achieving effective C&D waste management, particularly as China transitions towards a circular economy.

In summary, waste management in different sectors—ranging from municipal solid waste to electronic waste, textile-apparel manufacturing, and construction and demolition—requires a multi-faceted approach. The literature consistently argues for a paradigm shift towards a circular economy model, emphasizing the role of policy frameworks, technological innovations, and social awareness. These studies collectively contribute to a comprehensive understanding of the complexities involved in waste management across various sectors and provide valuable insights for policymakers, researchers, and practitioners alike.

1.2 Policy implications: A comprehensive examination

One of the most salient aspects of waste management within the circular economy framework is the role of regulatory choices. Alessandro Sarra et al. (2020) delve into this subject matter by examining the organization of solid waste management systems in Italy. Their research posits that the current regulatory framework in Italy could benefit from a more optimized approach to waste services. Specifically, they advocate for limiting the size of service-specific optimal territorial areas (SOTAs) and promoting the growth of service providers. This nuanced approach to regulation could serve as a model for other countries seeking to improve their waste management systems through legislative means.

The role of public perception and awareness in waste management cannot be overstated. P. Adekola et al. (2021) provide an empirical analysis of the implications of waste management on regional greenhouse gas emissions in Benin City, Nigeria. Their study is predicated on the awareness levels and perceptions of urban inhabitants. The research suggests that effective waste management policy should not only focus on technological and infrastructural solutions but also consider the socio-cultural dimensions. Specifically, the study calls for the integration of various aspects of regional government services such as infrastructure, urban planning and development, socioeconomics, public health, and regulation enforcement.

Financial considerations are another critical factor in waste management policy. Wan-Dong Yang et al. (2021) conduct a rigorous cost-benefit analysis of metal recovery from e-waste. Their study proposes an innovative e-waste emissions trading system that sets a cap on the total amount of e-waste that could be generated globally and per country. This approach aims to reduce both e-waste and carbon emissions, thereby aligning with the broader objectives of a circular economy. The study serves as a seminal work in understanding the economic implications of waste management policies and offers a viable solution for policymakers.

The context in which waste management occurs also has significant policy implications. M. Niles (2020) examines the food waste management behaviors of residents in Vermont, a predominantly rural U.S. state. The study finds that waste management strategies in rural regions may require a different approach compared to densely populated areas. It advocates for greater investment in education and infrastructure specifically tailored for backyard composting in rural settings. This research highlights the need for policy frameworks that are adaptable to the unique challenges and opportunities presented by different geographical contexts.

In conclusion, the policy implications of waste management in a circular economy are multi-faceted and complex, requiring a nuanced approach that considers regulatory choices, public perception, economic factors, and geographical context. The literature provides a robust framework for understanding these dimensions, offering valuable insights for policymakers, academics, and industry practitioners. Each of these studies contributes to a more comprehensive understanding of how policy can effectively shape waste management practices, thereby facilitating the transition to a more sustainable and circular economy.

1.3 EU's policy implications: A rigorous examination

Å. Triguero, C. Álvarez-Aledo, and María C. Cuerva (2016) provide a comprehensive analysis of the factors influencing the willingness to accept different waste management policies across 28 European Union countries. Their study evaluates the role of individual and socio-demographic characteristics, contextual variables, and environmental awareness in shaping public opinion on waste management policies. The paper argues that understanding these factors is crucial for implementing proactive and preventive approaches that engage all stakeholder groups, including consumers, firms, and institutions. This research serves as an empirical foundation for policy formulation, emphasizing the need for a nuanced understanding of public perception and demographic variables.

A case study conducted by M. Spišáková, P. Mézároš, and T. Mandičák (2021) focuses on the economic aspects of construction and demolition waste (CDW) management in Slovakia, a member of the European Union. The study confirms the economic benefits of environmentally friendly construction waste management methods, thereby aligning with the EU's environmental priorities. The paper provides valuable insights into the economic parameters that could influence waste management policies, particularly in the construction sector.

J. M. Turner and Leah Nugent (2016) analyze the effectiveness of Extended Producer Responsibility (EPR) policies for single-use batteries in the European Union. Their research highlights the need for EPR policies to consider not just collection rates and recycling efficiencies but also the life cycle consequences of end-of-life management. The paper argues for a more comprehensive approach to EPR policies, which could serve as a model for other waste streams with marginal secondary value, such as textiles and plastics.

The paper by E. Chioatto and P. Sospiro (2022) titled "Transition from waste management to circular economy: the European Union roadmap" suggests a focus on the EU's strategic approach to transitioning from traditional waste management practices to a circular economy model. This paper offers valuable insights into the EU's policy roadmap for waste management within the framework of a circular economy.

The European Union's waste management policies are characterized by a multi-dimensional approach that considers economic, environmental, and social factors. The literature provides a robust framework for understanding the policy implications specific to the EU context, offering valuable insights for policymakers, academics, and industry practitioners. These studies collectively contribute to a comprehensive understanding of how the EU's policy landscape is shaping waste management practices, thereby facilitating the transition to a more sustainable and circular economy.

1.4 Synthesizing conclusion

This literature review has endeavored to provide a comprehensive analysis of waste management across a multitude of sectors, including Municipal Solid Waste Management, Electronic Waste, Textile-Apparel Manufacturing, and Construction and Demolition. The review has also extended its scope to examine the intricate policy implications within the overarching framework of a circular economy, with a particular focus on the European Union. The synthesis of these seminal studies reveals a common thread: the imperative for a multi-faceted approach that harmonizes technological innovations, policy frameworks, and social awareness. Literature consistently advocates for a paradigm shift towards a circular economy, emphasizing the role of policy interventions, public perception, economic considerations, and even geographical contexts.

Moreover, the review underscores the complexity and multi-dimensionality of waste management policies, particularly within the European Union. It highlights the need for nuanced approaches that consider a range of factors, from individual and socio-demographic characteristics to economic parameters and life cycle consequences. These studies collectively contribute to a more comprehensive understanding of the complexities involved in waste management across various sectors and geographical contexts. They offer valuable insights that can inform and guide policymakers, academics, and industry practitioners in shaping effective waste management practices.

In summary, the literature provides a robust framework for understanding the multi-dimensional aspects of waste management, thereby facilitating the transition to a more sustainable and circular economy. The review serves as an invaluable resource for stakeholders across the spectrum, offering a synthesized understanding that could catalyze future research and policy formulation in this critical domain.

2. Methods and methodology

The present section articulates the methodological architecture and specific analytical techniques implemented for the segmentation of waste management practices across 27 European Union countries. The exposition aims to provide a level of detail sufficient to permit the replication of this research and to serve as a basis for further scholarly endeavors.

The dataset used in this study was sourced from Eurostat, the statistical office of the European Union. It offers a comprehensive array of waste management metrics for 27 EU member states, focusing on the most recent year available. The metrics encompass recycling rates of various materials, including plastic packaging, metallic packaging, paper/cardboard packaging, and wooden packaging. The credibility and comprehensiveness of Eurostat data provide a robust empirical foundation for the study.

For the segmentation analysis, the study utilized the Segmentation Module within Enginius software. Enginius specializes in advanced analytical tools that are particularly well-suited for segmentation and clustering tasks.

Hierarchical Clustering was the primary analytical tool employed, using Ward's method as the linkage criterion. This approach minimizes the sum of squared differences within each cluster, facilitating the creation of homogeneous groupings. Ward's method was selected for its ability to produce an interpretable dendrogram that aids in visualizing the clustering process.

To corroborate the robustness of the hierarchical clusters, K-Means Clustering was also executed. This algorithm seeks to partition the data into a pre-specified number of clusters by minimizing the within-cluster sum of squares. The optimal cluster count was further confirmed through scree plot analysis.

The scree plot functioned as a pivotal diagnostic tool for determining the optimal number of clusters. It visually displays within-cluster heterogeneity for each cluster solution, using the sum of squared errors (SSE) as its metric. The point at which the SSE ceases to decline substantially—the "elbow point"—was designated as the indicator for the optimal number of clusters.

Post clustering, a Principal Component Analysis (PCA) was applied to the standardized data to reduce its dimensionality for visual representation. The first two principal components were extracted and plotted, encapsulating 69.0% of the total data variance. This step was crucial for understanding the multidimensional relationships between variables and clusters.

Given the public nature of Eurostat data, the research did not necessitate specific ethical approvals. Nevertheless, all data were managed with the utmost confidentiality and utilized exclusively for academic investigation.

3. Results

The subsequent section elucidates the empirical findings of this research, offering a rigorous, datadriven perspective on waste management practices across 27 European Union member states. Utilizing a multifaceted analytical approach, the study has segmented these nations into four distinct categories, each characterized by a unique profile of waste management metrics. The segments have been aptly renamed to reflect their defining characteristics, thus providing a nuanced lens for policy analysis and managerial decision-making.

The Results section is organized into distinct subsections to facilitate comprehension and scholarly scrutiny. Initially, the determination of the number of segments is discussed, highlighting the statistical, managerial, and targetability considerations that informed the choice of a 4-segment solution. This is followed by a description and analysis of these segments, which includes an examination of their centroids based on key waste management variables.

Moreover, graphical representations such as dendrograms and scree plots are presented to supplement the quantitative analyses. These visual tools serve not only to corroborate the chosen segmentation but also to provide deeper insights into the underlying structure of the data.

By employing a rigorous empirical framework, this section aims to furnish stakeholders with actionable insights while also laying the foundation for the subsequent Discussion and Policy Implications sections.

3.1. The number of segments

The optimal number of segments was determined by a confluence of factors: statistical fit, managerial relevance, and targetability. While these criteria often intersect, they may not always align perfectly, necessitating a judgment call for the selection of the right number of segments. In this study, a 4-segment solution was selected based on statistical criteria, corroborated by a scree plot analysis. The segmentation technique employed was hierarchical clustering, a method known for its utility in generating dendrograms, which were used for further analysis.

The dendrogram serves as a graphical representation of the hierarchical clustering process, illustrating the step-by-step amalgamation of observations into clusters. It is read from the bottom, where all observations are distinct, to the top, where they converge into a singular segment. The height in the dendrogram indicates the Euclidean distance between clusters being merged at each step. Significant leaps in height suggest that two disparate groups are being combined, which may imply that the clustering process should be terminated prior to such a point to maintain homogeneity within clusters.

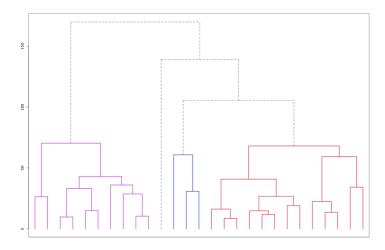


Figure 1. Dendrogram

The scree plot is another critical tool for determining the optimal number of clusters. It represents the within-cluster heterogeneity for each cluster solution. A high value indicates that the observations within the cluster are highly dissimilar, which is generally undesirable. This could occur if the number of clusters is too small to encapsulate the data's inherent variability.

The scree plot employs the sum of squared errors (SSE) as its measurement metric. SSE is calculated as the sum of the squared distance between each observation and its respective cluster centroid, summed over all observations. The "elbow" in the scree plot signifies a point beyond which the addition of more clusters doesn't significantly reduce the within-cluster heterogeneity. In this study, an elbow was observed, affirming the choice of a 4-segment solution.

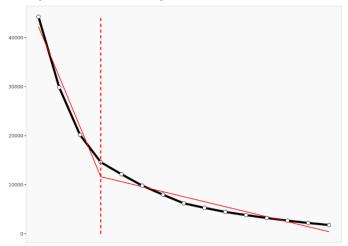


Figure 2. Scree plot

From a statistical perspective, the 4-segment solution was corroborated by both the dendrogram and the scree plot, each offering unique insights into the clustering process. The dendrogram provided a hierarchical view of how observations were grouped into clusters, while the scree plot quantitatively assessed the homogeneity within these clusters. This multifaceted approach lends a robust empirical framework to our understanding of waste management practices across various European countries, aligning closely with the managerial and policy implications discussed in the broader study.

This 4-segment solution not only satisfies statistical rigor but also offers actionable insights for policymakers and practitioners in the field of waste management. Future studies may delve deeper into each segment to understand the nuanced factors contributing to their respective waste management performances.

By employing both the dendrogram and scree plot in conjunction, this study offers a comprehensive, statistically sound analysis that enriches the empirical depth of our understanding of waste management within the European Union.

3.2. Segment description and analysis

The present study undertakes a nuanced stratification of waste management practices across 27 European countries, clustered into four taxonomically distinct segments. These segments—namely, "Eco-Progressive Leaders," "Balanced Recyclers," "Underperforming Outlier," and "Recycling Laggards"—are nomenclatured to encapsulate the inherent characteristics that differentiate them. Each segment is meticulously defined by its centroid, representing the mean values of key waste management variables: plastic packaging, metallic packaging, paper/cardboard packaging, and wooden packaging recycling rates.

This subsection commences by delineating the segmental composition and the typifying variables, subsequently furnishing a graphical interpretation through Principal Component Analysis (PCA). The visual representation, while elucidative, captures only 69.0% of the data's variance and should be interpreted with analytical circumspection.

Through this segmented analysis, we aim to provide empirically robust and actionable insights for policymakers and industry stakeholders, elucidating divergent paradigms in waste management across Europe.

The study encompasses 27 European countries, classified into four distinct segments, each renamed to align more closely with their salient characteristics:

- 1. **Eco-Progressive Leaders (Segment 1)**: 13 countries, constituting 48% of the population.
- 2. **Balanced Recyclers (Segment 2)**: 10 countries, accounting for 37% of the population.
- 3. **Underperforming Outlier (Segment 3)**: 1 country, comprising 4% of the population.
- 4. **Recycling Laggards (Segment 4)**: 3 countries, making up 11% of the population.

Segment Membership:

- Eco-Progressive Leaders (Segment 1): AT, CZ, DE, EE, FI, FR, HU, LI, LT, LU, NO, SE, SI
- Balanced Recyclers (Segment 2): BE, DK, ES, IE, IS, IT, LV, NL, PT, SK
- Underperforming Outlier (Segment 3): CY
- Recycling Laggards (Segment 4): HR, MT, RO

Each segment's centroid is characterized by the average values of each segmentation variable:

- Population Average:
 - Plastic Packaging: 37.1%
 - Metallic Packaging: 77.3%
 - Paper/Cardboard Packaging: 81.7%
 - Wooden Packaging: 40.83%
- Eco-Progressive Leaders (Segment 1, 48% of population):
 - Plastic Packaging: 36.4%
 - Metallic Packaging: 79.3%
 - Paper/Cardboard Packaging: 85.6%
 - Wooden Packaging: 27.18%
- Balanced Recyclers (Segment 2, 37% of population):
 - Plastic Packaging: 40.5%
 - Metallic Packaging: 75.9%
 - Paper/Cardboard Packaging: 80.9%
 - Wooden Packaging: 70.71%

- Underperforming Outlier (Segment 3, 4% of population):
 - Plastic Packaging: 48.6%
 - Metallic Packaging: 72.5%
 - Paper/Cardboard Packaging: 82.9%
 - Wooden Packaging: 20.90%
- Recycling Laggards (Segment 4, 11% of population):
 - Plastic Packaging: 24.8%
 - Metallic Packaging: 41.9%
 - Paper/Cardboard Packaging: 67.1%
 - Wooden Packaging: 6.97%

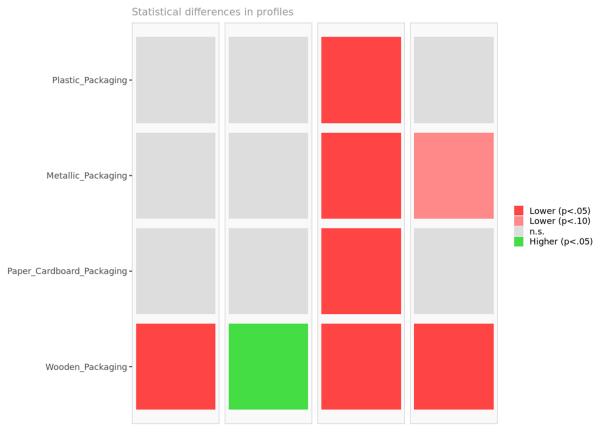


Figure 3. Segment differences per segment

The segments manifest divergent paradigms in waste management:

- **Eco-Progressive Leaders**: These nations generally excel in metallic and paper/cardboard recycling but have room for advancement in wooden packaging.
- **Balanced Recyclers**: This segment comprises nations with a balanced approach to recycling across various waste types.
- Underperforming Outlier: Cyprus (CY), the lone country in this segment, has lower-than-average
 performance in each variable, particularly in wooden packaging recycling, making it an underperforming outlier.
- Recycling Laggards: These countries, including Croatia (HR), Malta (MT), and Romania (RO), are significantly behind in all types of recycling, necessitating urgent and comprehensive policy interventions.

These segments provide a nuanced lens through which to understand waste management practices across Europe. They validate the 4-cluster solution and furnish empirically robust insights for policymakers and industry stakeholders.

The ensuing chart furnishes a visual depiction of the identified segments, their constituent members, and the variables contributing to segmentation. This graphical representation is derived from plotting the initial two dimensions emanating from a Principal Component Analysis (PCA) applied to the standardized segmentation data. Overlay techniques have been employed to superimpose segment-specific details onto this plot.

It is imperative to note that the chart only features the first two dimensions of the PCA, capturing 69.0% of the data variance. Therefore, certain inter-segment distinctions, not captured within these two dimensions, may not be visually discernible in this representation. Variables devoid of variance have been systematically omitted from the analysis.

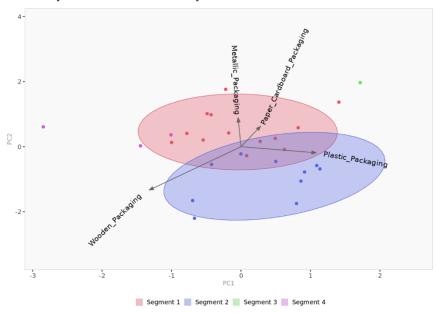


Figure 4. Segment space

While the chart offers valuable insights into variable correlations, it may not be wholly indicative of the optimal number of segments due to its limited dimensionality. Clusters appearing to overlap in this two-dimensional space may well be discrete when other dimensions are considered.

Thus, while this graphical representation serves as an instrumental guide for preliminary analyses, it should be interpreted with caution for tasks requiring more nuanced understanding, such as determining the optimal number of segments.

In summary, the segmented analysis of waste management practices across 27 European countries has yielded a four-cluster framework, each distinctly characterized by its waste management profile. The segments—Eco-Progressive Leaders, Balanced Recyclers, Underperforming Outlier, and Recycling Laggards—serve as a nuanced lens for understanding the heterogeneity in waste management strategies across Europe. These segments are validated through rigorous statistical methods, including hierarchical clustering and Principal Component Analysis (PCA).

However, it is critical to note that the PCA's two-dimensional representation captures only 69.0% of the total variance, indicating that additional dimensions and variables may offer further insights. Thus, while the segments and their graphical representation provide valuable preliminary insights, they should be interpreted cautiously, especially for tasks requiring a more granular understanding, such as the formulation of targeted policy interventions.

This segmented approach not only substantiates the four-cluster solution but also furnishes an empirically robust platform for both policymakers and industry stakeholders. It offers a stratified understanding of the challenges and opportunities that lie ahead in harmonizing waste management practices across a diverse European landscape.

4. Discussion

The current study elevates the discourse on waste management practices by introducing a nuanced, four-segment typology that encapsulates the diversity of practices across 27 European countries. The methodological underpinning of this segmentation is particularly robust, utilizing hierarchical clustering techniques validated through both dendrogram and scree plot analyses. The use of these dual validation techniques lends empirical rigor to the segmental divisions and provides a multifaceted understanding of waste management paradigms.

While the dendrogram offers a hierarchical microcosm of segmental evolution, the scree plot quantitatively gauges the efficacy of these divisions by assessing within-cluster heterogeneity. Both these tools concur on the optimality of a 4-segment solution, thereby reinforcing the validity of the segmentation framework. Furthermore, the Principal Component Analysis (PCA) substantiates these segments by capturing 69.0% of the total variance, although caution is advised in interpretation due to the multi-dimensionality of waste management practices.

The study goes beyond statistical validation to explore the managerial relevance of these segments. The segments—Eco-Progressive Leaders, Balanced Recyclers, Underperforming Outlier, and Recycling Laggards—are not mere statistical artifacts but represent meaningful classifications with distinct waste management profiles. Each segment conveys a unique set of challenges and opportunities for policy intervention, thereby aligning closely with the managerial and policy implications outlined in the broader study.

For instance, the Eco-Progressive Leaders signify countries where waste management is relatively efficient but requires incremental improvements in specific sectors, such as wooden packaging. On the other hand, the Recycling Laggards represent a more critical policy concern, requiring urgent and comprehensive interventions to improve their waste management indices.

Strategic Importance of Segment-Specific Policy Frameworks

The segmentation undertaken in this study holds significant implications for policymakers at the European Union (EU) level. The EU, being a heterogeneous amalgamation of member states with varying economic, social, and environmental contexts, requires a policy framework that is both unified in its objectives but flexible in its implementation. The identification of distinct segments—Eco-Progressive Leaders, Balanced Recyclers, Underperforming Outlier, and Recycling Laggards—provides the EU with an empirically robust basis for crafting targeted waste management policies.

For the Eco-Progressive Leaders, EU policies could focus on incentivizing advancements in less efficient areas, such as wooden packaging recycling. The Balanced Recyclers may benefit from policies that foster best practices across all types of waste, thereby elevating their already balanced performance. For the Underperforming Outlier, a more intensive intervention might be required, possibly involving technical assistance and capacity-building measures. Lastly, the Recycling Laggards segment may necessitate a multipronged policy approach involving regulatory enforcement, financial incentives, and public awareness campaigns to address the stark deficiencies in their waste management practices.

The segment-specific insights derived from this study can synergize with existing EU directives on waste management, such as the Circular Economy Package and the Waste Framework Directive. These existing regulations could be refined to incorporate the nuanced insights provided by this segmentation, thereby making them more responsive to the diverse needs of the member states.

Given the empirical rigor of the segmentation, it may also serve as a basis for monitoring and evaluation within the EU's policy framework. Using the key variables identified in this study—plastic packaging, metallic packaging, paper/cardboard packaging, and wooden packaging—the EU can establish key performance indicators (KPIs) that are aligned with the segmental characteristics. This would enable more accurate tracking of policy impacts and facilitate timely adjustments.

The findings of this study also call for a degree of policy harmonization across the EU. Waste management is intrinsically linked to other policy areas such as industry, agriculture, and transportation. As such, an integrated policy approach that takes into account these inter-sectoral linkages could yield more sustainable outcomes. For example, policies aimed at improving metallic packaging recycling rates could be aligned with industrial policies that incentivize the use of recycled materials.

It is pivotal to underscore that while the PCA offers a useful preliminary visualization of the segments, it captures only a fraction (69.0%) of the total variance. Additional research employing more sophisticated multivariate techniques could unveil other dimensions that this study might not have

encapsulated. This extends an invitation for future research to delve into the intricacies of each segment, perhaps by employing additional variables or through longitudinal analysis to track changes over time.

In essence, this study presents a segmental analysis that is both statistically robust and managerially relevant, offering a granular understanding of the heterogeneous waste management practices across Europe. The four identified segments serve as a strategic foundation for both policymakers and industry stakeholders, offering targeted insights for effective waste management strategies. However, given the limitations inherent in the PCA's two-dimensional representation, these findings should be considered a point of departure rather than an ultimate conclusion. Future research endeavors should aim to build upon this foundational work, exploring other dimensions of waste management practices to provide a more comprehensive understanding.

The segmental analysis elucidated in this study offers a robust empirical foundation upon which the EU can develop, refine, and implement waste management policies. By tailoring these policies to the unique needs and challenges posed by each segment, the EU stands to gain not just in terms of environmental sustainability but also in economic efficiency and social acceptability. Moreover, the study paves the way for an integrated, harmonized policy approach that can potentially elevate waste management standards across the EU while respecting the diversity and complexity of its member states.

5. Conclusions

This study has provided a comprehensive, empirically grounded analysis of waste management practices across 27 European Union member states. Utilizing a multifaceted methodological approach that incorporated hierarchical clustering and Principal Component Analysis (PCA), the study has successfully segmented these countries into four distinct categories: Eco-Progressive Leaders, Balanced Recyclers, Underperforming Outlier, and Recycling Laggards. Each of these segments has been rigorously characterized by its waste management profile, involving key variables such as plastic, metallic, paper/cardboard, and wooden packaging recycling rates.

The study's findings hold substantial theoretical implications by offering a nuanced understanding of waste management heterogeneity within the European context. Moreover, the empirically validated segments provide a robust framework for targeted policy interventions. From a practical standpoint, the findings serve as a strategic guide for policymakers, regulatory bodies, and industry stakeholders by identifying areas of priority and potential avenues for improvement within each segment.

While the study has made significant strides in understanding waste management practices across the EU, it is not without limitations. Notably, the two-dimensional PCA accounted for 69.0% of the total variance, suggesting that additional dimensions could offer further nuanced insights. Future research should aim to explore these dimensions and possibly integrate qualitative data for a more comprehensive understanding.

The study's findings hold profound implications for the development and refinement of EU waste management policies. By recognizing the unique needs and challenges of each segment, policymakers are better positioned to craft targeted and effective interventions. The study thereby contributes to the broader discourse on sustainable development and environmental management at both the national and supranational levels.

In conclusion, the study has fulfilled its aim of providing an empirically robust, nuanced lens through which to understand the complexities of waste management practices across the European Union. It has not only substantiated the four-cluster solution through rigorous statistical methods but also furnished actionable insights for various stakeholders involved in waste management. The findings offer a robust platform for harmonizing waste management practices across a diverse European land-scape, thereby contributing to the attainment of broader sustainability goals.

This concludes the analytical journey undertaken in this study, serving as a cornerstone for future research and policy interventions in the domain of European waste management.

Funding: This research was funded by VEGA, grant number 1/0462/23, entitled "Circular economy in the context of social requirements and market constraints", grant share: 100%.

References

- 1. Adekola, P. O., Iyalomhe, F. O., Paczoski, A., Abebe, S. T., Pawłowska, B., Bąk, M., & Cirella, G. T. (2021). Public perception and awareness of waste management from Benin City. *Scientific Reports*, 11(1), Article 1. https://doi.org/10.1038/s41598-020-79688-y
- 2. Hafidi, M., Safwat, H., Achouri, O., El Fels, L., Elagroudy, S., Chaouki, B., Mostapha, A., isl, Hodgkinson, I., & Guo, J. (2022). *Solid Waste Management in the Context of a Circular Economy in the MENA Region*. https://doi.org/10.3390/su14010480
- 3. Huang, B., Wang, X., Kua, H., Geng, Y., Bleischwitz, R., & Ren, J. (2018). Construction and demolition waste management in China through the 3R principle. *Resources, Conservation and Recycling*, 129, 36–44. https://doi.org/10.1016/j.resconrec.2017.09.029
- 4. Chioatto, E., & Sospiro, P. (2023). Transition from waste management to circular economy: The European Union roadmap. *Environment, Development and Sustainability*, 25(1), 249–276. https://doi.org/10.1007/s10668-021-02050-3
- Khairul Akter, M. Md., Haq, U. N., Islam, Md. M., & Uddin, M. A. (2022). Textile-apparel manufacturing and material waste management in the circular economy: A conceptual model to achieve sustainable development goal (SDG) 12 for Bangladesh. *Cleaner Environmental Systems*, 4, 100070. https://doi.org/10.1016/j.cesys.2022.100070
- 6. Niles, M. (2020). Majority of Rural Residents Compost Food Waste: Policy and Waste Management Implications for Rural Regions. *Frontiers in Sustainable Food Systems*, 3, 123. https://doi.org/10.3389/fsufs.2019.00123
- 7. Sarra, A., Mazzocchitti, M., & Nissi, E. (2020). Optimal regulatory choices in the organization of solid waste management systems: Empirical evidence and policy implications. *Environmental Science & Policy*, 114, 436–444. https://doi.org/10.1016/j.envsci.2020.09.004
- 8. Shahabuddin, M., Uddin, M. N., Chowdhury, J. I., Ahmed, S. F., Uddin, M. N., Mofijur, M., & Uddin, M. A. (2023). A review of the recent development, challenges, and opportunities of electronic waste (e-waste). *International Journal of Environmental Science and Technology*, 20(4), 4513–4520. https://doi.org/10.1007/s13762-022-04274-w
- 9. Spišáková, M., Mésároš, P., & Mandičák, T. (2021). Construction Waste Audit in the Framework of Sustainable Waste Management in Construction Projects—Case Study. *Buildings*, 11(2), Article 2. https://doi.org/10.3390/buildings11020061
- 10. Triguero, A., Álvarez-Aledo, C., & Cuerva, M. C. (2016). Factors influencing willingness to accept different waste management policies: Empirical evidence from the European Union. *Journal of Cleaner Production*, 138, 38–46. https://doi.org/10.1016/j.jclepro.2016.05.119
- 11. Turner, J. M., & Nugent, L. M. (2016). Charging up Battery Recycling Policies: Extended Producer Responsibility for Single-Use Batteries in the European Union, Canada, and the United States. *Journal of Industrial Ecology*, 20(5), 1148–1158. https://doi.org/10.1111/jiec.12351
- 12. Yang, W.-D., Sun, Q., & Ni, H.-G. (2021). Cost-benefit analysis of metal recovery from e-waste: Implications for international policy. *Waste Management*, 123, 42–47. https://doi.org/10.1016/j.wasman.2021.01.023
- 13. Zhang, D. Q., Tan, S. K., & Gersberg, R. M. (2010). Municipal solid waste management in China: Status, problems and challenges. *Journal of Environmental Management*, 91(8), 1623–1633. https://doi.org/10.1016/j.jenvman.2010.03.012

The position of the Slovak printing industry in the Industry 4.0

Monika Soľavová 1, Vladimír Bolek 2,*

- Department of Information Management, Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia; monika.solavova@euba.sk
- ² Department of Information Management, Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia; vladimir.bolek@euba.sk
- * Correspondence: vladimir.bolek@euba.sk

Abstract:

The printing industry is a branch of manufacturing that reproduces and prints patterns and gives them the final shape of the product. It is characterised as a more or less non-repetitive custom production and is now part of the communication sector, which also includes other media (cross media), including electronic media. Printing still fulfils the tasks of raising the level of society in terms of culture, information and education and generally facilitates the economic growth of society and is used by all sectors of the economy. The aim of this paper is to highlight the status of the printing industry, identify the impact of the COVID-19 corona crisis on the printing industry in Slovakia. The paper identifies 24 significant impacts of the coronary crisis on the Slovak economy and also highlights which of these impacts also affect the printing industry.

Keywords: printing industry; Industry 4.0; information technology, corona crisis, COVID-19, impact

Introduction

The printing industry is one of the smaller industries in Slovakia in terms of production volume. Although it is not one of the giant industries that influence the economy of countries, nor does it decisively affect GDP, it is important to realise that printing is present in all sectors and accompanies products from the supply chain to the end consumer. It also plays an important role in preserving cultural heritage and promoting literacy and education, and is used by all sectors of the national economy.

The penetration of information technology into everyday life is bringing about changes in society. Information that we used to obtain mainly in print is now also available digitally. Automation, digitisation, big data, the Internet of Things, the development of biodegradable materials, the introduction of information and communication technologies and the geometric growth in the spread of information over time have made it necessary for the printing industry to create an environment capable of recognising and adapting to the needs of the user. Another necessity is the adaptation of the staff structure and the alignment of the educational process with the current needs of the labour market.

The Research and Development Centre for the Printing Industry, which in the past dealt with trends and changes in the industry and their impact on the printing industry, closed down in 1990. Consequently, for several decades there has been a distinct absence of an organisation dedicated to research and development of the printing industry in the context of the ongoing economic changes in the world, in Europe and in Slovakia. However, this does not mean that the printing industry is abandoned. There is the Association of the Printing Industry in Slovakia, which is a voluntary association of independent legal entities operating in the printing and related industries. Members of the Union are printers operating in the Slovak Republic, major suppliers of equipment, software and materials for the printing industry, schools with a focus on printing as well as individual members. In the structure of the social partnership dialogue, it defends the interests of employers, both towards the central government and authorities and towards the employees' representatives, represented by the higher trade union (SOZ PP).

This article provides an overview of the evolution of the average monthly wage, labour productivity, profitability between 2009 (just after the financial crisis of 2008) and 2020 (the beginning of the pandemic crisis, which was followed by the material and energy crisis in a short time sequence) according to official data of the Statistical Office of the Slovak Republic in the Eurostat methodology. The aim of the scientific article is to identify the impact of the global pandemic COVID-19 on the printing industry.

1. Theoretical background

The printing industry is referred to as a manufacturing industry and is mostly printing companies that use various types of printing techniques - offset printing, screen printing, gravure printing, overhead printing, digital printing, pad printing, etc... The products of the printing industry provide communication with, inform and educate the end consumer. At the same time, they provide presentation, protection and added value to the products of other industries. They create positive feelings for consumers, i.e. they increase psychological comfort (e.g. printing of utility items, textiles, reproductions of works of art, etc.).

The ongoing industrial revolution Industry 4.0 and the emerging Industry 5.0 are also pushing the printing industry, as well as all industries, towards new possibilities. Industry 4.0 is seen as a revolution in manufacturing, integrating production processes with new technologies to achieve maximum output with minimum resource consumption. It has promoted higher productivity in enterprises by integrating new technologies and digitizing them. Its advent has stimulated scientific and technological progress, giving rise to new, innovative information and communication technologies (ICTs) that build the intelligence of society's environment. In the printing industry, topics such as print on demand, printed electronics, web to print, green packaging, value-added printing and others are being discussed.

The classical way of printing publications involves a greater number of operations in the preparatory phase of technological processing. Simplicity in the technological process of preparing publications through Print on Demand has been supported by the digitisation and archiving of created files, digital printing and operational response to market demands. Soft bound publications are processed using this technology. The advantage is that publishing houses are able to place even first-time authors on the market in this way. Then, after a successful pilot project, the project is commissioned for commercial offset printing. Another advantage is the reduction of storage and packaging requirements, as only the required number of books is produced (Šíp, 2015).

Inkjet printing is based on the formation of small droplets of liquid to transfer precise amounts of material onto a substrate under digital control. It has become relatively mature and is of great industrial interest due to its flexibility for graphic printing and its potential use in less conventional applications such as additive manufacturing (AM), commonly referred to as 3D printing, the production of printed electronics and other functional devices. Its advantages over conventional printing processes are numerous. For example, it produces little or no waste, is versatile due to the variety of processes, is noncontact and does not require a master template, meaning that print patterns can be easily changed (Villalba-Diez et al., 2019).

The COVID-19 pandemic caused by coronavirus has spread to more than 180 countries, leading to an overload of different healthcare systems worldwide. Due to the high number of patients and the disruption in the supply chain, this has caused a shortage of medical devices and personal protective equipment. In this context, additive manufacturing (3D printing) has emerged as one remarkable manufacturing process, due to its accessibility and flexibility in the rapid production of complex and monolithic parts or even mechanical systems (Longhitano et al., 2021).

The Covid-19 pandemic has also had a negative impact on the printing industry. The largest investment in media flows through advertisers, who are now moving from print media (e.g. newspapers, magazines) to digital media (e.g. television, internet). The crisis has been the cause of a decline in advertisers' business turnover, resulting in reduced advertising budgets on different media platforms. The decline in advertising revenues is also due to the development of digital media. Advertising seeks to inform, persuade and convince. In other words, advertising is the most effective means of communication to disseminate the advertiser's information, products, services and ideas to the audience. However, print media is still interesting because published data can still be stored and reused if necessary. It is believed that print media are better able to avoid inappropriate data and present messages more accurately (Bara et al., 2021).

2. Methods and methodology

The theoretical background of the scientific article is based on a detailed analysis of domestic and foreign literature, comparing the definitions of several authors. It identifies the position of the printing industry in Slovakia. It assesses the impact of the COVID-19 pandemic and the corona crisis on the Slovak economy and economy.

Based on a detailed analysis of scientific and professional sources and the current state of knowledge, it identifies the impacts of the pandemic on the national economy and the printing industry. Identifies 24 significant impacts of this pandemic on the Slovak economy and looks for links and impact on the printing industry:

- closure of borders,
- closure of schools,
- closure of establishments in the accommodation and catering, other services and trade sectors,
- logistical problems,
- introduction of home office or clerical work,
- hospital closures,
- increased sick leave of employees,
- increased parental sick leave,
- loss of jobs,
- increase in energy prices,
- reduced availability of energy,
- reduction in customer demand,
- lack of raw material inputs,
- reduction in production,
- closure of small firms,
- shortage of medicines and medical equipment,
- shift of purchasing to online environment,
- fuel shortages,
- increased production of single-use plastics,
- excessive pricing,
- disinvestment in renewables,
- increased demand for packaging,
- increase in unemployment,
- weakening of the economy,
- insolvency of companies.

The scientific article works with secondary statistical data. The data were obtained from the Slovak Statistical Office and the Association of Printing in Slovakia. The position of the printing industry is also assessed through economic indicators such as average wage, labour productivity on sales, labour productivity on value added, profitability on own sales. The individual indicators were monitored for a basic breakdown of printing products by NACE category:

- NACE 1811 means printed newspapers, magazines and periodicals published at least four times a week (newspapers),
- NACE 1812 is printed newspapers, magazines and periodicals published less than four times a week, printed books, brochures and pamphlets, printed maps, labels and price lists,
- NACE 1813+1814 is typesetting and prepress services, finishing (post press).

3. Results

At the last professional printing conference Print Progress there was a speech of the President of the Association of Printing in Slovakia (Blubla, 2022) entitled "When today we do not know what will happen tomorrow". The title is symptomatic of the current times. It is impossible to know what

tomorrow will bring, but based on statistical data and analyses it is possible to follow the development and trend. The results and graphical representations presented are based on official data from the Statistical Office of the Slovak Republic, using Eurostat methodology, and focus on the period between 2009 (just after the 2008 financial crisis) and 2020 (the beginning of the pandemic crisis, with which the material and energy crises followed in short succession).

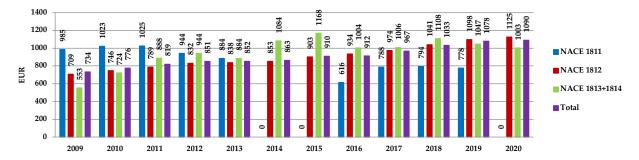


Figure 1. Average wage by NACE category

Source: processing by Association of Printing in Slovakia

Note: where zero is reported, this is a so-called confidential figure, i.e. the data are reported for three or fewer organisations.

In Figure 1 in years 2019 and 2020, year-on-year wage growth is moderating. The highest average monthly wage achieved was in 2020 and was €1,125 in the largest NACE 1812 manufacturing segment.

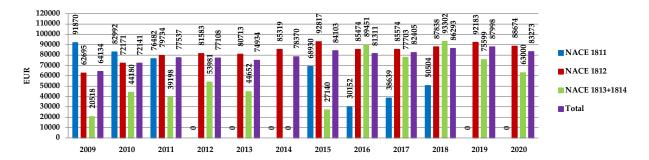


Figure 2. Labour productivity from sales by NACE category

Source: processing by Association of Printing in Slovakia

Note: where zero is reported, this is a so-called confidential figure, i.e. the data are reported for three or fewer organisations.

Labour productivity from sales (Figure 2) is also highest at NACE 1812, and has been on an upward trend until 2019. In 2020, a decline of 3.8% is recorded as a result of the emerging pandemic crisis. A significant decline in 2020 is recorded in labour productivity from sales at NACE 1813+1814 by 16.7%.

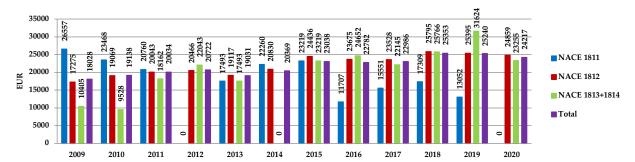


Figure 3. Labour productivity from value added by NACE category

Source: processing by Association of Printing in Slovakia

Note: Where zero is reported, this is a 'confidential figure', that is, data are reported for three or fewer organisations.

The highest labour productivity from value added (Figure 3) is achieved at NACE 1813+1814 in 2019. A decline of 26.5% is observed in 2020 as a result of the emerging pandemic crisis.

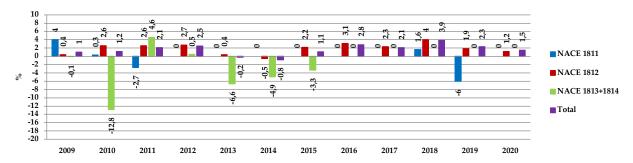


Figure 4. Profitability from own sales/revenue by NACE category

Source: processing by Association of Printing in Slovakia

Note: where zero is reported, this is a so-called confidential figure, i.e. the data are reported for three or fewer organisations.

Based on the statistical data obtained, the highest profitability is achieved by products classified in NACE group 1812, but here too there is a visible decrease in profitability on own sales from 2018. In 2020, a decrease of 36.8% compared to 2019 has been recorded.

The assessment carried out concerns the entities of the printing industry in Slovakia. The most important printing enterprises in Slovakia are:

- NEOGRAFIA, a.s., Martin production of non-periodical printed matter, books with high added value, production of magazines, catalogues and cardboard packaging. Provides a complete production cycle from the preparation of printing, through the printing itself to the finishing book processing and shipping. Approximately 70% of the production is oriented for export to developed foreign markets. According to FinStat, NEOGRAFIA, a.s. is on track to turn a profit in 2022, up to €138,871 from €220,254 in 2021, and its revenues are up 26% to €46.18 million. Total debt is at 41.03% and gross margin is at 21.33%. The company is ranked between 250-499 employees in terms of headcount.
- Slovenská Grafia, a.s., Bratislava production of periodical publications, mainly magazines with added value through various post-process refinements. It is a producer of quality children's magazines. A significant part of production is also corporate catalogues. It is the only printer in Central Europe with a certificate for printing materials from the Danish LEGO company. According to FinStat, Slovenská Grafia a.s. reduced its profit by 94% to €145,004 in 2022 and its sales increased by 20% to €91.87 million. Total debt is at 47.08% and gross margin is at 18.99%. The company is ranked between 250-499 employees in terms of headcount.
- TBB, a. s., Banská Bystrica excellent production of non-periodical publications books with exceptional added value and exclusive limited collector's books, which are regularly ranked at the top positions in competitions The Most Beautiful Books of Slovakia and The Golden Seal, at international book exhibitions in Bologna, Italy, or at the International Book Exhibition in Frankfurt am Main, Germany. According to FinStat, TBB, a. s. reduced its profit by 36% to €562,735 in 2022, and its sales grew by 23% to €31.07 million. Total debt is at 54.16% and gross margin is at 32.10%. The company is ranked between 250-499 employees in terms of headcount.
- Petit Press, a.s., Bratislava the only printing house in Slovakia oriented to the production of periodical publications - newspapers with nationwide coverage and with the possibility of inserting supplements and leaflets. They are also a producer of several regional periodicals.

According to FinStat, Petit Press, a.s. profit decreased by 45% to €872,303 in 2022 and its revenue increased by 8% to €24.04 million. Total debt is at 55.21% and gross margin is at 37.55%. The company is ranked between 250-499 employees in terms of headcount.

- Kasico, a.s., Bratislava production of valuables (postage stamps, passports, gift vouchers, diplomas, certificates, indexes, certificates, certificates, holograms, passes, tickets and other valuables), other printing products such as posters, leaflets, books, calendars, etc. According to FinStat, company KASICO, a. s. went into loss in 2022 from € 6,819 in 2021 to € -226,798 and its sales increased by 17 % to € 3,921 million. Total debt is at 60.64% and gross margin is at 28.18%. The company is classified in the number of employees between 50-99 employees.
- Cofin, a.s. Ľubotice production of lenticular printing (Lenticular graphics is a special technology of graphics finishing and UV printing that allows to create an impression of depth or movement.) According to FinStat, Cofin, a.s. reduced its profit by 97% to €3,164 in 2022, and its sales increased by 3% to €1.102 million. Total debt is at 65.66% and gross margin is at 40.77%. The company is ranked between 10-19 employees in terms of headcount.
- PURGINA, s.r.o., Bratislava production of wine and alcohol labels, graphic labels for food and cosmetics, pharmaceutical labels, durables and thermo labels. According to FinStat, PURGINA spol. s r.o. reduced its loss by 11% to € -314,940 in 2022 and its sales increased by 10% to € 6.579 million. Total debt is at 88.29% and gross margin is at 26.57%. The company is classified in the number of employees between 25-49 employees.
- OBALOTAVA, a.s., Slovenská Ľupča production and manufacture of packaging made of smooth and corrugated cardboard and for the development and production of board games. According to FinStat, OBALOTAVA a.s. increased its profit by 123% to €192,299 in 2022 and its sales increased by 31% to €4.070 million. Total debt is at 60.90% and gross margin is at 33.39%. The company is classified in the number of employees between 25-49 employees.
- CHEMOSVIT FÓLIE, s.r.o., Svit production, refining and sale of packaging films food, non-food, carrier bags, bags. According to FinStat, CHEMOSVIT FÓLIE, s.r.o. went from a profit of € -1.710 million to € 120,883 in 2022 and its sales grew by 18% to € 105.8 million. Total debt is at 68.88% and gross margin is at 20.40%. The company is ranked between 500-999 employees in terms of headcount.

The measures taken to contain the spread of the COVID-19 pandemic have negatively affected the entire economy, consumption has been curtailed and there has been an overall slowdown in the economy. The consequence was a growing number of insolvencies, bankruptcies as well as an increasing number of unemployed. National governments, including Slovakia, responded by adopting new laws to provide protection not only for entrepreneurs but also for citizens. The European Union has put in place measures and the necessary steps to ensure the recovery of the economy after the negative impact of the pandemic (Krásna, 2021).

In Slovakia, the impact of the COVID-19 crisis and anti-pandemic measures has been felt in employment and wages. Economic activity of business entities in most sectors has slowed down to a halt. As a result of the forced reduction in business activity and the decline in consumer demand, many employers were exposed to cost-cutting pressures and redundancies. According to the National Bank of Slovakia, the pandemic has caused losses in the labour market more on the income side than in the number of jobs. This was mainly due to a fall in the number of hours worked. The majority of jobs have been maintained thanks to the fiscal measures taken. At the same time, however, there has been a shift of people into inactivity and a reduction in cross-border mobility has led to a decline in the number of foreign workers. The performance of the Slovak economy has fallen significantly and employment has declined. According to a survey by the National Business Centre, up to 95% of small and medium-sized enterprises in sectors primarily affected by the government's measures are feeling the negative impact of the pandemic measures (Štalmachová & Strenitzerová, 2021; NPC, 2020; SBA, 2020; NBS, 2020). Table 1 lists some of the impacts of the COVID-19 crisis on the Slovak economy and the printing industry.

Table 1: Impact of the COVID-19 crisis

Impact of the COVID-19 crisis	SR	Printing industry
Closure of borders	X	Χ

Closure of schools	Х	
Closure of establishments in the accommodation and cater-	Х	
ing, other services and trade sectors	^	
Logistical problems	Х	Χ
Introduction of home office or clerical work	Х	Χ
Hospital closures	Х	
Increased sick leave of employees	Х	Х
Increased parental sick leave	X	Χ
Loss of jobs	Х	Χ
Increase in energy prices	Х	X
Reduced availability of energy	Х	X
Reduction in customer demand	Х	Χ
Lack of raw material inputs	X	Χ
Reduction in production	Х	Χ
Closure of small firms	X	Χ
Shortage of medicines and medical equipment	Х	*
Shift of purchasing to online environment	X	Χ
Fuel shortages	Х	X
Increased production of single-use plastics	Х	*
Excessive pricing	Х	X
Disinvestment in renewables	Х	X
Increased demand for packaging		*
Increase in unemployment	Х	
Weakening of the economy	Х	X
Insolvency of companies	Х	X

Source: own processing

Note: * the above impacts have not had a negative impact on the printing industry; on the contrary, they represent new opportunities.

The table 1 lists 25 impacts of the COVID-19 crisis, of which 24 had a significant impact on the Slovak economy. For the printing industry, 3 impacts did not have a direct impact on the sector: school closures, closures in the accommodation and catering sector, other services and trade, and hospital closures. The former has an indirect impact, which is mainly reflected in the impact of increased parental sick leave. The latter may have caused problems in the provision of catering for employees, but had no direct impact on the printing industry. The third impact had no impact on the printing industry. The table identified 3 impacts that did not have a negative impact on the printing industry but are new opportunities for the industry. These impacts are the shortage of medicines and medical equipment. During the COVIDS-19 crisis, there was a rapid increase in the consumption of personal protective equipment such as face shields, face masks, mask making tapes, etc. Here, additive printing (3D printing), which is similar to inkjet printing technology (layering of material and self), affordable and inexpensive, has emerged as a viable alternative for their production. It is also an environmentally friendly technology. It is waste-free and odourless. This technology has also proved to be applicable in the second impact, which we see as an opportunity for the printing industry. This is the impact of increased production of single-use plastics (e.g. sampling sticks, face masks, etc.). The third impact identified as an opportunity for the printing industry is increased demand for packaging. As a result of the population shift to the online zone, the demand for packaging has increased. In addition to providing product protection in transit, packaging has often been in the position of securing the sale of goods. Packaging also had utilitarian value (usable for other purposes) and aesthetic value (packaging sells). These are all qualities that apply to packaging in general, but during the COVID-19 crisis, these qualities took on greater importance.

Nowadays, the emerging Industry 5.0 is becoming an increasingly important topic and is gaining high attention and position in addressing the advancing challenges. In simple terms, it is a call to put sustainable development into practice by integrating human values and advanced technologies.

Compared to Industry 4.0, Industry 5.0 focuses more on the development of a sustainable, human centred and resilient business environment. Its advanced technologies can contribute to optimising supply chains that have been significantly disrupted by the COVID-19 pandemic, furthermore, they can achieve more sustainable production methods, reduce waste, improve connectivity and facilitate visibility (Karmaker et al., 2023).

In the article "The impact of innovative information technologies and systems on the achievement of financial and process effects of the enterprise" the authors present the results of research aimed at achieving financial and process benefits of the integration of innovative ICT and systems into the company. The research results declare that ubiquitous innovative technologies and IS can help companies to succeed in competition, simplify their work and effectively exploit the opportunities offered, as well as identify potential threats. The research also showed that there are statistically significant differences between companies in achieving individual financial and process benefits, depending on the size of the company. The highest levels were achieved by larger large and medium-sized companies. They also accept the result that in manufacturing companies, the integration of ubiquitous technologies into processes, digitalization and automation streamline production activities, better evaluate data, and improve business and corporate management processes. In non-manufacturing enterprises, it is about streamlining service delivery. In general, it can therefore be assessed that ICT has a positive impact on the performance of companies. Equally positive findings have been observed in small and micro enterprises, with a reduction in response time to customer requests (Bolek & Zelina, 2021). The results of this research are applicable to all areas of the economy, where the printing industry is also included. Of course, the companies in this sector are represented from small enterprises to large companies. Based on current trends, it can be assumed that their efficiency and performance are affected by the ubiquitous ICT, which is reflected in every department of manufacturing companies. We can only assume to what extent this will affect individual jobs. We are also dealing with the concepts of data collection and analysis, the Internet of Things, digital production, digitalisation, virtualisation, etc. The introduction of these technologies into manufacturing companies is called ambient business intelligence (Bolek & Romanová, 2020).

4. Discussion

The industrial sectors in Slovakia as well as worldwide are influenced by the changes brought by successive or overlapping crises and the challenges brought by the new industrial revolution Industry 5.0.

The printing industry faced several challenges and constraints as a result of the crisis. The COVID-19 pandemic crisis resulted in the imposition of quarantine measures and plant closures, which led to production curtailments, delays in order fulfilment, and loss of revenue. Customers (advertising agencies, publishers and corporations) reduced their orders or stopped them altogether. In view of the measures in place, customer preferences have also changed and customers have moved online. Logistical problems have arisen in the import of raw materials and the export of printing products. Manufacturing companies faced reduced demand, increased costs for basic raw materials such as paper, inks, printing plates. Their production due to high energy prices is reflected in the price of raw materials. The limited availability of energy is causing a slowdown or even a shutdown of printing production as older technologies are energy intensive. This leads to the need to invest in new technologies with a lower energy burden, increased productivity and production efficiency. In addition to the effects caused by the ongoing crises, the printing industry is facing labour shortages. This is mainly due to the retirement of the 'strong' classes and the reduced interest in manual work on the part of the younger generation, despite the fact that manual work can no longer be spoken of to the same extent as 20 years ago.

5. Conclusions

The printing industry, like all other industries, is undergoing fundamental changes in all aspects of the current economic environment, which have been affected by successive crises. The COVID-19 pandemic has been replaced by the war in Ukraine and the struggle with high energy prices. Companies have struggled to respond to the situations that have arisen and to changes in customer behaviour that are initiating changes in the adoption of innovative technologies. During the COVID-19 crisis, the

human factor proved to be the weakest link and, in times of reduced energy availability, outdated technologies set up for high energy consumption proved to be also the problem. Thus, companies are trying to renew technologies, invest in new, more efficient technologies with high flexibility, low energy operation, introduce software solutions to streamline processes. The best and fastest way to overcome crises seems to be investing in innovative technologies and technologies that increase production efficiency or replace the weakest links in the production process. The COVID-19 crisis has highlighted some new opportunities for the printing industry - e.g. in additive printing (3D printing) and packaging printing.

The Industry 5.0 concept aims to improve the sustainability and resilience of every industry and to focus on the needs of people. It focuses on the relationship between people and technology, incorporating aspects of environmental impact, improving employee productivity and morale, enhancing product quality, resource efficiency and creating jobs with increased value. It is the new jobs that will require employees with knowledge of digital and innovative technologies, capable of changing mindsets.

Funding:

The paper was elaborated within VEGA No. 1/0662/23 Digital transformation of companies and their readiness to integrate the elements of Industry 5.0 – proportion 100 %.

References

- 1. Bara, A., Affandi, F., Farid, A. S., & Marzuki, D. I. (2021). The Effectiveness of Advertising Marketing in Print Media during the Covid 19 Pandemic in the Mandailing Natal Region. *Budapest International Research and Critics Institute-Journal (BIRCI-Journal)*, 4(1), 879-886.
- 2. Blubla, P. (2022). Keď dnes nevieme, čo bude zajtra. PritProgress, 2022(04). 14-19.
- 3. Bolek, V. & Romanová, A. (2020). Predictors of ambient intelligence: an empirical study in enterprises in Slovakia. *Electronics*, 9(10), 1655. https://doi.org/10.3390/electronics9101655
- 4. Bolek, V. & Zelina, M. (2021). Impact of Innovative Information Technologies and Systems on Achieving Financial and Process Effects of a Company. *IBIMA Business Review*, 2021(2021), https://doi.org/10.5171/2021.422543.
- Karmaker, C. L., Bari, A. M., Anam, M. Z., Ahmed, T., Ali, S. M., de Jesus Pacheco, D. A., & Moktadir, M. A. (2023). Industry 5.0 challenges for post-pandemic supply chain sustainability in an emerging economy. *International Journal of Production Economics*, 258, 108806. https://doi.org/10.1016/j.ijpe.2023.108806
- 6. Krásna, D. (2021). Ekonomické dopady súčasnej globálnej pandémie COVID-19 so zreteľom na ekonomiku Slovenskej republiky. *Scientific Journal Public administration and Regional Development*, 17(2), 25-33.
- 7. Longhitano, G. A., Nunes, G. B., Candido, G., & da Silva, J. V. L. (2021). The role of 3D printing during COVID-19 pandemic: a review. *Progress in additive manufacturing*, 6, 19-37.
- 8. Národná banka Slovenska. (2020). Mesačný bulletin NBS. 2020(12). Národná banka Slovenska.
- 9. Národné podnikateľské centrum. (2020). *Výsledky prieskumu názorov podnikateľov na dopady druhej vlny korona-krízy*. Národné podnikateľské centrum, 2020.
- 10. Šíp, R. (2015). Workflow manažmentu polygrafickej výroby v podmienkach print on-demand. *Manažment podnikania a vecí verejných–dialógy*, 29(10), 48.
- 11. Slovak business agency. (2020). Vplyv pandémie COVID-19 na zamestnanosť na Slovensku. Slovak business agency, 2020.
- 12. Štalmachová, K., Strenitzerová, M. (2021). Vplyv pandémie covid-19 na jednotlivé sektory národného hospodárstva vo vzťahu k zamestnanosti. *Pošta, telekomunikácie a elektronický obchod,* 2021. https://doi.org/10.26552/pte.C.2021.1.4
- 13. Villalba-Diez, J., Schmidt, D., Gevers, R., Ordieres-Meré, J., Buchwitz, M., & Wellbrock, W. (2019). Deep learning for industrial computer vision quality control in the printing industry 4.0. *Sensors*, 19(18), 3987. https://doi.org/10.3390/s19183987

Enterprise Social Media

Anna Hamranová 1*, Benita Beláňová 2

- ¹ Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia; anna.hamranova@euba.sk
- ² Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia; benita.belanova@euba.sk
- * Correspondence: Anna Hamranová, anna.hamranova@euba.sk

Abstract: The purpose of our paper is to characterize the concept of Enterprise Social Media (ESM) from the perspective of several authors, to examine selected results of the Eurostat survey on the use of ESM for individual business sectors within the EU and to compare them with selected results of our own survey conducted in companies operating in Slovakia. Standard methods of scientific work were used to process the paper, namely: analysis, synthesis, comparison and selection (to analyze domestic and foreign literature); questionnaire survey in enterprises in Slovakia; statistical methods: descriptive statistics, contingency tables (to evaluate the results of the questionnaire survey in MS Excel); synthesis (to formulate conclusions and recommendations). We consider the main findings to be the fact that the use of social media in Slovakia was the highest rated by companies in the Information and Communication sector. We consider this phenomenon natural, as this sector is a leader in the use of information and communication technologies. Because of this, it is also in this sector that the highest level of dissatisfaction with the quality and use of information obtained in this way occurs. Conversely, a low level of use of social media was observed especially in the Accommodation sector, where the use of social media was rated below average by the Slovak-based enterprises, in contrast to the Eurostat survey, where it was rated one of the highest values. We consider this significant difference to be an important signal to address this issue in more detail and to look for room for improvement in this sector, especially for the sake of promoting tourism in Slovakia, which has a high potential.

Keywords: social media, enterprise social media, economic activity, questionnaire survey

Introduction

Social media and their use, whether in users' private or professional lives, has been emerging in the literature since after 2000 (Wise and Steemers, 2000; Hansen and Hansen, 2004; Lievrouw, 2004; Lister et al., 2008). In this period, social media were referred to as "new media" and, according to Lister et al. (2008), were characterized by the following main features:

- 8. Digitality represents a property of the new medium and its form of storage using bi-narrative code. The data transmitted by the medium is encoded in binary and is thus stripped of its physical form, the transmitted data can be compressed into a minimal space and thus represents easier manipulation.
- 9. Interactivity gives the user the opportunity to interfere in the computational processes and observe the results of this interaction in real time, thus activating his role and moving him from a purely passive user to an active user.
- 10. Hypertextuality this property of new media is associated with the notion of hypertext, representing text that allows the user to proceed non-linearly in reading it based on hypertext links and his own will. The different parts of the hypertext are interconnected and therefore post-forces this possibility.
- 11. Virtuality from the point of view of new, digital media, virtuality is not the opposite of reality, but part of it.
- 12. Dispersion represents the opposite of centralization and from the point of view of the new media therefore the opposite of centralized mass media e.g. in terms of consumption. Mass media are mass media in terms of the number of users, but not in the traditional sense of the word, which primarily includes analogue media. In terms of the production of media texts, they also exist as a counterpart to the traditional mass media, since they narrow the gap between the professional and amateur spheres of media text production. From another point of view of the intersection of

consumption and production, technologies have become available and used by professionals and amateurs alike.

The concept of ESM (Enterprise Social Media) gradually emerged for social media used in the corporate sphere. Several scientific articles have been published that have provided guidance on how enterprises can use social media to build human, social and organizational capital (Mandiwala & Watson, 2014; Kane, 2015; Alimam et al., 2017; Weber & Shi, 2016).

The purpose of our paper is to characterize the concept of ESM from the perspective of several authors, to pre-examine selected results of the Eurostat survey on the use of ESM for different business sectors within the EU and to compare them with selected results of our own survey conducted in companies operating in Slovakia.

1. Theoretical background

The chapter includes a historical perspective on the ESM, definitions of the ESM, important ESM pay forms and selected Eurostat research results, which will be compared with the results of our research.

Leonardi et al (2013) state that the emergence of ESM in companies and organizations has usually followed one of three basic paths, namely:

- Based on the use of publicly available sites such as Facebook, Google+ and Twitter (Kaplan & Haenlein, 2010; Efimova & Grudin, 2007; DiMicco & Milllen, 2007);
- From private implementations of open source software or implementations of proprietary software, either installed on the company's own servers or as a hosted (cloud) service (Danis & Singer, 2008; Majchrzak et al., 2006; Huh et al., 2007);
- From their own proprietary solutions, often created by software vendors as prototypes for later incorporation into commercial offerings (DiMicco et al., 2008; Steinfield et al., 2009; Brzozowski, 2009).

1.1. ESM definitions

There are several definitions of both social media and enterprise social media in the literature. The definition given by R. Adámik (2023), was originally published by the CIPR (Chartered Institute for Public Relation, UK). By its very name, social media involves building community and networks and encouraging its users to participate and engage" (CIPR, 2011). The author further states, "The definition implies that the most important characteristic of social media channels is encouraging users and customers to interact and create their own content. Social media can also be used just to display their content, but this does not take advantage of their full potential. The essence of why social media is social is that: social media is digital media that encourages users to participate, interact and share."

Next, we present the definition of ESM by Leonardi et al. (2013), which is also shared by Weber and Shi (2016). Leonardi et al. (2013) defined ESM as: "Web-based platforms that allow workers to

- communicate messages with specific coworkers or broadcast messages to everyone in the organization;
- explicitly indicate or implicitly reveal particular coworkers as communication partners;
- post, edit, and sort text and files linked to themselves or others;
- view the messages, connections, text, and files communicated, posted, edited and sorted by anyone else in the organization at any time of their choosing".

From a different perspective the definition of ESM is looked at by Ma et al. (2020) who state, "Enterprise social media can be defined as the use of social media in work and social interactions. Work-related use mainly refers to employees who use enterprise social media for work-related activities, such as posting and updating a project, while social use refers to employees who use enterprise social media for company related activities, such as organizing a social event".

M. Onofrej (2023) emphasizes the understanding of the difference between social media and ESM: Social media are divided into public, such as Facebook or Twitter, and enterprise social media (ESM), whose private network is protected by a corporate firewall. "The two groups share most of the same features, but there are some important differences that relate to the limitations of ESMs. For example, in corporate social media, employees have limited control of notifications, which means they can't

prevent receiving a notification from their CEO, etc. In enterprise social media, relationships are typically predefined based on team, department or project affiliation."

It is possible to agree with all definitions, but we consider the definition by Leonardi et al. (2013) to be the most accurate.

1.2. ESM platforms

Enterprise social media platforms provide a space for self-presentation where employees construct, co-create, and maintain an online image among their peers (Sun et al., 2021).

Adamik (2023) identified the key social media platforms for the reason of setting the right corporate strategy in this area, which are:

- Social networks: In most countries, Facebook, Instagram and Snapchat (consumer environments), LinkedIn (business environments) and Twitter (both environments) are the primary platforms for people to interact with each other.
- Social news: Almost all newspapers and magazines have an online format where readers can engage in discussions by commenting on articles.
- Blogs: Expert blogs that can build the core of a company's social media strategy.
- Social community: There are independent forums that are part of the main site, but are aimed at gathering a specific subset of people. In this way, companies can create their own community.
- Social customer service: Customer support forums are increasingly being used by companies. Customers use an online form to post their questions or complaints and of course they also require a response. This gives these forums significant importance.
- Social learning: These are mainly platforms such as Yahoo! Answers, Quora and the like. These
 sites explain to visitors how and with what products they can solve their problems, which hides
 considerable business potential. Wikipedia also falls into this category.
- Social streaming: these are media that focus on photos (Pinterest), videos and podcasts.
- Social search: After the launch of Google+, search engines have expanded their functions, e.g., to include votevoting for pages via Google +1. However, with the waning popularity of Google+, these features are seen less and less.
- Social commerce: It is mainly relevant for retail. It includes reviews and ratings of products and promotional coupons that can be provided e.g. when registering on one of the sites offering the products to which the discount is linked. (Adamik, 2023).

1.3. ESM research published by Eurostat

Our research was based on published Eurostat surveys (Eurostat, 2021) in EU member states, from which we selected businesses using social media by economic activity (Figure 1).

Figure 1 shows the use of different types of social media in EU companies by media and economic activity categories, with the social media categories divided into four groups (social networks, company blogs or microblogs; multimedia content sharing websites and wiki-based knowledge sharing tools) (Eurostat, 2021). Considering the economic activity, during 2021 the percentage of EU enterprises using social networks ranged from 86 % of enterprises in the accommodation sector and 81 % in the information and communication sector to 41% of enterprises in transport and storage and in construction. Multimedia content sharing websites were used by more than 5 out of 10 businesses in the information and communication sector and in the accommodation sector, but by less than 1 out of 5 enterprises in transport and storage sector, construction and in the electricity, gas, steam, air conditioning and water supply sector. Enterprise blog or microblogs were popular types of social media among enterprises in the information and communication sector (39 % of the enterprises). On the contrary, less than 10 % of the EU businesses in manufacturing, transport and storage and construction used enterprise blog or microblogs.

Based on the mentioned literature and Eurostat surveys, we set the main objective of the paper, which was to investigate the approach of enterprises operating in Slovakia to the use of social media, the creation of a research model, the implementation and evaluation of a questionnaire survey in enterprises in Slovakia. In the survey, we focused on the approach of enterprises of different industries to the use of social media in personnel management and personnel marketing.

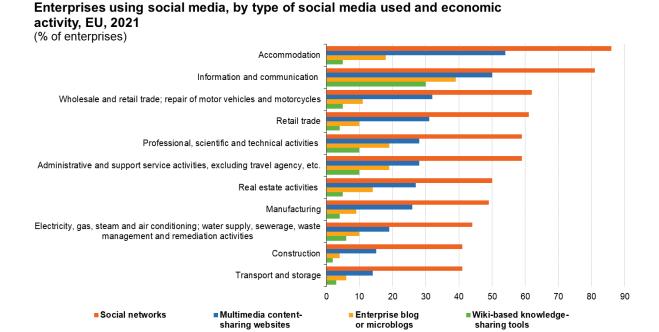


Figure 1. Enterpises EU using social media, social networsks (%), 2015 and 2021.

Source: Processed according to Eurostat, 2021

We consider the main findings to be the fact that the use of social media in Slovakia was rated highest by enterprises in the Information and Communication sector. We consider this phenomenon to be natural and it is also documented by the fact that in this sector there is also dissatisfaction with the quality and use of information obtained in this way. The research revealed a problem in the Accommodation sector in particular, where businesses operating in Slovakia rated their use of social media below average, with the Eurostat survey giving one of the highest values. We consider this difference to be a significant signal for improvement in this sector, primarily due to the support of tourism in Slovakia.

2. Methods and methodology

In addition to the study of scientific and professional literature, the main scientific method was a questionnaire survey. The survey was conducted in the first half of 2021 and involved 115 respondents, with the aim of the survey being to investigate the level of approach of Slovak enterprises operating in one individual business sectors to the use of social media in the field of personnel marketing and personnel management.

Standard methods of scientific work were used to process the paper, namely:

- Analysis, synthesis, comparison and selection (to analyze domestic and foreign literature);
- Questionnaire survey in enterprises in Slovakia;
- Statistical methods: descriptive statistics, contingency tables (to evaluate the results of the questionnaire survey in MS Excel);
- Synthesis (to formulate conclusions and recommendations).

The object of the research was the use of social media in personnel marketing and personnel management in Slovak companies. The survey was conducted on the basis of the research variables model. The research variables (Table 1) were selected from a larger research model that consisted of 26 variables. Only variables that were rated on a 5-point Likert scale from 1 to 5 were selected, with a rating of 1 corresponding to minimum agreement and a rating of 5 corresponding to maximum agreement. These variables were divided into two groups. The first group of variables concerned the use of social media in HR marketing (variables PM1, PM3 and PM6), while the second group examined the use of social media in HR management (PZ1, PZ3, PZ4, PZ5, PZ8 and PZ12).

Table 1. Model of research variable

Code	Research variable
	Personnel marketing group variables
PM1	Business uses social media in personal marketing
PM3	The company / top management supports the use of social media in HR marketing
PM6	Level of experience of the company with information obtained through social media
1 1/10	in the field of personnel marketing
	Personnel management group variables
PZ1	The company uses social media in personnel management
PZ3	Within social media, all employees are communicatively connected
PZ4	Employees use social media for informal communication
PZ5	The company / top management supports the use of social media in personnel man-
123	agement
PZ8	Quality of information provided by social media
PZ12	Experience with information obtained through social media in HR management

Source: Prepared by authors

3. Results

The results are presented in the following structure: the research sample, the results of the evaluation of the research variables of the personnel marketing research group and the results of the evaluation of the research variables of the personal management research group.

3.1. Research sample

The research sample consisted of 115 randomly selected enterprises operating in Slovakia. Their percentage representation based on the set parameters (P1 – size of the enterprise and P2 – economic activity) is shown in Table 2.

Table 2. Research sample.

Parameter	Attibute	% incidence	
	Micro	19.13%	
P.1 Enterprise size	Small	21.74%	
P 1 Enterprise size	Medium	25.22%	
	Large	33.91%	
	Accommodation	4.35%	
	Construction	4.35%	
	Electricity, gas, steam, and air condi-		
	tioning; water supply, sewerage,	1.74%	
	waste management and remediation		
	activities		
P 2 Economic activity	Information and Communication	11.30%	
	Manufacturing		
	Other activities	36.52%	
	Professional, scientific and technical	2.400/	
	activities	3.48%	
	Retail trade	18.25%	
	Transport and Storage	1,74%	

Source: Prepared by authors

The highest representation in the research sample was 33.91% of large enterprises; the remaining groups of enterprises had approximately the same representation (from 25.22% - medium-sized enterprises, to 19.13% micro-enterprises). In terms of business sector, the sector classified as Other activity

had the highest representation in the research sample (36.52%. This is followed by Manufacturing (18.27%) and Retail trade (18.25%). The Information and Communication sector (11.30%) also had an incidence of more than 10%. Other recorded sectors with an incidence of less than 10% were Accommodation and Construction (4.35%), Professional, scientific and technical activities (3.48%) and Electricity, gas, steam, and air conditioning; water supply, sewerage, waste management and remediation activities and Transport and Storage (1.74% each).

3.2. Results of the evaluation of the research variables of the Personnel marketing group

The relevant results are shown in Table 3, with the maximum and minimum values highlighted in bold.

Table 3. Results of the evaluation of the research variables of the Personnel marketing group.

Economic activity	Mean of PM1	Mean of PM3	Mean of PM6
Accommodation	3.20	3.40	3.20
Construction	3.00	3.40	3.40
Electricity, gas, steam, and			
air conditioning; water sup-			
ply, sewerage, waste man-	3.00	3.50	3.50
agement and remediation ac-			
tivities			
Information and Communi-	4 21	2.05	2.22
cation	4.31	3.85	3.23
Manufacturing	3.38	3.19	3.43
Other activities	3.57	3.33	3.38
Professional, scientific and	2.00	2.00	2.50
technical activities	3.00	3.00	3.50
Retail trade	3.67	3.33	3.38
Transport and Storage	3.50	3.50	3.50

Source: Prepared by authors.

In the variable PM1 – Enterprises uses social media in personnel marketing, the highest average value was achieved by the Information and communication sector (4.31) and the lowest average value was achieved by the Construction, Electricity, gas, steam, and air conditioning; water supply, sewerage, waste management and remediation activities and Professional, scientific and technical activities sectors (identical 3.00).

Similarly, the variable PM3 - Business / top management supports the use of social media in personal marketing was rated highest by the Information and Communication industry and lowest by only 1 industry, namely Professional, scientific and technical activities.

The level of enterprises experience with information obtained through social media in personnel marketing (PM6 indicator) was rated highest (3.50) by the Electricity, gas, steam, and air conditioning; water supply, sewerage, waste management and remediation activities and Transport and Storage industries, and lowest by the Accommodation industry (3.20). Interestingly, the Information and Communication sector rated this variable the second lowest (3.23). We assume that IT professionals work in this sector and have higher expectations from the quality of the information obtained through social media and their practical use.

3.2. Results of the evaluation of the research variables of the Personnel management group

Similar to be previous subsection, the results are presented in Table 4, with maximum and minimum values highlighted in bold.

Table 4. Results of the evaluation of the research variables of the Personnel management group

Economic Activity	Mean of					
Economic Activity	PZ1	PZ3	PZ4	PZ5	PZ8	PZ12
Accommodation	4.00	3.00	4.00	3.50	4.00	3.50
Construction	2.20	2.00	2.80	2.60	3.00	3.40
Electricity, gas, steam, and						
air conditioning; ater sup-						
ply, sewerage, waste man-	3.50	4.00	2.50	4.00	2.50	3.50
agement and remediation						
activities						
Information and Communi-	4.23	3.77	4.23	4.08	3.38	3.23
cation	4.23	3.77	4.23	4.00	3.30	3.23
Manufacturing	3.62	3.05	3.19	3.19	3.29	3.10
Other activities	3.76	3.19	3.52	3.55	3.21	3.29
Professional, scientific and	3.00	3.50	3.25	2.75	3.25	3.00
technical activities	3.00	3.30	3.23	2.73	3.23	3.00
Retail trade	4.10	3.24	3.52	3.19	2.95	3.38
Transport and Storage	4.00	3.00	4.00	3.50	4.00	3.50

Source: Prepared by authors

In our research on the use of social media in HR management, the individual values are evident in Table 4. The highest ranked variable was PZ1 (The company uses social media in HR management, followed by PZ4 (Employees uses social media for informal communication). We hypothesize that the rating of these variables was the easiest and most familiar to the respondents. The third highest rated variable was PZ5 (The company/top management supports the use of social media in HR management), which we consider to be a strong signal for the use of social media in the future.

The lowest ranked variables were PZ12, PZ8 and PZ3, indicating that the least respondents were satisfied with the experience gained through social media, the quality of the experience and the fact that not all employees are connected to each other through communication.

4. Discussion

Regarding the evaluation of individual industry rankings, in our HR marketing survey, variables in the Information and communication, Other activities, Retail trade and Transport and storage industries were ranked above average, while the Accommodation, Construction, Electricity, gas, steam, and air conditioning; water supply, sewerage, waste management and remediation activities, Manufacturing and Professional, scientific and technical activities industries were ranked below average.

Evaluation in the area of HR management, the same industries were in the above average and below average group, except for Accommodation, which rated this group of variables above average.

It was not possible to compare the results of the surveys conducted by Eurostat with the results of our surveys directly using the research variables because the surveys differ in the structure of the research sample and in the variables being compared. We have therefore chosen the order of ranking of the industries surveyed, which is presented in Table 5. From the Eurostat survey, we classified the industries that did not appear in our survey into the Other activities group.

Table 5. Ranking of economic activity in individual surveys

Economic Activity	Eurostat survey	Our survey – HR marketing	Our survey –HR man- agement
Accommodation	2.	7 8.	3.
Construction	8.	7 8.	9.
Electricity, gas, steam, and air conditioning; water	7.	5. – 6.	5.

supply, sewerage, waste			
management and remedia-			
tion activities			
Information and Communi-	3.	1	1
cation	3.	1.	1.
Manufacturing	6.	5 6.	6.
Other activities	1.	4.	3.
Professional, scientific and	5.	9.	7.
technical activities	3.	9.	7.
Retail trade	4.	3.	4.
Transport and Storage	9.	2.	2 3.

Source: Prepared by authors

Table 5 shows that the surveys differ the most in the Accommodation and Transport and Storage sectors (the rankings differ by more than 2 places). The rankings of the other sectors are within a maximum of 2 post-rankings, which can be considered acceptable. We see a problem in particular in the Accommodation sector, in which businesses operating in Slovakia ranked the use of social media below average, at 7th-8th out of 9, while according to Eurostat research, the Accommodation sector (according to our adjusted data) is ranked 2nd. We see this as a call for significant improvement, particularly in order to promote tourism in Slovakia (MDSR, 2023).

The main limitation of our research is the size of the research sample and the different methodology of data collection and evaluation compared to the Eurostat survey. For further research, we suggest, first of all, expanding the research sample of enterprises operating in Slovakia and establishing criteria comparable to research by other authors.

Funding: This research was funded by VEGA No. 1/0662/23 Digital transformation of companies and their readiness to integrate the elements of Industry 5.0 – proportion 100 %.

References

- 1. Adámik, R. (2021). Sociálne média a ich platformy. *Budmanazer.sk*. https://budmanazer.sk/socialne-media-a-ich-platformy-2/.Alimam, M., Bertin, E., & Crespi, N. (2017). ITIL perspective on enterprise social media. *International Journal of Information Management*, 37(4), 317-326. https://doi.org/10.1016/j.ijinfomgt.2017.03.005
- 2. Brzozowski, M. J. (2009). WaterCooler: exploring an organization through enterprise social media. *Proceedings of the* 2009 *ACM International Conference on Supporting Group Work*, 219-228. https://doi.org/10.1145/1531674.1531706
- 3. CIPR (2011). CIPR Social Media Best Practice Guide. https://issuu.com/cipr_uk_members/docs/cipr_social_media_best_practice_guidance_2011_
- 4. Danis, C., & Singer, D. (2008). A wiki instance in the enterprise: opportunities, concerns and reality. *Proceedings of the 2008 ACM conference on Computer supported cooperative work*, 495-504. https://doi.org/10.1145/1460563.1460642
- DiMicco, J. M., & Millen, D. R. (2007). Identity management: multiple presentations of self in facebook. Proceedings of the 2007 ACM International Conference on Supporting Group Work, 383-386. https://doi.org/10.1145/1316624.1316682
- 6. DiMicco, J., Millen, D. R., Geyer, W., Dugan, C., Brownholtz, B., & Muller, M. (2008). Motivations for social networking at work. *Proceedings of the 2008 ACM conference on Computer supported cooperative work*, 711-720. https://doi.org/10.1145/1460563.1460674
- 7. Dirbach, J. (2017) Podnikové sociálne médium. To je hit budúceho roka. Kariéra Info. https://kariera-info.zoznam.sk/cl/1000154/1332375/Podnikove-socialne-medium--To-je-hit-buduceho-roka
- 8. Efimova, L., & Grudin, J. (2007). Crossing boundaries: A case study of employee blogging. *IEEE 40th Annual Hawaii International Conference on System Sciences (HICSS'07)*, 86-86. https://doi.org/10.1109/HICSS.2007.159
- 9. Eurostat (2021). Social media statistics on the use by enterprises. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Social_media_-_statistics_on_the_use_by_enterprises
- 10. Hansen, M. B., & Hansen, M. B. N. (2004). New philosophy for new media. MIT press. ISBN 9780262582667
- 11. Kane, G. C. (2015). Enterprise social media: Current capabilities and future possibilities. *MIS Quarterly Executive*, 14(1). Online ISSN: 1540-1960

- 12. Kaplan, A. M., & Haenlein, M. (2010). Users of the world, unite! The challenges and opportunities of Social Media. *Business horizons*, 53(1), 59-68. https://doi.org/10.1016/j.bushor.2009.09.003
- 13. Leonardi, P. M., Huysman, M., & Steinfield, C. (2013). Enterprise social media: Definition, history, and prospects for the study of social technologies in organizations. *Journal of computer-mediated communication*, 19(1), 1-19. https://doi.org/10.1111/jcc4.12029
- 14. Lievrouw, L. A. (2004). What's changed about new media? Introduction to the fifth anniversary issue of new media & society. *New media & society*, 6(1), 9-15. https://doi.org/10.1177/1461444804039898
- 15. Lister, M., Dovey, J., Giddings, S., Grant, I., & Kelly, K. (2008). New media: A critical introduction. *Taylor & Francis*. https://doi.org/10.4324/9780203884829
- 16. Majchrzak, A., Wagner, C., & Yates, D. (2006). Corporate wiki users: results of a survey. *Proceedings of the 2006 international symposium on Wikis*, 99-104. https://doi.org/10.1145/1149453.1149472
- 17. Mandviwalla, M., & Watson, R. (2014). Generating Capital from Social Media. MIS Quarterly Executive, 13(2), 97-113. Online ISSN: 1540-1960
- 18. Ministerstvo dopravy SR MDSR (2023). Prioritné oblasti podpory na rok 2023. https://www.podporaturizmu.sk/
- 19. Onofrej, M. (2013). 5 odporúčaní, ako efektívne využiť sociálne médiá vo firme. *Kariéra Info*. https://kariera-info.zoznam.sk/cl/1000154/1337253/5-odporucani--ako-efektivne-vyuzit-socialne-media-vo-firme
- 20. Steinfield, C., DiMicco, J. M., Ellison, N. B., & Lampe, C. (2009). Bowling online: social networking and social capital within the organization. *Proceedings of the fourth international conference on Communities and technologies*, 245-254. https://doi.org/10.1145/1556460.1556496
- 21. Sun, Y., Fang, S., & Zhang, Z. J. (2021). Impression management strategies on enterprise social media platforms: An affordance perspective. *International Journal of Information Management*, 60, 102359. https://doi.org/10.1016/j.ijinfomgt.2021.102359
- 22. Weber, M. S., & Shi, W. E. I. (2017). Enterprise social media. *The international encyclopedia of organizational communication*, 1-9. https://doi.org/10.1002/9781118955567.wbieoc072
- 23. Wise, R., & Steemers, J. (2000). Multimedia: a critical introduction. Psychology Press. ISBN 9780415121507

Internet of Things as an useful business tool

Peter Zahradník 1

- ¹ Faculty of business management, University of Economics in Bratislava, Bratislava, Slovakia; peter.zahradnik@euba.sk
- * Correspondence: peter.zahradnik@euba.sk

Abstract: It is important for a business manager to stay focused and sharp due to an active competition. We suggest implementation of a several kinds of Internet of Things to a business. We described Internet of Things theoretically and also, we described a ways of using Internet of Things as a tool of increasing a business competitiveness. We have set a hypothesis for verification, which we verified by statistical verification of variables of questionnaire by binomial logistic regression.

Keywords: internet of things, business, management

Introduction

We are at a turning point in our society, where the world around us is deeply embedded in intelligent objects that are wirelessly connected to each other and possibly via the Internet. A network of such physical objects or things that are embedded with electronics, software, sensors, and an Internet connection that allows those objects to collect and exchange data forms the basis of the Internet of Things philosophy (Dhondge, 2016).

Technological advancements continue to disrupt how organizations compete and create value in almost every industry and society. The recent digital transformation movement has expanded the reliance of companies and organizations in software technologies, such as cloud computing, big data, artificial intelligence, internet-of-things, and also increase the risk associated with software usage (Nguyen & Chirumamilla, 2019).

Small and medium enterprises (SMEs) play a critical role in the economic growth of a nation, and their significance is increasingly acknowledged. More than 90% of commercial establishments, almost 70f% of jobs, and 55% of the GDP are held by SMEs in mature economies. Additionally, this sector accounts for 70% of employment possibilities and up to 40% of the GDP in developing countries. Technologically, the Internet of Things (IoT) enables multiple connected devices, i.e., "things", to add value to businesses, as they can communicate and send messages or signals promptly (Mhlongo & Sethibe, 2023).

1. Theoretical background

The Internet of Things, or even the Internet of Things, is a term that expresses a network of devices containing various electronics, sensors and other elements that allow these devices to communicate and exchange data, while each device is clearly identifiable in the network. This concept was introduced by Kevin Ashton in his 1998 presentation. The IoT has emerged to be a part of people's everyday life in today's digital era. It also serves as one of the drivers for IR 4.0; it has influenced every aspect of the human life. (Rock & Tajudeen & Chung, 2022)

With the increasing number of smart appliances on the market, the Internet of Things (IoT) is playing a key role in smart homes. The IoT describes a network of physical objects embedded with sensors. Smart homes require many IoT devices, which are connected through the Internet (Chen et. Al, 2021).

The Internet of Things gathers information from the atmosphere and performs some operations on its own without human interruption. We can control the amount of data and reduce data loss, waste and costs. We will find machine failures in industry and eliminate them (PhD Academy, 2021).

The Internet of Things is a set of sensing, communication and computing technologies for connecting physical objects such as wearable devices, vehicles and buildings. A large amount of data is

generated from the linked "things". Data analysis plays a central role in the automated and intelligent decision-making process for managing and optimizing the Internet of Things (Liu, 2020).

IoT enables the collection of high-resolution data for the physical world where, as in the digital world, every aspect of business operations can be measured in real-time. This capability facilitates high-resolution management, such as short optimization cycles in industrial production, logistics and equipment efficiency, comparable to methods like A/B-Testing or Search Engine Optimization, which are state of the art in digital business (Weinberger et al., 2016).

The Internet of Things consists of real-world things and sensors connected to or combined with these things and connected to them via a wired and wireless network. IoT sensors can use different types of connections such as RFID, Wi-Fi, Bluetooth and ZigBee. In **addition**, they enable broadband connectivity using many technologies such as GSM, GPRS, 3G and LTE. IoT-enabled things will share information about the state of things and the environment with people, software systems and other devices (Zeinab & Elmustafa, 2017).

The Internet of Things (IoT) and its applications are becoming popular among many users nowadays, as it makes their life easier. Because of its popularity, attacks that target these devices have increased dramatically, which might cause the entire system to be unavailable. Some of these attacks are denial of service attack, sybil attack, man in the middle at-tack, and replay attack. Therefore, as the attacks have increased, the detection solutions to detect malware in the IoT have also increased (Alshahrani, 2021).

Development of accessible and cheap sensors as well as the possibility to transfer and process huge amounts of data offer new possibilities for many areas utilizing till now conventional approaches. Navigation of robots and autonomous vehicles is no exception in this aspect and Internet of Things (IoT), together with the means of computational intelligence, represents a new way for construction and use of robots (Vaščák et. al., 2021).

1.1 Elements that provided support for existence of Internet of Things

We have provided some definitions and characteristics of the Internet of Things. The authors agree on the main idea of the Internet of Things, namely the connection of all elements of the selected environment via the Internet, in order to ensure communication.

Among the elements that supported the emergence and existence of the Internet of Things, we include the following 3 elements:

- 1. the availability of broadband wireless internet and the emergence of a necessary, ubiquitous and distributed computing environment across the planet,
- 2. miniaturized sensors built into everyday objects, home security and health monitoring systems, collection and connection and communication of data from sensors built into other products or people
 - 3. Collaborative robots (cobots) using artificial intelligence and machine learning

Enabling real-time data analysis, learning, and sensing from the transfer of large data from a server of built-in IoT sensors (Özdemir & Hekim, 2018).

2. Methods and methodology

We based our article on literature research. We select the relevant foreign and domestic literature. We mainly focused on articles and proceedings from Web of Science and Google Scholar. Then we compared them and focus on application part. We used qualitative-quantitative research. Qualitative research was applied on 5 businesses where we used expert interviews to know the certain areas of IOT usage in businesses. With gathered information from the literature and qualitative research we have constructed the questionnaire which was a part of quantitative research. In application part we did an questionnaire for over 180 selected business units in Slovakia that uses several features of IOT. The questionnaire was focused mainly about usage of selected IOT features in business. We also set one hypothesis for verification:

H1: The use of Internet of Things elements is statistically significantly dependent on the size of the company. At the end we will create a conclusion.

Since the questionnaire was consisting mostly of yes or no questions, we will use binomial logistic regression for statistical verification of the hypothesis. We evaluated each question in relation to the size

of business unit. According to Cronbach alfa, the reliability of questionnaire was 0,845 in total and 0,835-0,849 for each variables which is considered as important reliability.

3. Results

In the chapter results we focused on the current challenges that are related to Internet of Things and the partial outcome of the questionnaire.

3.1. Current challenges related to Internet of Things

Workflows in the analyzed business environment, home, office, and other intelligent spaces in Windows will be characterized by the interaction between organizations, which requires the operation of highly dynamic and ad-hoc relationships. Currently, very limited ICT support is available, and the following key challenges exist. Network Foundation, Security, Privacy and Trust, and Heterogeneity Management.

Network Foundation - limitations of the current Internet architecture in terms of mobility, accessibility, manageability and scalability are some of the main obstacles to the full functionality of IoT.

Security, privacy and trust - The security challenges are:

- (a) secured IoT architecture security must be ensured at the time of design and execution,
- (b) proactive identification and protection of the Internet of Things against arbitrary attacks (eg DoS and DDoS Attacks) and data misuse
- (c) proactive identification and protection of the Internet of Things against malicious software or viruses. In the area of user privacy, there are specific challenges:
- (a) control over personal data (personal data protection) and control over an individual's physical data, location and movement (privacy in place),
 - (b) the need for privacy enhancing technologies and applicable laws to protect; and
 - (c) standards, methodologies, and tools for managing user and object identities.

In the area of trust, some of the specific challenges are:

- (a) The need for easy and natural exchange of critical, protected and sensitive data for example, intelligent objects will communicate on behalf of users / organizations with services they can trust,
 - (b) trust must be part of the IoT concept and must be built in.

Heterogeneity management - Managing heterogeneous applications or environments is a big challenge (Bandyopadhyay & Sen, 2011).

From the company's point of view, it is necessary to ensure compatibility not only between internally used applications but also operating systems of computers, smartphones, tablets or other elements entering the Internet of Things.

The Internet of Things may face two main challenges to ensure the smooth running of network access. The first question concerns the fact that there are different networks today.

Another question is related to the size of the Big Data IoT. Other current issues, such as address, restriction, automatic address setting, security features such as authentication and encryption, and features for efficient delivery of voice and video signals are likely to be affected in the implementation of the IoT concept, but these technological challenges will overcome these challenges. The Internet of Things promises a new future in cloud-related technologies, Big Data and security solutions. By integrating all these problems into the Internet of Things, the development of smarter applications will be rapidly accelerated (Zeinab & Elmustafa, 2017).

3.2 Statisticall evaluation of variables

In the next table, we will evaluate all of the variables with binomial logistic regression. The codes of variables stands for the usage of "blank", where blank stands for the selected feature of IOT. IV.1 – RFID; IV.2 – GPS, IV.3 – 3D print, IV.4 – Wi-Fi, IV.5 – Usage of IT with IOT support, IV.6 – Smart business, IV.7 – Communication in business is supported by IOT, IV.8 – 5G network, IV.9 – Smart parking, IV.10 – Tracking. The responds were collected from the questionnaire, that was a part of authors dissertation thesis. Every question had its own added sub question, where respondents could be more specific and explain the areas of usage certain types of Internet of Things in their business.

Variable	X ²	df	р	Odds ratio/p	R ² N
variable	Λ²	aı			(Nagelkerke)
IV.1	22.59	3	<0.0001	0.21/<0.0001	0.157
IV.2	7.01	3	0.072	3.60/0.0003	0.050
IV.3	33.36	3	< 0.0001	0.095/<0.0001	0.273
IV.4	5.66	3	0.130	22/<0.0001	0.267
IV.5	24.10	3	< 0.0001	0,36/0.0003	0.219
IV.6	30.706	3	< 0.0001	0.643/0.143	0.205
IV.7	11.24	3	0.0105	0.475/<0.0001	0.142
IV.8	0.507	3	0.899	1.30/0.378	0.0043
IV.9	15.189	3	0.0017	0.00/0.994	0.206
IV.10	11.80	3	0.0081	0.278/0.0003	0.083

Source: Custom processing according to Jamovi software

Table 1 shows that in the case of using the Internet of Things, we can accept the hypothesis H1 (The use of Internet of Things elements is statistically significantly dependent on the size of the company) for only 5 out of 10 variables: IV.1: The company uses RFID; IV.3: The company uses 3D printing; IV.5: The company's employees use IT elements with the support of the Internet of Things; IV.7: Communication in the company is also implemented with the help of the Internet; IV.10: The company implements vehicle monitoring. In the case of variables for which statistical significance was not proven: IV.2: The company uses GPS; IV.4: The enterprise uses Wi-Fi; IV.6: The enterprise is considered a smart enterprise; IV.8: The enterprise uses a 5G network; IV.9: The company is dedicated to intelligent parking, we accept hypothesis H0: The use of Internet of Things elements does not statistically significantly depend on the size of the company.

RFID technology or Radio Frequency IDentification is a technology used to identify products and employees. In our research sample, 35.48% of companies use RFID technology, and 54.54% of them are large companies.

4.30% of all enterprises and 17.39% of micro-enterprises use RFID technology when paying with ATM cards, then when supporting production management in the automotive industry, tracking production, identifying objects, collecting data and entering it into the internal information system.

4.30% of all businesses and 21.05% of small businesses use RFID for monitoring company vehicles and tracking products for clients. Half of the small businesses that use RFID elements said that they use RFID for the company's attendance and security system and for smart cards for employees.

In our research sample, 36 micro enterprises use GPS, which is 19.35% of all enterprises in the research sample and 78.26% of micro enterprises. 28 micro enterprises (60.87%) in the research sample use GPS as a priority for vehicle navigation on roads. In addition to the traditional area, the remaining micro-enterprises also use GPS for field measurements, live tracking of shipments for customers, route visualization and vehicle movement history.

GPS is also used by 22 small businesses from the research sample, which is 11.83% of all businesses and 57.89% of all small businesses from the sample. 18 small businesses use GPS mainly for vehicle navigation and the remaining small businesses for tracking shipments and monitoring company vehicles.

As with small businesses, exactly 22 medium-sized businesses from the research sample use GPS, which makes up the same percentage numbers, due to the same number of respondents from small and medium-sized businesses. Medium-sized enterprises from the research sample used GPS as a priority for tracking vehicles in terms of their protection and security and for tracking shipments. 2 medium-sized enterprises use a commercial product using a GPS device for vehicle tracking and at the same time evaluating driving data such as vehicle consumption, starting method, driving style and others. Based on these data, employees are evaluated with a variable wage component.

In our research sample, 32 companies use 3D printing, of which the majority of companies are large companies, representing 12.90% of all companies. Micro-enterprises were represented in 4 cases and used 3D printing as a priority for the creation of samples during development and also in the production of parts and components for individual single-purpose machines. Medium-sized enterprises used 3D printing to create 3D models or directly to manufacture specific products. 37.50% of large enterprises

from the research sample use 3D printing. 10 large enterprises use 3D printing for design and prototyping, and the remaining large enterprises from the research sample use 3D printing for the production of plastic spare parts, the production of small parts or as an aid for the automation of production processes. We believe that the area of product design is one of the areas of 3D printing that can have a positive effect on the operation of a manufacturing company, as the production of 3D parts does not have to be so expensive. The preparatory process and programming required for the design of the elements is demanding, but the production itself is a relatively economically advantageous solution for manufacturing companies.

The fourth variable turned out to be the most frequently used element from the Internet of Things. Among micro enterprises, 95.65% of micro enterprises from the research sample use the Internet of Things. They mainly use Wi-Fi to connect to the Internet for devices in offices. Other businesses use Wi-Fi to record orders and communicate with customers, access online data and cloud services, as well as access stock cards and the logistics module. As with micro businesses, most small businesses use Wi-Fi to connect to the Internet. Other small businesses used Wi-Fi to connect machines and cameras in businesses, to connect gas boilers for remote control, as well as for the management area of the company offices, online payments for communication in the internal system.

Our research sample included the majority of companies using elements of information technology for the performance of business activities. 77.42% of the companies from the research sample used each selected IT element for their activity.

78.26% of micro-enterprises from the research sample use mobile devices for the area of internal communication or for the area of management and data collection from the customer's production. A selected sample of micro-enterprises uses mobile devices to manage social networks and to communicate with B2C and B2B customers. Micro businesses use computers mainly for accounting support and business management support in the area of creating orders, communicating with customers and for routine administrative activities in businesses. 4 micro-enterprises use PCs for software development along with planned maintenance of equipment in the enterprise. 95.65% of the micro-enterprises from the research sample used smartphones mainly to secure communication between employees and customers. 5 micro enterprises used smartphones for remote access to enterprises, control of enterprises and production as well as control through camera systems.

78.95% of small businesses used mobile devices mainly for internal communication. A minority of small businesses used mobile devices for effective collaboration and immediate reporting of changes in business processes. Small businesses used computers for processes ranging from administration to accounting. In addition to administrative activities, most companies used PCs for communication at the workplace. A selected group of businesses used PCs to operate and manage electronic stores. 4 small businesses also used PCs for product development and design and programming. In addition to communication, smartphones were used by small businesses for e-banking, logging into slovensko.sk and also for marketing communication. As in the case of micro enterprises, a group of small enterprises was found that used smartphones to control and monitor the enterprise through an implemented camera system.

In addition to communication, 78.95% of medium-sized enterprises used mobile devices for forwarding and logistics - tracking shipments, picking shipments and dispatching them. 2 medium enterprises used mobile devices for the development of mobile applications. 100% of medium-sized enterprises from the research sample used computers in their business processes. In addition to basic administration, they devoted themselves to the development and design of software solutions and the management of technological processes. They also used PCs to control access to the card system and for office automation.

There were 76 enterprises in the research sample that were considered Smart, which is 41.94% of all enterprises in the research sample. 18 micro enterprises (39.13% of micro enterprises), 10 small enterprises (26.32% of small enterprises), 6 medium enterprises (15.79% of medium enterprises) and 42 large enterprises (65.63% of large enterprises). Despite the fact that a larger percentage of enterprises from the research sample confirmed the use of several "smart" elements, they did not consider themselves a smart enterprise. In the supplementary questions, they identified that it was difficult to identify what a smart enterprise means and what cannot yet be considered a smart enterprise. In large

enterprises, the percentage of smart enterprises was higher, which was due to the amount of investments in smart technologies as well as the self-awareness of what can already be considered a smart enterprise.

In our research sample, a very small part of the companies devoted themselves to the field of intelligent parking - only 6.45% of the companies in the research sample, and at the same time, from our point of view, it is a useful area, especially for medium and large companies that need to manage their fleet wisely. 78 enterprises of the research sample (41.93%) use vehicle monitoring to support their activities. They primarily focus on the area of property protection, but they are also dedicated to the area of electronic logbook registration, evaluation of drivers' driving styles, and based on a good evaluation by the system, they also allocate variable wage components to employees in the form of bonuses. All sizes of companies are engaged in monitoring, at least for the purpose of securing assets.

Businesses have also identified the use of smart metering, which means the use of intelligent measurement systems, for example, in the area of heating, energy and water consumption.

4. Discussion

Smart logistics has become a promising solution for handling the increasing complexity and volume of logistics operations. Technologies, such as the Internet of Things, information communication technology, and artificial intelligence, enable more efficient functions into logistics operations. However, they also change the narrative of logistics management (Feng & Ye, 2021).

In the process of implementing the Internet of Things, the object itself has identity in-formation and identification equipment and encounters difficulties in communication security during the process of entering the network communication. Just like the Internet and wireless sensor networks, there are security issues in information transmission. Therefore, it is of great significance to study the mobile Internet of Things network security technology depression to protect the communication information in the mobile Internet of Things (Sun et. al., 2021).

Tremendous efforts have been devoted to 5G and Internet of Things (IoT) over the last decade due to their potential applications, such as smart city, home robotics, and Augmented Reality (AR). 5G represents a complete revolution in mobile networks for accommodating the ever-growing demands of users, services, and applications (Lv et al., 2021).

Device-to-device communications have been considered as an indispensable enabler, which reduces the traffic burden associated with fifth generation (5G) mobile networks. To improve the radio spectrum utilization under such a communications scheme, cognitive spectrum sensing can be used to identify temporarily available spectrum chunks for direct interconnections among user devices (Dao et al., 2020).

The devices that are connected over the internet, known as internet of things (IoT), are also at very high risk of phishing attack (Naaz, 2021). The companies need to take care of the security levels in business since it is not very wise to have unprotected documents. It is necessary for a business to have a security policy that helps a company to gain its trust factor. In the current level of competition there are no places for mistakes.

The IoT is a current trend that needs to be taken seriously, since businesses can use that for increasing business competitiveness. If the company wants to still get the same market share, it needs to implement anything that can raise its rank between competition.

Due to a Covid-19 the companies had to invest more into the digitalization and other areas that empower the ability of working on company tasks from home. The company start to use multiple online platforms either for meetings, calls but also for a managing of business. We believe that it is possible for employees to work from home and deliver a comparable result in comparison with working from an office.

In the area of the Internet of Things, we recommend that selected companies implement the use of GPS or other technologies that can be used for tracking and tracking products as well as materials during the production process. Ensuring a wireless connection to the Internet as well as the wireless connection of devices at the workplace does not ensure effective business activity, but with the use of Wi-Fi connection in companies, it is easier to connect devices to each other and, therefore, to control them better.

Funding: This research was funded by VEGA No. 1/0662/23 Digital transformation of companies and their readiness to integrate the elements of Industry 5.0 – proportion 100 %.

References

- 1. Alshahrani, H. M. (2021). Coll-iot: A collaborative intruder detection system for internet of things devices. *Electronics*, 10(7), 848.
- 2. Bandyopadhyay, D., & Sen, J. (2011). Internet of things: Applications and challenges in technology and standardization. *Wireless personal communications*, 58, 49-69.
- 3. Chen, T. L., Kang, T. C., Chang, C. Y., Hsiao, T. C., & Chen, C. C. (2021). Smart Home Power Management Based on Internet of Things and Smart Sensor Networks. Sensors & Materials, 33. DOI: 10.18494/SAM.2021.3184
- 4. Dao, N. N., Na, W., Tran, A. T., Nguyen, D. N., & Cho, S. (2020). Energy-efficient spectrum sensing for IoT devices. *IEEE Systems Journal*, 15(1), 1077-1085.
- 5. Dhondge, K. (2016). Internet of things (IoT) applications with diverse direct communication methods. University of Missouri-Kansas City.
- 6. Feng, B., & Ye, Q. (2021). Operations management of smart logistics: A literature review and future research. *Frontiers of Engineering Management*, 8, 344-355.
- 7. Liu, X. (2020). Statistical Data Analysis for Internet-of-Things: Scalability, Reliability, and Robustness (Doctoral dissertation, Acta Universitatis Upsaliensis).
- 8. Lv, Z., Lloret, J., Song, H., De Souza, J. N., & Mavromoustakis, C. X. (2021). Guest Editorial: 5G for Internet of Things. *IEEE Network*, 35(2), 16-17.
- 9. Melnyk, L. H., Dehtyarova, I. B., Dehtiarova, I. B., Kubatko, O. V., & Kharchenko, M. O. (2019). Economic and social challenges of disruptive technologies in conditions of industries 4.0 and 5.0: the EU Experience.
- 10. Mhlongo, T., van der Poll, J. A., & Sethibe, T. (2023). A Control Framework for a Secure Internet of Things within Small-, Medium-, and Micro-Sized Enterprises in a Developing Economy. *Computers*, 12(7), 127. DOI: 10.3390/computers12070127
- 11. Naaz, S. (2021). Detection of phishing in internet of things using machine learning approach. *International Journal of Digital Crime and Forensics (IJDCF)*, 13(2), 1-15.
- 12. Nguyen Duc, A., & Chirumamilla, A. (2019). Identifying security risks of digital transformation-an engineering perspective. In Digital Transformation for a Sustainable Society in the 21st Century: 18th IFIP WG 6.11 Conference on e-Business, e-Services, and e-Society, I3E 2019, Trondheim, Norway, September 18–20, 2019, Proceedings 18 (pp. 677-688). Springer International Publishing. DOI: 10.1007/978-3-030-29374-1_55
- 13. Özdemir, V., & Hekim, N. (2018). Birth of industry 5.0: Making sense of big data with artificial intelligence, "the internet of things" and next-generation technology policy. *Omics: a journal of integrative biology*, 22(1), 65-76.
- 14. PhD Research Topics in Internet Of Things | Dissertation on IOT. (n.d.). http://www.phdinfo.org/PhD_in_internet_of_things.html?fbclid=IwAR12COQle1QfiuVTjsh2TKYIdudYndeB2fLL8tjMVb7-9d94i7uXsbdFCTA
- 15. Rock, L. Y., Tajudeen, F. P., & Chung, Y. W. (2022). Usage and impact of the internet-of-things-based smart home technology: A quality-of-life perspective. *Universal Access in the Information Society*, 1-20. DOI:10.1007/s10209-022-00937-0
- 16. Sun, N., Li, T., Song, G., & Xia, H. (2021). Network security technology of intelligent information terminal based on mobile internet of things. *Mobile Information Systems*, 2021, 1-9.
- 17. Vaščák, J., Pomšár, L., Papcun, P., Kajáti, E., & Zolotová, I. (2021). Means of IoT and fuzzy cognitive maps in reactive navigation of ubiquitous robots. *Electronics*, 10(7), 809.
- 18. Weinberger, M., Bilgeri, D., & Fleisch, E. (2016). IoT business models in an industrial context. *at-Automatisier-ungstechnik*, 64(9), 699-706. DOI: 10.1515/auto-2016-0054
- 19. Zeinab, K. A. M., & Elmustafa, S. A. A. (2017). Internet of things applications, challenges and related future technologies. *World Scientific News*, 67(2), 126-148.

Mapping the Evolution of Leadership 4.0: A Bibliometric Analysis

Zuzana Skorková 1,*, Katarína Procházková 2

- ¹ Faculty of Business Management, University of Economics in Bratislava, Slovakia, zuzana.skorkova@euba.sk
- ² Faculty of Business Management, University of Economics in Bratislava, Slovakia, katarina.prochazkova@euba.sk
- * Correspondence: zuzana.skorkova@euba.sk;

Abstract: In the context of digitization and technological progress, the concept of "Leadership 4.0" has emerged as a central focus in discussions surrounding organizational management during the era of digital transformation. This research article conducts a bibliometric analysis within the field of Leadership 4.0, with the objective of comprehensively grasping the scope and dynamics of this subject within the academic domain. Employing a systematic examination of pertinent publication trends, influential authors, and citation relationships, we reveal noteworthy patterns that influence the trajectory of Leadership 4.0 research. Our contribution involves a bibliometric analysis of Leadership 4.0, utilizing 105 scientific outputs from the Web of Science database. The visualization of our findings is facilitated through VOSviewer version 1.6.18. The analysis offers an insight into the predominant themes explored by researchers and pinpoints potential avenues for future investigations in this dynamically evolving realm of leadership.

Keywords: Leadership 4.0, Digital leader, E-leader, bibliometric analysis, VOSviewer

Introduction

In the contemporary landscape of digital transformation, the concept of Leadership 4.0 takes center stage in the realm of organizational management. This era, marked by swift technological advancements and widespread digitization, demands a paradigm shift in leadership approaches. The impetus for Leadership 4.0 arises from the rapid evolution of technologies and the ongoing process of digital transformation, fundamentally altering the operational dynamics of organizations.

Digital leadership, intricately linked with Industry 4.0 (Bach & Sulíková, 2021; Karakose et al., 2022; Oberer & Erkollar, 2018), has emerged as a defining leadership style in this transformative age. The urgency and prominence of Leadership 4.0 gained momentum during the global upheaval caused by the Covid-19 pandemic (Krehl & Büttgen, 2022). With a substantial workforce transitioning to remote work, the pandemic has significantly influenced various spheres of public life, from business activities (Ziek & Smulowitz, 2014; Zulu & Khosrowshahi, 2021) to educational institutions (AlAjmi, 2022; Alward & Phelps, 2019).

Despite its increasing significance, the role of leadership, particularly digital leadership, in forging strategic alliances and fostering dynamic capabilities remains an underexplored territory (Mihardjo et al., 2019). This gap underscores the need for a deeper examination.

Conducting a bibliometric analysis on the concept of "Leadership 4.0" serves multiple beneficial objectives. Initially, it enables a thorough exploration of the current literature and research environment related to Leadership 4.0. This encompasses the identification of influential authors, noteworthy journals, and prominent trends in academic discussions. The bibliometric analysis of Leadership 4.0 contributes to the academic community by providing a structured summary, aiding in trend recognition, pinpointing research gaps, and promoting collaboration within this dynamic field of leadership studies.

Through a meticulous analysis encompassing publication trends, influential authors, and citations we aim to unravel significant patterns shaping the trajectory of Leadership 4.0 research. Our systematic exploration provides an insightful overview of the key themes researchers have delved into, pinpointing areas that merit further exploration in this dynamically evolving domain of leadership.

1. Theoretical background

Leadership is a multifaceted subject that invites various perspectives, each demanding distinct definition. In this investigation, we refrain from using the terms "manager" and "leader" interchangeably. Specifically, a manager is an individual with an official title and corresponding authority. Conversely, a leader, irrespective of managerial status, possesses the capacity to influence others. The possession of a formal position or managerial role is not obligatory for an individual to be considered a leader, as indicated by the work of (Lussier, 2015).

According to (Oberer & Erkollar, 2018) Leadership 4.0 represents the style of leadership relevant to the era of Industry 4.0. The Leadership 4.0 style, tailored for digital leaders, encompasses a rapid, cross-hierarchical, team-oriented, and collaborative approach, placing significant emphasis on fostering innovation.

Taxonomy of digital leadership types were characterized in the research of (Zulu & Khosrowshahi, 2021), who identified six themes: proactive and forward-thinking; supportive; uncoordinated; cautious; resistant and visionless and undriven leaders.

Leadership 4.0 is closely tied to the use of digital tools, leading to increased efficiency and the monitoring of team progress. However, as argued by (Goodhue & Thompson, 1995), flexibility in their selection is crucial. (Krehl & Büttgen, 2022) focused on the synchronization and categorization of these tools, addressing the issue of unnecessary tool fragmentation. The authors recommend the use of a smaller number of digital tools with greater functional variation. Nonetheless, Leadership 4.0 also emphasizes the need for emotional connection among team members, which proves particularly challenging in a remote environment. Research of (Zimmermann et al., 2008) highlights the complexity of communication in virtual space, which can lead to unnecessary misunderstandings and the experience of negative emotions. As (Krehl & Büttgen, 2022) asserts, remote leadership should prioritize effective communication over control. (Ilter et al., 2023) proved that relationship-oriented leadership behavior may promote employees' sense of belonging while working from home and prevent negative effects of isolation, poorer motivation, and impaired performance using appropriate media.

The work of (Quaquebeke & Gerpott, 2023) explores the impact of artificial intelligence on Leadership 4.0. It advocates for the need for a new skill among leaders, namely, setting ethical boundaries for increasingly powerful artificial intelligence (AI). It is evident that the algorithms themselves do not provide employees with unethical instructions for intentional harm or discrimination against certain individuals. Instead, they replicate biases inherent in the data on which they were trained. Upcoming leaders need to develop the ability to assess AI technology ethically, as merely providing transparency in algorithms appears inadequate (Leib et al., 2023). (Quaquebeke & Gerpott, 2023) assume that traditional managerial functions will be replaced by artificial intelligence, while leadership functions—focused on influencing, motivating, and human relationships—will remain within the realm of humans.

2. Methods and methodology

The examined publications were sourced from the Web of Science Database. An online literature search was carried out in September 2023, focusing on article with Title or Key words containing the words "virtual leader*" or "digital leader*" or "Leader* 4.0" or "e-leader" or "online leader* or "remote leader*". The research areas of Business Economics, Education Research or Psychology were selected. The database yielded a total of 105 resources, which included 73 articles, 14 proceeding Papers, 11 Editorial Materials, 9 Book Chapters, 6 Early Access, 3 Book Review and 3 Review Articles. The list of these documents was downloaded for further processing, utilizing VOSviewer version 1.6.18 to visually represent and analyze bibliometric trends. The research sample is described in more details in Table 1.

 Table 1. Description of the Papers Used in Bibliographic Analysis.

Results found	105
Citing articles Total	553
Citing articles without self-citations	515
Times cited Total	730
Times cited without self-citation	603
Times Cited – Average per item	6,95

11-111000

Source: Web of science (WOS) database.

3. Results and Discussion

Figure 1 depicts the temporal evolution of our research sample based on both the quantity of publications and the volume of citations. Based on Figure 1, we observe a significant rise in both the number of citations and publications, particularly in 2022. This graph underscores the current relevance of the topic. Simultaneously, we anticipate a continued growth trend, given the substantial number of publications dedicated to the topic this year as well.

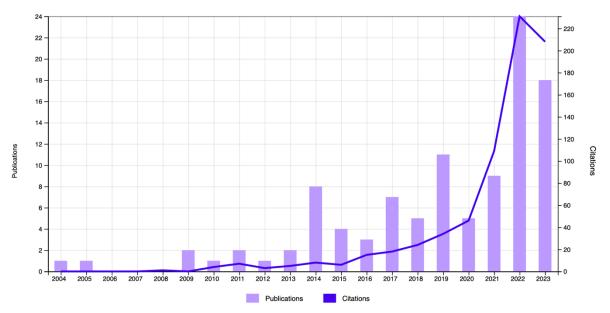


Figure 1. Times Cited and Publications Over Time, Articles from WOS.

Source: Web of science (WOS) database.

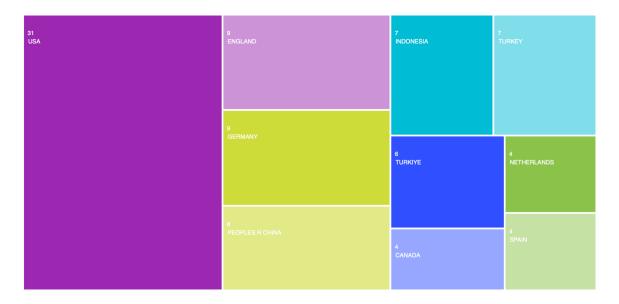


Figure 2. Articles by country.

Source: Web of science (WOS) database.

Based on Figure 2, we observe the countries of origin for the selected publications. The USA leads the rankings, followed by Germany and England.

In Table 2, we present an overview of the most cited works along with their respective authors. Despite the relatively recent emergence of the topic, these works have garnered a notably high number of citations. Frequently, the most cited papers serve as influential and foundational contributions to a specific field. Recognizing these highly cited papers is crucial for researchers and scholars as it helps identify key works that have significantly shaped the development of the subject. Authors of such highly cited papers are often regarded as thought leaders in their respective fields, providing valuable insights and expertise. One notable document is the article titled "How LEGO Built the Foundations and Enterprise Capabilities for Digital Leadership" (El Sawy et al., 2020), which holds the highest citation count at 121. This article discusses the strategic priorities of the LEGO Group, emphasizing digitization as a fundamental element for the company to maintain its position as a global industry leader.

Table 2. The most cited papers.

				Total
				Cita-
Title	Authors	Source Title	Year	tions
How LEGO Built the Foundations and				
Enterprise Capabilities for Digital Lead-	(El Sawy et al.,			
ership	2020)	Mis Quarterly Executive	2020	121
Leadership 4.0: Digital Leaders in the	(Oberer &	International Journal Of Organiza-		
Age of Industry 4.0	Erkollar, 2018)	tional Leadership	2018	55
	(Kane et al.,	•		
How Digital Leadership Is(n't) Different	2019)	Mit Sloan Management Review	2019	47
Impact of digital leadership capability on	,			
innovation performance: The role of plat-	(Benitez et al.,			
form digitization capability	2022)	Information & Management	2022	37
Remote Leadership, Communication Ef-	(Neufeld et al.,	0		
fectiveness and Leader Performance	2010)	Group Decision And Negotiation	2010	33
	,	Industrial And Organizational Psy-		
Virtual Leadership: An Important Lead-		chology-Perspectives On Science And		
ership Context	(Schmidt, 2014)	Practice	2014	26
Are Headmasters Digital Leaders in	(Altınay Aksal,	Egitim Ve Bilim-Education And Sci-		
School Culture?	2016)	ence	2016	23
The impact of digital leadership on teach-				
ers' technology integration during the		International Journal Of Educational		
COVID-19 pandemic in Kuwait	(AlAjmi, 2022)	Research	2022	20
Parameter and the second secon	(Zulu &			
A taxonomy of digital leadership in the	Khosrowshahi,	Construction Management And Eco-		
construction industry	2021)	nomics	2021	19
The Virtual Leader Construct: The Mass				
Mediatization and Simulation of Trans-	(Boje & Rhodes,			
formational Leadership	2005)	Leadership	2005	18
Paradoxical Virtual Leadership: Recon-				
sidering Virtuality Through a Paradox	(Purvanova &			
Lens	Kenda, 2018)	Group & Organization Management	2018	17
Development of a training concept for	11011010, 2010)	Group & Grantization management	2010	
leadership 4.0 in production environ-	(Helming et al.,			
ments	2019)	Research. Experience. Education.	2019	16
Leading Growth through the Digital	(Petrucci &			10
Leader	Rivera, 2018)	Journal Of Leadership Studies	2018	16
	(Ziek &	Julian of Bondolonip ordaneo	_510	10
The impact of emergent virtual leader-	Smulowitz,	Leadership & Organization Develop-		
ship competencies on team effectiveness	2014)	ment Journal	2014	16
Context Matters: Testing a Model of Re-		Journal Of Leadership & Organiza-	2011	10
mote Leadership	Kelloway, 2012)		2012	15
more readersuit	110way, 2012)	tional studies	2012	1.0

Source: Own processing based on WOS.

In VOSviewer analysis, we identified a total of 460 keywords, with a minimum occurrence threshold set at 3 times. Out of these, 46 keywords met the established threshold. These keywords were further organized into 5 clusters, comprising 45 distinct items. The analysis revealed a network of 366 links, showcasing the relationships between different keywords. The total link strength among these keywords amounted to 628, indicating the overall connectivity and strength of associations within the keyword network. By analyzing the co-occurrence of keywords, researchers can identify key themes or topics that are frequently discussed together in the literature. This helps in understanding the major areas of focus within a particular field. The clusters formed by related keywords can reveal emerging trends and shifts in research focus over time. Researchers can observe how certain topics gain or lose prominence within the academic community. The network of links between keywords provides insights into the relationships between different concepts. This helps researchers map out knowledge networks and understand the interconnectedness of ideas within a given domain. The clusters can be observed in Table 3.

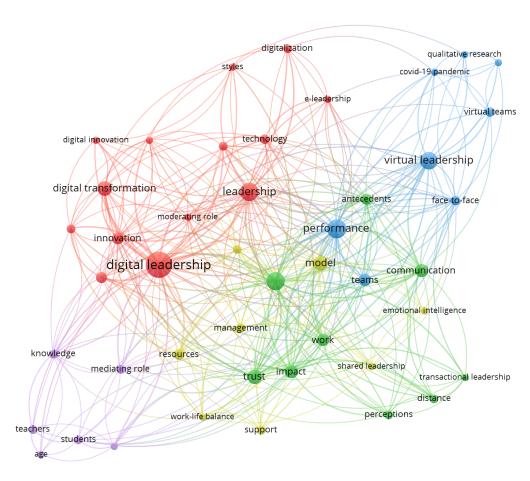


Figure 3. Bibliometric analysis by keywords and clusters.

Source: Own processing in VOSviewer.

Table 3. Bibliometric analysis by keywords – clusters.

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	
digital innovation	antecedents	covid-19 pandemic	emotional intelligence	age higher educa-	
digital leadership digital transfor-	communication	face-to-face	management	ion	
mation	distance	performance	model	knowledge	
digitalization	impact	qualitative research	resources	mediating role	

dynamic capabiliperception students ties remote leadership servant leadership e-leadership transactional leadership shared leadership teachers transformational leadership virtual leadership firm performance support virtual teams work-life balance implementation trust innovation work leadership moderating role styles technology transformation Source: Own processing.

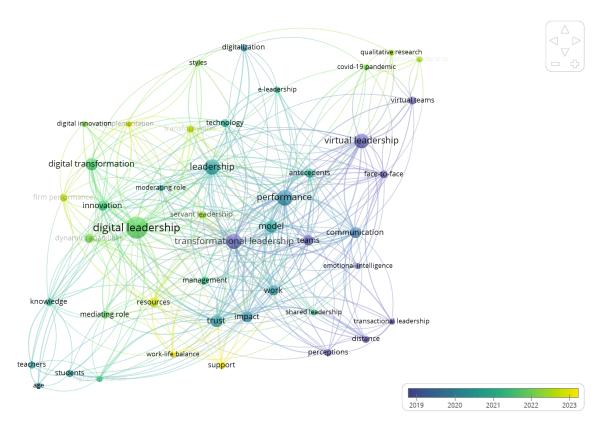


Figure 4. Bibliometric analysis by keywords and clusters, overlay visualization. **Source:** Own processing in VOSviewer.

The overlay map produced in VOSviewer depicts the progression of research on the chosen topic over four years. It reveals a transition in the initial research emphasis from virtual and transformational leadership to novel areas like work-life balance and firm performance. The color scale signifies the average publication dates for each term, ranging from 2019 to 2023, with endpoints automatically set by VOSviewer. Consequently, terms appearing in yellow might have a notably later average date in the dataset, while terms in dark blue may have an earlier average date.

5. Conclusions

In conclusion, our bibliometric analysis of Leadership 4.0 offers valuable insights into the evolving landscape of research within this dynamic field. The exploration of 105 scientific outputs from the Web

of Science database has allowed us to map out the current literature and identify influential authors, and significant publication trends.

The temporal evolution underscores the increasing relevance of Leadership 4.0. The surge in citations and publications, particularly in 2022, reflects the growing interest and importance of this topic within academic discourse. This momentum is likely to continue, given the substantial number of publications dedicated to the subject. The identification of the most cited papers, such as "How LEGO Built the Foundations and Enterprise Capabilities for Digital Leadership," highlights key contributions that have significantly shaped the development of Leadership 4.0. These works provide foundational insights and contribute to the thought leadership in this domain. Our keyword analysis identifies 460 keywords organized into 5 clusters. This network of keywords and clusters allows researchers to discern major themes, track emerging trends, and understand the interconnections within the field. The overlay map further visualizes the progression of research, indicating shifts from virtual and transformational leadership to newer areas like work-life balance and firm performance.

In summary, our comprehensive bibliometric analysis contributes to the academic community by offering a structured summary, aiding in trend recognition, pinpointing research gaps, and promoting collaboration within the evolving realm of Leadership 4.0 studies. This research sets the stage for future investigations, guiding scholars toward unexplored territories and facilitating a deeper understanding of the multifaceted landscape of digital leadership.

Funding: This research was funded by KEGA 001EU-4/2021 – Project of a study program in field of economics and management, which reflects conditions of digital age, appeal of sustainability of economic activity and global citizenship and VEGA 1/0623/22 Virtualization in people management– employee life cycle in businesses in the era of digital transformation.

References

- 1. AlAjmi, M. K. (2022). The impact of digital leadership on teachers' technology integration during the COVID-19 pandemic in Kuwait. International Journal of Educational Research, 112, 101928. https://doi.org/10.1016/j.ijer.2022.101928
- 2. Altınay Aksal, F. (2016). Are Headmasters Digital Leaders in School Culture? TED EĞİTİM VE BİLİM, 40(182). https://doi.org/10.15390/EB.2015.4534
- 3. Alward, E., & Phelps, Y. (2019). Impactful Leadership Traits of Virtual Leaders in Higher Education. Online Learning, 23(3). https://doi.org/10.24059/olj.v23i3.2113
- 4. Bach, C., & Sulíková, R. (2021). Leadership in the Context of a NewWorld: Digital Leadership and Industry 4.0. Managing Global Transitions, 19(3), 209–226. https://doi.org/10.26493/1854-6935.19.209-226
- 5. Benitez, J., Arenas, A., Castillo, A., & Esteves, J. (2022). Impact of digital leadership capability on innovation performance: The role of platform digitization capability. Information & Management, 59(2), 103590. https://doi.org/10.1016/j.im.2022.103590
- 6. Boje, D. M., & Rhodes, C. (2005). The Virtual Leader Construct: The Mass Mediatization and Simulation of Transformational Leadership. Leadership, 1(4), 407–428. https://doi.org/10.1177/1742715005057232
- 7. El Sawy, O. A., Kræmmergaard, P., Amsinck, H., & Vinther, A. L. (2020). How LEGO Built the Foundations and Enterprise Capabilities for Digital Leadership. V R. D. Galliers, D. E. Leidner, & B. Simeonova (Ed.), Strategic Information Management (5th vyd., s. 174–201). Routledge. https://doi.org/10.4324/9780429286797-8
- 8. Goodhue, D. L., & Thompson, R. L. (1995). Task-Technology Fit and Individual Performance. MIS Quarterly, 19(2), 213–236. https://doi.org/10.2307/249689
- 9. Helming, S., Ungermann, F., Hierath, N., Stricker, N., & Lanza, G. (2019). Development of a training concept for leadership 4.0 in production environments. Procedia Manufacturing, 31, 38–44. https://doi.org/10.1016/j.promfg.2019.03.007
- 10. Ilter, Y., Barth-Farkas, F., & Ringeisen, T. (2023). Digitale Führungskommunikation und organisationale Bindung von Beschäftigten im Homeoffice. Gruppe. Interaktion. Organisation. Zeitschrift für Angewandte Organisationspsychologie (GIO), 54(2), 259–271. https://doi.org/10.1007/s11612-023-00676-7
- 11. Kane, G. C., Phillips, A. N., Copulsky, J., & Andrus, G. (2019). How Digital Leadership Is(n't) Different. MIT Sloan Management Review. https://sloanreview.mit.edu/article/how-digital-leadership-isnt-different/
- 12. Karakose, T., Kocabas, I., Yirci, R., Papadakis, S., Ozdemir, T. Y., & Demirkol, M. (2022). The Development and Evolution of Digital Leadership: A Bibliometric Mapping Approach-Based Study. Sustainability, 14(23), Article 23. https://doi.org/10.3390/su142316171

- 13. Kelley, E., & Kelloway, E. K. (2012). Context Matters: Testing a Model of Remote Leadership. Journal of Leadership & Organizational Studies, 19(4), 437–449. https://doi.org/10.1177/1548051812454173
- 14. Krehl, E.-H., & Büttgen, M. (2022). Uncovering the complexities of remote leadership and the usage of digital tools during the COVID-19 pandemic: A qualitative diary study. German Journal of Human Resource Management, 36(3), 325–352. https://doi.org/10.1177/23970022221083697
- 15. Leib, M., Köbis, N., Rilke, R. M., Hagens, M., & Irlenbusch, B. (2023). Corrupted by Algorithms? How Algenerated and Human-written Advice Shape (Dis)honesty (arXiv:2301.01954). arXiv. https://doi.org/10.48550/arXiv.2301.01954
- Lussier, R. N. (2015). Leadership: Theory, application and skill development / by Robert N. Lussier and Christopher F. Achua (6th ed.). Cengage Learning.
- 17. Mihardjo, L. W. W., Sasmoko, S., Alamsjah, F., & Elidjen, E. (2019). Digital Leadership Impacts on Developing Dynamic Capability and Strategic Alliance Based on Market Orientation. Polish Journal of Management Studies, 19(2), 285–297. https://doi.org/10.17512/pjms.2019.19.2.24
- 18. Neufeld, D. J., Wan, Z., & Fang, Y. (2010). Remote Leadership, Communication Effectiveness and Leader Performance. Group Decision and Negotiation, 19(3), 227–246. https://doi.org/10.1007/s10726-008-9142-x
- 19. Oberer, B., & Erkollar, A. (2018). Leadership 4.0: Digital Leaders in the Age of Industry 4.0. International Journal of Organizational Leadership, 7(4), 404–412. https://doi.org/10.33844/ijol.2018.60332
- 20. Petrucci, T., & Rivera, M. (2018). Leading Growth through the Digital Leader. Journal of Leadership Studies, 12(3), 53–56. https://doi.org/10.1002/jls.21595
- 21. Purvanova, R. K., & Kenda, R. (2018). Paradoxical Virtual Leadership: Reconsidering Virtuality Through a Paradox Lens. Group & Organization Management, 43(5), 752–786. https://doi.org/10.1177/1059601118794102
- 22. Quaquebeke, N. V., & Gerpott, F. H. (2023). The Now, New, and Next of Digital Leadership: How Artificial Intelligence (AI) Will Take Over and Change Leadership as We Know It. Journal of Leadership & Organizational Studies, 30(3), 265–275. https://doi.org/10.1177/15480518231181731
- 23. Schmidt, G. B. (2014). Virtual Leadership: An Important Leadership Context. Industrial and Organizational Psychology, 7(2), 182–187. https://doi.org/10.1111/iops.12129
- 24. Ziek, P., & Smulowitz, S. (2014). The impact of emergent virtual leadership competencies on team effectiveness. Leadership & Organization Development Journal, 35(2), 106–120. https://doi.org/10.1108/LODJ-03-2012-0043
- 25. Zimmermann, P., Wit, A., & Gill, R. (2008). The Relative Importance of Leadership Behaviours in Virtual and Face-to-Face Communication Settings. Leadership, 4(3), 321–337. https://doi.org/10.1177/1742715008092388
- 26. Zulu, S. L., & Khosrowshahi, F. (2021). A taxonomy of digital leadership in the construction industry. Construction Management and Economics, 39(7), 565–578. https://doi.org/10.1080/01446193.2021.1930080

Factors affecting the level of digitization in Slovakia

Filip Stovíček 1, Lucia Čerňanová 2 and Vanda Čirčová 3

- ¹ Faculty of Business Management, University of Economics, Bratislava, Slovakia; filip.stovicek@euba.sk
- ² Faculty of Business Management, University of Economics, Bratislava, Slovakia; lucia.cernanova@euba.sk
- ³ Faculty of Business Management, University of Economics, Bratislava, Slovakia; vanda.circova@euba.sk

Abstract: . This article is focused on evaluating Slovakia's position in the Digital Economy and Society Index (DESI) as a measure of digitization in the countries of the European Union. The aim of the article is to identify the level of digitization measured by the DESI index. The results of the article identify the DESI dimensions in which Slovakia has the greatest shortcomings, but at the same time there is room for improvement. Statistical analyzes are used to investigate interdependencies between the position in the DESI index and the basic macroeconomic factor - GDP. The findings of the study provide valuable insights for policymakers, enterprises and stakeholders in Slovakia, enabling a deeper understanding of the driving forces of digitization.

Keywords: digitization, DESI index, European Union

Introduction

Due to the rapid advancement of technology, digitalization has emerged as a critically important theme in all nations across the globe, including Slovakia. Digitalizing various sectors of the economy has the potential to deliver diverse benefits, such as enhancing productivity and competitiveness. However, the degree of digitalization varies considerably among nations since it is subject to several factors. Various indices are available for quantifying the extent of digitalization.

This article concentrates on evaluating Slovakia's standing in the Digital Economy and Society Index (DESI), which gauges the level of digitalization in distinct European Union countries. The objective of this article is to ascertain the association between the level of digitalization measured by the DESI index and the fundamental macroeconomic indicator in each nation - GDP.

Statistical approaches have been employed in the article to scrutinize the interrelationships between the level of digitalization as gauged by the DESI index and the fundamental demographic and macroeconomic factors affecting digitalization. The outcomes of this study will offer insights that can aid policymakers, businesses, and other stakeholders in Slovakia in gaining a more comprehensive understanding of the factors impacting digitalization. Based on the findings, effective strategies can be formulated to facilitate and expedite the digital transformation of the country.

1. Theoretical background

The digital transformation denotes the process of introducing technologies into the societal environment, including the business sector. This process occurs through the development of technologies, whose impact on society is significant [Feroz et al., 2021]. The digitization process can be characterized as the conversion of analog information into digital, changing the way of economic and social life [Balcerzak – Pietrzak, 2017]. Digitization of business and public processes brings benefits to the entire society [Khan – Aftab, 2015]. The benefits brought about by digital transformation manifest themselves in the economic, social, and political aspects of life [Barrutia – Echebarria, 2021].

The process of digital transformation primarily involves the utilization of:

- Communication technologies, such as the internet and mobile networks,
- Devices designed for data collection, including various types of sensors,
- Technologies aimed at data processing, including artificial intelligence and neural networks [Ghobakhloo Iranmanesh, 2021].

The level of digitalization of businesses is to a certain degree impacted by the industry in which they operate. Various industries exhibit varying degrees of potential for digital transformation, with some having undergone considerable digital transformation much earlier than others, while some are only in the nascent stages of this process [Wlomert – Papies, 2016]. As an example of industry digitization, we can mention the music or film industry, where in recent years the sale of physical media has virtually ceased and these industries have been dominated by streaming services such as Spotify, Apple Music, Netflix, HBO Max, while services such as Airbnb and Booking.com have taken over the hotel industry [Verhoef et al., 2021].

1.1 Digitization as a competitive advantage

Digitization is a term that has been defined by several authors in professional literature. In the context of the business environment, digitization refers to investing in new technologies through which companies can effectively compete in a constantly changing environment [Gruber, 2018]. Thus, digitization can bring a competitive advantage to businesses, as it provides opportunities for entering new markets and acquiring new revenues.

In today's world, knowledge, which includes the process of digitization, is considered a fundamental element necessary to maintain a competitive advantage [Koch – Windsperger, 2017]. However, businesses and public administration authorities often struggle to find suitable tools to capture the current trend of digitizing processes. The process of digital transformation has become a key tool for improving competitiveness [Melovic et al, 2020]. Digital tools and applications have become the driving force behind the economy, thanks to the exponential growth in digital technologies in recent years. This growth has had a significant impact on the innovation introduced through digitization [Tajudeen et al., 2022]. Consequently, the importance of utilizing digital transformation is increasingly emphasized in society. Digitization can be defined as a ubiquitous synergy of digital innovations in the economy and society [Perez, 2015].

The importance of digitization is also recognized by governments of individual countries. Without adequate support, other countries will not be able to compete with the leaders of digitization and will not be able to ensure proper development. The European Union, for instance, adopted the Strategy for a Digital Single Market in 2015 [EP, 2015]. The European Commission is responsible for collecting data to assess the level of digitization in member states. In addition to the common European Strategy for a Digital Single Market, all EU member states have developed specific strategies to achieve their development and progress in the context of digital transformation.

Slovakia has defined its strategy for digital transformation until 2030, which focuses on the gradual implementation of digitization elements into the public sector and society. This implementation will facilitate businesses in implementing individual elements of Industry 4.0 into their processes. The digitization process has changed the way economic value is created. It influences the functioning of markets and creates new markets [MIRRI SR, 2019].

2. Methods and methodology

The main goal of this paper is to identify Slovakia's position in the DESI ranking (Digital Economy and Society Index), while also comparing Slovakia's standing with that of neighboring countries (V4 countries) across various dimensions of the DESI. We will examine the relationship between the basic economic indicator and the position of the countries in the DESI ranking. The outcome of this study will involve formulating recommendations to enhance Slovakia's digital proficiency.

2.1 Object of research

The object of investigation of this article is Slovakia, other V4 countries and Finland. In the following table, we present basic data on selected countries.

Table 2: Information about object of research

	Poland	Hungary	Czech re- public	Slovakia	Finland
Population	38.2 mil.	9.7 mil.	10.5 mil.	5.4 mil.	5.5 mil.
GDP per capita	43 455	42 665	49 957	36 704	59 808

Household debt (% of	= 0.40/	45.00/	77. 20/	04.004	454.00/
disposable income)	59.1%	45.2%	77.3%	86.9%	154.9%
Government debt (% of	68.3%	88.6%	48.4%	79.8%	92.20/
GDP)	08.3%	88.0%	48.4%	79.8%	82.3%
DESI Index 2022	24.	22.	19.	23.	1.

Source: OECD website: https://www.oecd.org/ [03.05.2023]

The basic data from Tables 1 will be used in a later analysis to investigate the dependencies between the position in the DESI index and the GDP adjustment.

2.2 Methodology of research

The present article relies on the utilization of the DESI ranking as its foundation. The analysis concentrates on the time span from 2018 to 2022. The DESI ranking has been compiled on a regular basis since 2014, featuring profiles of individual European Union countries and highlighting areas in need of prioritized actions. DESI encompasses four fundamental dimensions and monitors a total of 33 digitization-level indicators [3]. The structure of DESI is presented in the subsequent table.

Table 3: The Digital Economy and Society Index (DESI)

Dimension	Sub-dimension	Indicator
Human capital	Internet user skills Advanced skills and development	At least basic digital skills, Above basic digital skills, At least basic digital content creation skills, ICT specialists, Female ICT specialists, Enterprises providing ICT training, ICT graduates
Connectivity	Fixed broadband take-up Fixed broadband coverage Mobile broadband Broadband prices	Overall fixed broadband take-up, At least 100 Mbps fixed broadband take-up, At least 1 Gbps take-up, Fast broadband (NGA) coverage, Fixed Very High Capacity Network (VHCN) coverage, 5G spectrum, 5G coverage, Mobile broadband take-up, Broadband price inde
Integration of digital technol- ogy	Digital intensity Digital technologies for businesses e-Commerce	SMEs with at least a basic level of digital intensity, Electronic information sharing, Social media, Big data, Cloud, AI, ICT for environmental sustainability, e-Invoices, SMEs selling online, e-Commerce turnover, Selling online cross-border
Digital public services	e-Government	e-Government users, Pre-filled forms, Digital public services for citizens, Digital public services for businesses, Open data

Source: European Commission – The Digital Economy and Society Index — Countries' performance in digitisation, website: https://digital-strategy.ec.europa.eu/en/policies/countries-digitisation-performance/ [10.05.2023]

Following the literature review and the outlined methodology, the subsequent research questions were formulated:

RQ1: What is the extent of Slovakia's digital competitiveness as indicated by the DESI index?

RQ2: How is Slovakia's digital competitiveness progressing in comparison to the V4 countries?

RQ3: What is the correlation between countries' rankings in the DESI index and their GDP per capita levels?

These research questions were established as a complementary pursuit to the primary objective of this study, and addressing them will ensure the accomplishment of the main goal.

3. Results

In the analytical part of the contribution, we focused on defining the level of digital competitiveness of Slovakia according to the DESI ranking. The following graph shows the results of Slovakia in comparison with the V4 countries and the average of the European Union countries for the years 2018 - 2022.

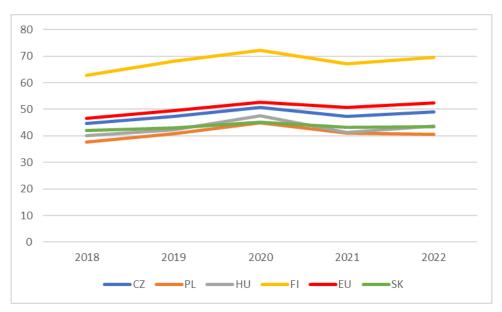


Figure 3: Overall rank in DESI index 2018 – 2022 in Slovakia, V4 countries and Finland **Source:** own processing according to DESI Index

As depicted in the graph, Slovakia, along with the other V4 countries, attained DESI index scores below the average level of European Union countries during the period of 2018-2022.

Among the V4 countries, the Czech Republic consistently achieved the highest level, while Poland exhibited consistently weaker results. Slovakia and Hungary performed at similar levels and exchanged positions in the DESI ranking, occupying the 22nd and 23rd spots in the years 2021 and 2022.

Finland has consistently held the leading position in the DESI index over the long term. Throughout the years 2018-2022, Finland secured the top rank three times and second place twice. In 2022, the score difference between Finland (69.6) and Slovakia (43.4) amounted to 26.2. The subsequent section of this article delves into a detailed examination of the factors contributing to the disparities among countries.

3.1. Analysis of the development of DESI index dimension in selected countries

A detailed analysis of the individual dimensions of the DESI index and their year-on-year changes has shown that the most significant changes occur in the Connectivity dimension. For clarity, we have highlighted all the year-on-year changes that were greater than 3 in the Table 3..

Slovakia is the only one among the selected countries that did not experience a change of more than 3 positions in any of the dimensions throughout the observed period.

In the Human capital dimension, it has worsened by 1 position overall since 2018, in the Connectivity dimension, it is currently at the same position as in 2018, in the Integration of digital technology dimension, it worsened by 3 positions in 2019 and has remained at that rank since then, in the Digital public services dimension, it worsened by 2 positions since 2018.

The results for the individual dimensions have also reflected in the overall result, with Slovakia worsening by 3 positions since 2018. In 2018, Slovakia was ranked 20th, and in 2022, it ranked 23rd out of all European Union countries, which indicates a placement near the bottom of the ranking.

Table 4: Year-on-year changes in positions in individual dementias of the DESI index for Slovakia, the V4 countries and Finland

		2019-2018	2020-2019	2021-2020	2022-2021
	Slovakia	0	-2	+1	0
	Czech	0	+2	-1	0
Human capital	Poland	+2	0	-2	0
	Hungary	-1	+1	-3	-1
	Finland	0	0	0	0
	Slovakia	-3	+3	+2	-2
Connectivity	Czech	0	-5	+2	+5
	Poland	-2	+5	-6	-4
	Hungary	-2	+9	-5	-1
	Finland	+7	-3	-4	+5
Integration of digital technology	Slovakia	-3	0	0	0
	Czech	0	+1	-6	-4
	Poland	0	+1	+1	-1
	Hungary	0	-2	0	+1
	Finland	-2	+3	+1	0
	Slovakia	-1	-1	+3	-1
Dicital muhlic con	Czech	0	-1	+2	+3
Digital public ser- vices	Poland	0	0	-2	0
vices	Hungary	0	+2	-1	+4
	Finland	0	-1	+1	+1
	Slovakia	-1	-1	0	-1
	Czech	+1	+1	-1	-1
Overall Rank	Poland	-1	+2	-1	0
	Hungary	0	+1	-2	+1
	Finland	+1	0	-1	+1

Source: own processing according to DESI Index

Similarly, to Slovakia, the other V4 countries are also experiencing stagnation. Interestingly, despite minor year-on-year changes, all V4 countries remained at the same position in 2022 as in 2018.

As we mentioned at the beginning of this subsection, the most significant year-on-year changes occur in the Connectivity dimension. Even the long-term leader of the DESI index, Finland, achieves inconsistent results in this dimension. This signifies a highly turbulent and rapidly changing dimension, where it is currently challenging for any country to gain a competitive advantage.

The dimensions that the V4 countries should pay increased attention to and strive to improve the most are Human capital and Digital public services. In the Human capital dimension, Finland remains the long-term leader (holding the first position in this dimension from 2018 to 2022), and we can conclude that it gains a competitive advantage over other European Union countries thanks to this dimension.

Another dimension with significant room for improvement in the V4 countries is Digital public services. As we can see from the results in Table 3, Hungary achieved a 4-position improvement in this dimension in 2022, which also contributed to its overall improvement by 1 position.

3.2. Analysis of the relationship between the level of GDP and the position in DESI index

In the subsequent section of the article, we focus on conducting a statistical analysis to examine the relationship between GDP level and the country's position or score in the DESI ranking.

Gross Domestic Product (GDP) serves as a fundamental macroeconomic measure that reflects the performance of an economy. When comparing different countries based on GDP level, it is crucial to consider the population size of each country. To avoid result distortion, we utilize the GDP per capita indicator.

We examined the relationship between the level of GDP per capita and the score in the DESI index in the statistical program Jamovi. We present the achieved results in the following table.

Table 5: Relationship between the level of GDP per capita and the score in the DESI Model Fit Measures

				Overall Model Test			
Model	R	\mathbb{R}^2	Adjusted R ²	F	df1	df2	p
1	0.53	0.28	0.25	9.81	1	25	0.004

Source: own processing

According to the results in Table 4, we can see that the significance level of p is less than 0.05. Based on the achieved result, we can conclude that the test is statistically significant. We can therefore conclude that the level of GDP per capita affects the level of the achieved score in the DESI ranking.

4. Discussion

The analysis of Slovakia's position in the DESI index over the years 2018-2022 revealed consistent rankings below the European Union average. The V4 countries, including Slovakia, experienced stagnation in their positions throughout this period. The Connectivity dimension emerged as the most volatile, indicating the rapid changes and challenges in this domain. Human capital and Digital public services were identified as key dimensions requiring improvement.

The statistical analysis demonstrated a significant relationship between the level of GDP per capita and the score in the DESI ranking. This suggests that economic development, as reflected by GDP per

capita, is directly linked to a country's position in digitization. Countries with higher GDP per capita tend to have higher scores in the DESI index, underlining the economic influence on digitization efforts.

The article recognizes that digitalization is a global phenomenon with profound implications for various sectors of society. It aligns with the broader global trend of countries prioritizing digitization to enhance competitiveness, economic growth, and innovation.

The findings have direct implications for policymakers in Slovakia. The identification of areas for improvement, specifically Human capital and Digital public services, highlights where policy efforts should be focused. Investment in education and digital infrastructure, as well as the promotion of egovernment services, can accelerate the digital transformation.

Future research can delve deeper into comparative analyses of V4 countries' digitization efforts. Investigating the specific policies and initiatives undertaken by these countries could provide insights into why certain countries perform better than others.

Conducting case studies on successful digital transformation initiatives within Slovakia can offer practical insights for businesses and policymakers. Examining best practices and success stories can help identify strategies for overcoming digitalization challenges.

Analyzing long-term trends in digitalization and its impact on economic growth and competitiveness would provide a comprehensive understanding of the evolving digital landscape. This research can track the progress made by Slovakia and other countries over extended periods.

Exploring how different sectors within Slovakia are embracing digital technologies can provide a nuanced understanding of the challenges and opportunities in various industries. This analysis can guide targeted interventions for sector-specific digital transformation.

5. Conclusions

Digitization is a contemporary phenomenon that has a profound impact on all aspects of life. Slovakia, like all European Union countries, experiences significant effects from digitalization.

Our article focuses on analyzing the Digital Economy and Society Index (DESI), and the findings reveal that Slovakia lags behind developed EU countries in terms of digitization.

The results confirm that the level of digitization is directly proportional to a country's economic development and is influenced by state support for digitization initiatives.

The identified areas for improvement, namely Human capital and Digital public services, require enhanced state support to foster progress in digitization. It is crucial for policymakers, businesses, and stakeholders in Slovakia to recognize the significance of these dimensions and work towards implementing effective strategies to accelerate the country's digital transformation. By addressing the identified areas, Slovakia can strive towards closing the digital gap and reaping the benefits of a digitally advanced society.

Funding:

This research was supported by internal grant project of the University of Economics in Bratislava No. I-23-102-00 Development of the Business Environment for Small and Medium Enterprises in Slovakia due to the implementation of Industry 4.0 Elements.

This research was supported by Slovak Academy of Sciences VEGA project No. 1/0582/22 Dimensions of cross-sectoral entrepreneurship of cultural and creative industry entities in the context of sustainable development.

This research was supported by Slovak Academy of Sciences VEGA project No. 1/0623/22 Virtualization in people management– employee life cycle in businesses in the era of digital transformation.

References

1. Balcerzak, A. P. - Pietrzak, M. B. (2017). Digital economy in Visegrad Countries. Multiplecriteria decision analysis at regional level in the years 2012 and 2015. DOI: 10.7441/joc.2017.02.01

- 2. Khan, S., Khan, S., AFTAB, M. (2015). Digitization and its impact on economy. IN: International Journal of Digital Library Services. Vol. 5, pp. 138-149. ISSN: 2250-1142.
- European Commission. (2023). The Digital Economy and Society Index Countries' performance in digitization. [online]. Available from: https://digital-strategy.ec.europa.eu/en/policies/countries-digitisation-performance
- 4. European Parliament. (2015). The ubiquitous digital single market. Report [online]. Available from: https://www.europarl.europa.eu/factsheets/en/
- 5. Feroz, A. et. al. (2021). Digital Transformation and Environmental Sustainability: A Review and Research Agenda. DOI: https://doi.org/10.3390/su13031530
- 6. Gruber, M. (2018). Digitalization in SME: A Framework to Get From Strategy to Action. In: A Master's Thesis submitted for the degree of Master of Business Administration. DOI: https://doi.org/10.34726/hss.2018.57297
- 7. Koch, T. Windsperger, J. (2017). Seeing through the network: Competitive advantage in the digital economy. IN: Journal of Organization Design. Vol. 6, pp. 1-30. DOI: https://doi.org/10.1186/s41469-017-0016-z
- 8. Perez, C. (2015). From long waves to great surges. IN: European Journal of Economic and Social Systems. Vol. 27, pp. 69 80. [online]. Available from: https://ideas.repec.org/a/ris/ejessy/0005.html
- 9. Tajudeen, F. P. et al. (2022). The impact of digitalisation vision and information technology on organisations' innovation. IN: European Journal of Innovation Management, Vol. 25, pp. 607-629. ISSN: 1460-1060.
- Ministerstvo investícií regionálneho rozvoja a informatizácie SR. (2019). Stratégia digitálnej transformácie Slovenska 2030. Report [online]. Available from: https://www.mirri.gov.sk/wp-content/up-loads/2019/06/Strategia-digitalnej-transformacie-Slovenska-2030.pdf
- 11. Barrutia, J. M. Echebarria, C. (2021). Effect of the COVID-19 pandemic on public managers' attitudes toward digital transformation. IN: Technology in Society, Vol. 67. DOI: https://doi.org/10.1016/j.techsoc.2021.101776
- 12. Melovic, B, et al. (2020). The impact of digital transformation and digital marketing on the brand promotion, positioning and electronic business in Montenegro. IN: Technology in Society, Vol. 63. DOI: https://doi.org/10.1016/j.techsoc.2020.101425
- 13. Ghobakhloo M. Iranmanesh, M. (2021). Digital transformation success under Industry 4.0: A strategic guide-line for manufacturing SMEs. IN: Journal of Manufacturing Technology Management, Vol. 32, pp. 1533-1556. ISSN: 1741-038X.
- 14. Verhoef, P. et. al. (2021). Digital transformation: A multidisciplinary reflection and research agenda. Journal of Business Research, 122, pp. 889 901. ISSN 0148-2963.
- 15. Wlomert, N. Papies, D. (2016). On-demand streaming services and music industry revenues Insights from Spotify's market entry. DOI: https://doi.org/10.1016/j.ijresmar.2015.11.0027.

Does Organizational Complexity Drive Green Innovation and so the Growth of Competitiveness Through Employee Motivation Tools?

Branislav Zagoršek 1,*, Andrea Čambalíková 2 and Martin Novysedlák 3

- ¹ Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia; branislav.zagorsek@euba.sk
- ² Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia; andrea.cambalikova@euba.sk
- ³ Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia; martin.novysedlak@euba.sk
- * Correspondence: branislav.zagorsek@euba.sk

Abstract: In this paper, we present a pilot research study to explore how pro-environmental employee motivation mediates the effect of organizational complexity on green innovation. In the current state of the world, where there is strong pressure to become more environmentally conscious, our study suggests a possible path to achieve this goal. Our objective was to test the structural model of pro-environmental employee motivation mediating the relationship between organizational complexity and green innovation. To investigate this, we used the SEM PLS method with the semopy package on a sample of 210 companies. Although the path coefficients were significant and provided valuable insights, the poor model fit did not allow us to further interpret the results. Instead, our findings suggest a promising direction for future research.

Keywords: Green Innovation, Organizational Complexity, Motivation

Introduction

Researchers are exploring potential relationships to increase innovation success and promote a shift towards green innovation. In our paper, we investigate whether organizational complexity affects green innovation and if employee motivation strategies related to green innovation mediate this effect.

The purpose of our publication is to explore possible relationships and find inspire future research.

To address our research question, we formulated the following hypotheses depicted on the Figure 1:

Hypothesis H1: More complex organizations are more likely to implement green innovations due to greater intellectual resources and increased opportunities for innovation.

Hypothesis H2: Employee motivation strategies mediate the impact of organizational complexity. This is because more complex organizations tend to have advanced tools to motivate employees. This motivation may translate into positive reinforcement for pro-environmental behavior and green innovation.

Hypothesis H2a: For H2 to hold true, there must be an influence of organizational complexity on employees' pro-environmental motivation strategies. More complex organizations typically have a wider variety of channels to introduce such strategies.

Hypothesis H2b: H2 can only be valid if there's an effect of employees' pro-environmental motivation strategies on green innovation, resulting from successful positive reinforcement.

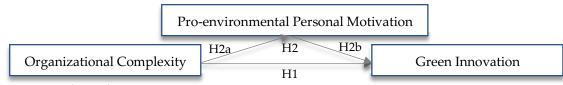


Figure 1. Hypotheses diagram

Source: Original

1. Theoretical background

The traditional relationship between innovation and predictors, such as organizational complexity has been well-documented in the past (Blau & McKinley, 1979). However, there exists a contextual gap regarding how this concept adapts to the current era marked by pro-environmental behavior and the AI revolution. While the question of innovation capacity and stimulus was explored by Prajogo & Ahmed (2006), a contextual gap remains in this area too. Meanwhile, innovation capacity can be conceptualized as organizational complexity, with the idea that a more complex system offers a broader array of opportunities for innovation. The influence of leadership and human resource management factors, considered as employee motivation, on green innovation has been proposed by various studies (Singh et al.,,, 2020; Awan et al., 2023, Song et al., 2022). These studies suggest that there is good foundation for our model and that there is a need to investigate the research gap.

2. Methods and methodology

To test our hypothesis, we employed the SEM_PLS method. The SEM_PLS approach was selected because it aligns well with our research direction. Given the exploratory nature of our study, the relatively small sample size, and the complex constructs involved, this method allows for the assessment of latent variable interactions and provides a more precise evaluation.

We aimed to collect cross-industry data from various industries and company sizes because green innovation spans across sectors. Our participants consisted of employees or owners from 252 companies in Slovakia. We utilized a nonprobability convenience sampling method to gather data. Although this sampling method was used, we did not identify any evident bias; therefore, we consider our sample to be almost as representative as a random sample. Our questionnaire garnered a total of 252 responses. After evaluating control questions, we had 210 valid respondents. All data were collected in November and December of 2022.

Our overall research sample was well-distributed: 29.7% micro-sized companies, 25.6% small-sized companies, 17.5% medium-sized companies, and 27.2% large-sized companies. The majority (72.5%) of the companies we studied have been in operation for over 10 years, while 12.1% have been in business for less than 5 years. In terms of industry distribution: 36.9% were in the service industry, 31.3% in manufacturing, 22.5% in trade, 6% in gastronomy, and 3.2% were software companies.

Table 1 provides an overview of the selected measurement variables and their respective scales.

For the SEM_PLS analysis, we used the Python programming language and the semopy package, as detailed in Igolkina & Meshcheryakov (2020) and Meshcheryakov et al. (2021). We addressed missing data through mean replacement, given that the missing percentage was below 5% and displayed no clear bias. Model fit was assessed using metrics such as CFI, RMSEA, among other fit indices.

Variable Description

The latent construct Organizational Complexity encapsulated three variables: company size by revenue, company size by the number of employees, and the organization's complexity concerning innovation. We gauged company size using the EU's standard 4-level scale, ranging from micro to large-sized companies. The complexity variable probed how innovation was structured within companies, whether it was managed by a specialized department, involved cross-organizational collaboration, or followed an open model.

The latent construct Green Innovation reflected 13 variables, as detailed in Table 1, which measured the scope and type of implemented green innovations. We recorded these as dummy variables, indicating whether a company had adopted them.

Lastly, the variable Pro-environmental Personal Motivation was measured as a dummy variable, denoting whether companies employed personal motivation tools to drive green innovations.

3. Results

In Table 1, we detail the observed variables, providing both their frequencies and the Cronbach's Alpha values for the constructs as descriptive statistics.

Table 1. Descriptive statistics of variables

Variable	Name	Fre	quen	cies (%	(_o)	Alpha
Organizational complexity	organizational_complex	1	2	3	4	0.7368
Company size by employees	sizeemp	29	26	19	26	
Company size by revenue	sizerev	38	20	21	22	
Complexity of organizational						
structure for innovation	innocompeten	11	66	21		
Proenvironmental behavior						
employee motivation	empl_motiv	0	1			NA()
Proenvironmental behavior						
employee motivation	v43	76	23			
Green innovation	green_inn_incl	0	1			0.8145
Products	envfriinarea	59	41			
Manufacturing process	v40	64	35			
Distribution and transporta-	v41	78	22			
tion						
Suppliers	v42	83	17			
General activities	v44	55	45			
None – area	v45	85	15			
Output	greeinobjoutp	78	21			
Waste	greeinobjwaste	57	43			
Integrated processes	greeinobjprocess	86	14			
Recycling	greeinobjrecyc	41	58			
Clean product	greeinobjprod	79	21			
Cleaning technology	greeinobjcleanin	76	24			
None – object	greeinobjNone	83	17			

Among the studied companies, the most prevalent object of green innovation was recycling, with 58% of the companies implementing it. Conversely, when considering the area of green innovation, general activities took the lead at 45%, closely followed by products at 41%.

For our analysis, we computed the path coefficients and their respective significance levels within our structural equation model. Key findings from our study include:

Green innovation was significantly influenced by organizational complexity with an estimated coefficient of 0.081 (p<0.01).

Green innovation was also markedly affected by pro-environmental employee motivation, registering an estimate of 0.249 (p<0.01).

Furthermore, employee motivation was significantly impacted by organizational complexity, with a coefficient of 0.07532 (p<0.01).

The entire structural model is visually represented in Figure 2. Additional details of the measurement model can be found in Table 2.

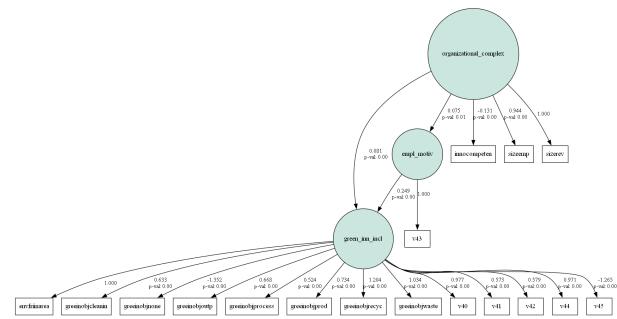


Figure 2. Structural model

Table 2. Measurement model

lval	op	rval	Estimate	Std. Err	z-value	p-value
green_inn_incl	~	organizational_com-	0.08124	0.02006	4.04967	0.00005
		plex				
green_inn_incl	~	empl_motiv	0.24916	0.01465	17.01104	0.00000
empl_motiv	~	organizational_com-	0.07532	0.02729	2.76030	0.00577
		plex				
envfriinarea	~	green_inn_incl	1.00000	-	-	-
v40	~	green_inn_incl	0.97695	0.18975	5.14864	0.00000
v41	~	green_inn_incl	0.57300	0.14773	3.87876	0.00010
v42	~	green_inn_incl	0.57885	0.13697	4.22619	0.00002
v44	~	green_inn_incl	0.97095	0.19406	5.00342	0.00000
v45	~	green_inn_incl	-1.26542	0.18752	-6.74801	0.00000
greeinobjoutp	~	green_inn_incl	0.66777	0.15223	4.38654	0.00001
greeinobjwaste	~	green_inn_incl	1.03434	0.19796	5.22491	0.00000
greeinobjprocess	~	green_inn_incl	0.52386	0.12639	4.14477	0.00003
greeinobjrecyc	~	green_inn_incl	1.20373	0.21005	5.73065	0.00000
greeinobjprod	~	green_inn_incl	0.73436	0.15553	4.72176	0.00000
greeinobjcleanin	~	green_inn_incl	0.63264	0.15356	4.11969	0.00004
greeinobjnone	~	green_inn_incl	-1.35157	0.19916	-6.78646	0.00000
sizerev	~	organizational_com-	1.00000	-	-	-
		plex				
sizeemp	~	organizational_com-	0.94445	0.07652	12.34176	0.00000
		plex				

innocompeten	~	organizational_com-	-0.13095	0.03615	-3.62282	0.00029
		plex				
v43	~	empl_motiv	1.00000	-	-	-
green_inn_incl	~~	green_inn_incl	0.03735	0.01162	3.21412	0.00131
empl_motiv	~~	empl_motiv	0.07677	0.02440	3.14649	0.00165
organizational_com-	~~	organizational_com-	1.22303	0.15725	7.77742	0.00000
plex		plex				
sizeemp	~~	sizeemp	0.25806	0.08166	3.16030	0.00158
v41	~~	v41	0.15585	0.01545	10.08512	0.00000
innocompeten	~~	innocompeten	0.30142	0.02956	10.19527	0.00000
greeinobjprocess	~~	greeinobjprocess	0.10753	0.01070	10.05079	0.00000
v43	~~	v43	0.09771	0.02485	3.93161	0.00008
greeinobjcleanin	~~	greeinobjcleanin	0.15968	0.01588	10.05431	0.00000
v42	~~	v42	0.12382	0.01233	10.03892	0.00000
greeinobjprod	~~	greeinobjprod	0.13902	0.01397	9.94828	0.00000
greeinobjoutp	~~	greeinobjoutp	0.14680	0.01466	10.01334	0.00000
v45	~~	v45	0.04212	0.00585	7.19941	0.00000
greeinobjwaste	~~	greeinobjwaste	0.18747	0.01912	9.80653	0.00000
sizerev	~~	sizerev	0.12469	0.08790	1.41854	0.15603
v40	~~	v40	0.17773	0.01808	9.83268	0.00000
greeinobjrecyc	~~	greeinobjrecyc	0.16391	0.01714	9.56186	0.00000
envfriinarea	~~	envfriinarea	0.18832	0.01914	9.83736	0.00000
greeinobjnone	~~	greeinobjnone	0.04274	0.00625	6.84040	0.00000
v44	~~	v44	0.19658	0.01990	9.87728	0.00000

Additionally, we evaluated the goodness-of-fit measures. The CFI stood at 0.726, while the RMSEA was 0.115. Other indicators are presented in Table 3.

Table 3. Goodness of fit indicators

Goodness of fit indicator	value
DoF	116.000
DoF Baseline	136.000
chi2	438.839
chi2 p-value	0.000
chi2 Baseline	1314.988
GFI	0.666
AGFI	0.609
TLI	0.679
NFI	0.666
CFI	0.726
RMSEA	0.115
AIC	69.821
BIC	193.664

4. Discussion

In this section, we delve into the interpretation and implications of the significant relationships identified in the structural model, as well as the implications arising from the model fit.

Our analysis revealed significant associations between organizational complexity and employees' pro-environmental behavior motivation and green innovation. Further, the model suggests a mediation effect, indicating that employees' pro-environmental behavior motivation mediate the relationship between organizational complexity and green innovation.

While these findings offer intriguing insights into the driving forces behind green innovation, caution is required in their interpretation. The model tested exhibits suboptimal fit, implying that further research is necessary before drawing definitive conclusions. Moreover, even though the relationships are statistically significant, the real-world effect of this model may be marginal.

5. Conclusions

Due to the suboptimal fit of the model, we refrained from delving deeper into the relationship between organizational complexity and green innovation, as well as the mediation effect of pro-environmental behavior employee motivation. Nonetheless, the reliability of the construct, combined with the identified significant relationships, indicates a need for further exploration of these relations. In an era where there's mounting pressure on businesses to adopt sustainable practices, both from societal and environmental standpoints, any instrument facilitating this green transition becomes invaluable. The role of pro-environmental behavior in employee motivation appears to be a promising avenue. We recommend employing a larger sample and considering potential model modifications and re-specifications.

Funding: This paper was supported by the scientific grant agency of Ministry of Education of Slovak Republic and Slovak Academy of Sciences (VEGA), grant number 1/0006/22.

References

- Awan, F. H., Dunnan, L., Jamil, K., & Gul, R. F. (2023). Stimulating environmental performance via green human resource management, green transformational leadership, and green innovation: a mediation-moderation model. *Environmental Science and Pollution Research*, 30(2), 2958-2976. https://doi.org/10.1007/s11356-022-22424-y
- 2. Blau, J. R., & McKinley, W. (1979). Ideas, complexity, and innovation. *Administrative Science Quarterly*, 24(2), 200-219. https://doi.org/10.2307/2392494
- 3. Igolkina, A. A., & Meshcheryakov, G. (2020). semopy: A python package for structural equation modeling. Structural Equation Modeling: A Multidisciplinary Journal, 27(6), 952-963. https://doi.org/10.1080/10705511.2019.1704289
- 4. Meshcheryakov, G., Igolkina, A. A., & Samsonova, M. G. (2021). semopy 2: A structural equation modeling package with random effects in python. *arXiv* preprint arXiv:2106.01140. https://doi.org/10.48550/arXiv.2106.01140
- 5. Prajogo, D. I., & Ahmed, P. K. (2006). Relationships between innovation stimulus, innovation capacity, and innovation performance. *R&D Management*, 36(5), 499-515. https://doi.org/10.1111/j.1467-9310.2006.00450.x
- 6. Singh, S. K., Del Giudice, M., Chierici, R., & Graziano, D. (2020). Green innovation and environmental performance: The role of green transformational leadership and green human resource management. *Technological forecasting and social change*, 150, 119762. https://doi.org/10.1016/j.techfore.2019.119762
- 7. Song, W., Yu, H. and Xu, H. (2021). Effects of green human resource management and managerial environmental concern on green innovation. *European Journal of Innovation Management*, Vol. 24 No. 3, pp. 951-967. https://doi.org/10.1108/EJIM-11-2019-0315

Mapping the Landscape of Education 4.0: A VOSviewer Bibliometric Analysis

Zuzana Skorková¹, Hana Gažová-Adamková², Kristína Korytinová³

- Department of Management, Faculty of Business Management, Economics University in Bratislava, Slovakia; <u>zuzana.skorkova@euba.sk</u>
- ² Department of Management, Faculty of Business Management, Economics University in Bratislava, Slovakia; <u>hana.gazova@euba.sk</u>
- ³ Department of Management, Faculty of Business Management, Economics University in Bratislava, Slovakia; kristina.korytinova@euba.sk
- * Correspondence: <u>zuzana.skorkova@euba.sk</u>

Abstract: The adoption of digital technologies heralds revolutionary innovations, opens new avenues in communication, transforms industrial production, and reshapes our approach to work, learning, and life. The Fourth Industrial Revolution has significantly impacted the world of work, necessitating current and future employees to possess skills, knowledge, and educational programs tailored to the future. Innovative approaches to education and professional training are imperative, as is the ability to adapt to evolving needs. To achieve these objectives, the educational system must be responsive to the requirements of Industry 4.0. The Education 4.0 concept also calls for a close collaboration between the industry and the academic sector in preparing human resources for Industry 4.0. In our contribution, we engage in bibliometric analysis of the Education 4.0 topic based on 305 scientific outputs published in the Web of Science database. We employ VOSviewer version 1.6.18 for visualizing the results. The outcome of our research includes a summary of current trends in the field of Education 4.0, as well as a detailed analysis of published papers.

Keywords: Education 4.0; Industry 4.0; Bibliometric analysis, Vosviewer

Introduction

The landscape of education has undergone a substantial transformation in recent years, eliciting inquiries into optimal teaching methods with the integration of technology and the internet. Presently, educational approaches, procedures, and activities are oriented towards customization, enhancing the efficiency, accessibility, and flexibility of knowledge generation and information transfer. Within this framework, considerable emphasis is placed on the concept of 'Education 4.0'. Emerging educational initiatives are designed to address contemporary educational challenges within the context of Education 4.0 (Miranda et al., 2021a). Education 4.0 entails technology-driven strategies that facilitate high-quality learning, aiming to foster innovative and intelligent educational behaviors (Srivani et al., 2022).

Advancing education to bolster innovation and transition to a new phase necessitates the development and alignment of educational systems by leveraging the new relationships that need to be established. According to (Boca, 2021), this relationship is articulated as: student + teacher + technology = smart learning, encompassing the utilization of e-learning and online electronic tools. Advocates of smart education, such as (Zhu et al., 2016), advocate for an approach where students engage with the educational process as closely as possible to real-world scenarios, necessitating the integration of the education system with both tangible and virtual realms. In this vein, (Zhu et al., 2016) and (Hartono et al., 2018) underscore the imperative of hybrid education and introduce the term 'smart learning' to encapsulate the adaptation of education to the digital age.

1. Theoretical background

1.1. Industry 4.0 and Education 4.0

The Fourth Industrial Revolution is marked by disruptive technologies, processes, and practices closely associated with the digital revolution. This era introduces significant changes, as cutting-edge technologies like artificial intelligence, blockchain, digital transformation, and 5G gradually find practical applications (Chaka, 2020) underscores the pivotal role of artificial intelligence, machine learning, and algorithms in this revolution. The transformative impact of the Fourth Industrial Revolution on education, denoting progress and development, is highlighted by (Maria et al., 2018). Consequently, there arises a necessity for a more precise definition of "Education 4.0."

In the context of Industry 4.0, education demands the modernization of educational systems, encompassing classroom organization, management, assessment, pedagogy, ethics, and professional development (González-Pérez & Ramírez-Montoya, 2022a). The Fourth Industrial Revolution is influencing the reshaping of work environments and the imperative to cultivate new skills. Research, as indicated by (van Laar et al., 2017) draws connections between 21st-century competency frameworks and digital competency frameworks, culminating in a model integrating core and contextual competencies. Core competencies include information management, communication, collaboration, creativity, critical thinking, and problem-solving, while contextual competencies comprise ethical awareness, cultural awareness, flexibility, self-management, and lifelong learning. The changing landscape calls for academic programs supporting these competencies within holistic learning frameworks.

(Noh & Karim, 2021) emphasize the emerging need to cultivate creative thinking and innovation skills in students for Education 4.0, focusing on user-centered learning, empathy, collaboration, optimism, experimentation, prototyping, and mindfulness of the process. The Fourth Industrial Revolution is facilitating the increasing convergence of real and virtual information worlds, propelling education into a new realm of virtual learning through digitalization and robotization (Benešová & Tupa, 2017). Consequently, there is a growing reliance on analyzing vast datasets (Big Data) to foresee potential differentials and adapt in real time to changing conditions (Richert et al., 2016).

The Partnership for 21st Century Skills, a collaborative organization of governments and businesses, outlines a framework for developing skills, capabilities, and attitudes essential for success in the 21st century workplace and society. The framework categorizes competencies into three types: learning skills (creativity and innovation, critical thinking and problem-solving, communication and collaboration), literacy skills (information literacy, media literacy, ICT literacy), and life skills (flexibility and adaptability, initiative and self-management, social and intercultural skills, productivity and responsibility, leadership and accountability) (González-Pérez & Ramírez-Montoya, 2022b).

The influence of the Fourth Industrial Revolution, commonly referred to as Industry 4.0, on human activities is undeniable, exerting a profound impact across various facets of life. Among these, the field of education stands out, necessitating substantial transformations and the establishment of new paradigms to align with contemporary and emerging trends. (Miranda et al., 2021a) assert that Education 4.0 mandates the adaptation of traditional learning methods, incorporating strategies, technologies, and activities that enable students to access pertinent learning and training programs while embracing the tenets of Education 4.0.

In response to the evolving demands, traditional education models are transitioning towards a learner-centered paradigm, facilitating the development of competencies crucial for adapting to change, as stated by (Valentín et al., 2013). Education 4.0 aims to deliver more efficient, accessible, and flexible learning programs. Emerging teaching and learning methods leverage technology and proven principles, strategies, styles, and pedagogies, particularly in higher education. This has given rise to innovative face-to-face, distance, and hybrid learning programs, optimizing the creation and transfer of knowledge and resources (Miranda et al., 2021a).

Learning-by-doing models are increasingly favored in education, fostering environments where students are encouraged to learn and discover through experimentation. Gamification is employed to enhance student engagement, skill development, and real-life application (Almeida & Simoes, 2019). (Prieto et al., 2019) advocate for Industry 4.0 technology labs, supporting the creation of technological environments for academic research and industrial promotion through active learning methodologies. Augmented reality is proposed as an alternative in modular learning systems with interactive virtual

models processed in real time (Martin et al., 2018). (Caluza, 2020) asserts that Education 4.0 promotes the use of advanced technologies to facilitate learning ecosystems, requiring proficiency in information and communication technologies among teachers.

The dynamic nature of the higher education ecosystem, emphasizing the connections between knowledge, industry, and humanity in Education 4.0, is underscored by (Jamaludin et al., 2020). Pedagogical practices supported by technology implementations often leverage modern Internet of Things (IoT) techniques such as Artificial Intelligence, Machine Learning, High Data Processing, Data Science, Data Analytics, and Cloud Computing (Cheng et al., 2019). Virtual Image Processing for virtual and experiential environments is also employed (Salinas-Navarro et al., 2019).

Adapting to this trend necessitates the entire education system and institutions to evolve. Universities and academics must develop their knowledge and skills to align with the needs of the current and future Generation Z. Flexibility and adaptability to changing trends, new knowledge, and expertise are imperative for academics and students alike (Ellahi et al., 2019). (Ramirez-Montoya et al. (2021) emphasize the role of teachers as change agents, requiring the transformation of their knowledge, skills, and competencies. They propose that innovation necessitates the integration of three fundamental aspects: the ingenious idea, the macro-environment involving the learning environment and society, and the micro-environment enabling innovation.

Incorporating the concept of Education 4.0 into the learning and development process provides a platform for educators and students to harness modern infrastructure and emerging technologies, thereby enhancing pedagogical practices in higher education (Jhonattan et al., 2021).

The emergence of Education 4.0 has highlighted the important need for seamless integration between industry and academia. This synergy is essential to prepare students for a rapidly evolving job market where technology and innovation are transforming industries at an unprecedented pace (González-Pérez & Ramírez-Montoya, 2022b). Collaboration between industry and academia enables educational institutions to align their curriculum with real-world demands and ensure students graduate with the skills and knowledge needed to thrive in the digital age (Oke & Fernandes, 2020). In addition, it provides opportunities for research, internships and mentorships, fostering a dynamic learning ecosystem that not only benefits students, but also fosters innovation and economic growth. In Education 4.0, this integration is essential for the sustainable development of both education and industry.

This collaboration helps bridge the gap between academic knowledge and real-world applications. Industry input provides valuable insights into the skills and competencies needed in the modern workforce. By working closely with educational institutions, industries can help shape curriculum and training programs to ensure that graduates are well-prepared for the demands of the job market. This alignment not only benefits students but also increases the efficiency of talent acquisition for companies (Ahmed et al., 2022). The cooperation between industry and the educational sector in Education 4.0 is pivotal for producing a workforce that is adaptable, skilled, and ready to thrive in an increasingly digital and interconnected world (Horváth & Szabó, 2019). It's a symbiotic relationship that benefits both sides and plays a vital role in shaping the future of education and industry alike.

1.2. Navigating the Frontiers of Education 4.0: Addressing Challenges and Charting Future Trajectories

Education 4.0 is essential to prepare individuals and societies for the opportunities and challenges of the 21st century. Meeting its challenges is not only a matter of progress in the field of education, but also a means of stimulating economic growth, promoting innovation, promoting equality and solving global problems (Mourtzis et al., 2018).

The modern Education 4.0 teaching concept encourages overcoming challenges, which can be included in groups as follows (Miranda et al., 2021b; Oliveira & De Souza, 2021):

- 1. Access and Infrastructure:
 - Challenges: Digital Divide, Cost of Technology Implementation, Lack of Standardization. Description: This group focuses on issues related to the availability and affordability of technology, as well as the need for standardized approaches to digital learning.
- 2. Pedagogical and Teaching:

Challenges: Resistance to Change, Teacher Training, Pedagogical Challenges, Assessment Methods

Description: These challenges pertain to the methods of teaching and learning, including resistance to new approaches, the need for educator training, adapting teaching methods, and developing effective assessment strategies (Adnan et al., 2019).

3. Quality and Security:

Challenges: Quality Assurance, Privacy and Data Security.

Description: Ensuring the quality of education in online environments and addressing concerns related to the privacy and security of student data fall under this category.

4. Technological Integration:

Challenges: Overreliance on Technology, Continuous Adaptation.

Description: This group centers on the role of technology in education, emphasizing the need to strike a balance and the necessity for continuous adaptation to technological advancements.

5. Equity and Inclusion:

Challenges: Equity and Inclusion.

Description: This category highlights challenges related to ensuring that Education 4.0 benefits all students, irrespective of their background, abilities, or disabilities, promoting equal opportunities.

Each group represents a set of challenges that, when addressed collectively, can contribute to the successful implementation and improvement of Education 4.0. Predictions of future developments and potential directions of Education 4.0 research focus on the ever-continuing integration of advanced technology and data analytics into education. However, researchers predict that artificial intelligence and machine learning will play a key role in personalized learning experiences. Virtual and augmented reality will transform traditional classrooms into a digital environment (Kamalov et al., 2023). In addition, there is an increasing emphasis on promoting digital literacy and critical thinking skills to prepare students for an increasingly connected, data-driven world (Meirbekov et al., 2022).

2. Methods and methodology

The examined publications were sourced from the Web of Science Database. An online literature search was carried out in September 2023, focusing exclusively on the topic of Education 4.0. The database yielded a total of 305 resources, which included 151 articles, 130 conference proceeding papers, 19 peer-reviewed articles, 7 early access publications, 6 editorial materials, and 2 book chapters. The list of these documents was downloaded for further processing, utilizing VOSviewer version 1.6.18 to visually represent and analyze bibliometric trends. The research sample is described in more details in Table 1. Figure 1 depicts the temporal evolution of our research sample based on both the quantity of publications and the volume of citations. It is evident that the zenith in the number of publications occurred in 2021, whereas the pinnacle in the number of citations was observed in 2022. Bibliometric analysis of key words, co-citated authors and citation was provided.

Table 1. Description of the Papers Used in Bibliographic Analysis.

Results found	305
Citing articles Total	1,247
Citing articles without self-citations	1,113
Times cited Total	1,735
Times cited without self-citation	1,288
Times Cited – Average per item	5,69
H-Index	19

Source: Web of science (WOS) database.

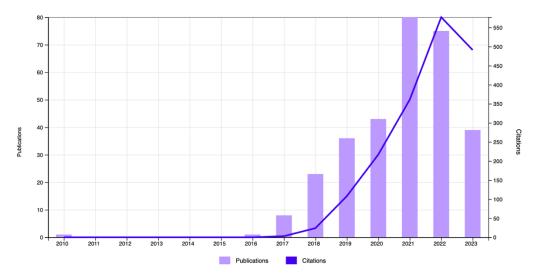


Figure 1. Times Cited and Publications Over Time, Articles from WOS, Topic – Education 4.0.

Source: WOS.

There are 50 documents from Mexico, 41 from Malaysia, 23 from Germany, India and Spain, 20 from Brazil, 15 from Romania, 12 from both Portugal and Czech Republic, 10 from Russia, 9 from Peru, Philippines and USA, 7 from Slovakia. The rest of countries had less than 7 documents.

3. Results

3.1. Bibliometric analysis of keywords

Keywords supplied by the paper's authors, which appeared more than five times in the Web of Science core database, were included in the ultimate analysis. Out of a total of 1,116 keywords, 40 met this criterion and were considered for further examination. As it is visualized in Figure 2 – 40 items created 6 clusters, 261 links with total links strengths 270,50. The clusters are presented in Table 2.

Table 2. Bibliometric analysis by keywords – clusters.

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
blockchain	artificial intelli- gence	complex thinking	digital transfor- mation	active learning augmented re-	engineering edu- cation
challenges	big data	covid-19 educational inno-	gamification	ality	stem
design	blended learning	vation	mobile learning	industry 4.0	
education	e-learning	higher education	simulation	skills	
framework	education 4.0	knowledge	technology		
future	internet	open innovation			
impact	internet of things				
industry	learning analytics				
innovation	machine learning				
management					
model					
performance					
students					
university Source: Own pro	cessing.				

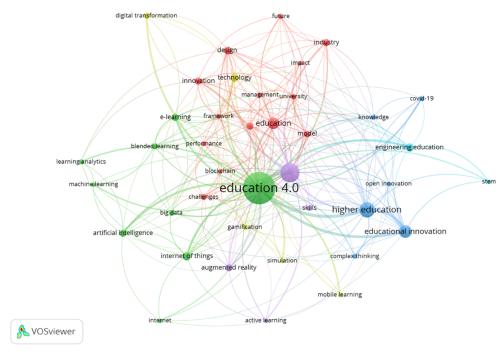


Figure 2. Bibliometric analysis by keywords and clusters.

Source: Own processing in VOSviewer.

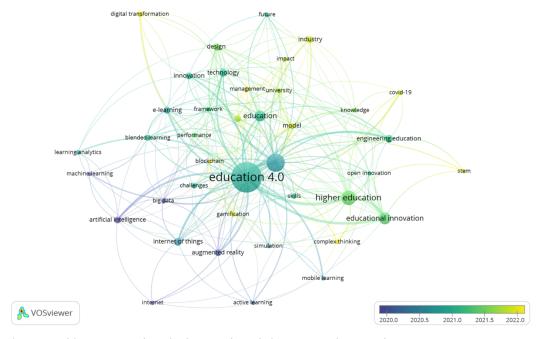


Figure 3. Bibliometric analysis by keywords and clusters, overlay visualization.

Source: Own processing in VOSviewer.

Through the overlay visualization, a clear distinction emerges between the keywords and topics related to Education 4.0. In early 2020, prominent terms included "artificial intelligence," "augmented reality," "internet," "active learning," "machine learning," and "big data." However, by the end of 2022, new themes had surfaced, primarily influenced by the impact of Covid-19. These included "gamification," "digital transformation," "blockchain," and "complex thinking." These are the indicators of the future trends in research. For more details see Figure 3.

3.2. Bibliometric analysis of citations per authors

Minimum number of documents of an author was set up to 1, minimum number of citations of an author was 10. Of the 958 authors, 169 meet the threshold. Bibliometric analysis by citations per author and clusters are presented in Figure 4. In Table 4. we presented the most influential research papers in the topic of Eduction 4.0. as per number of total citations.

Table 4. The Most Influential research papers in the topic of Education 4.0

				Total Cita-
Title	Authors	Source Title	Year	tions
	114411010	27th International Conference On Flexible	1011	410110
Requirements for Education and Qualification	(Benešová &	Automation And Intelligent Manufactur-		
of People in Industry 4.0	Tupa, 2017)	ing, Faim2017	2017	227
	, , , , , , , , , , , , , , , , , , , ,	8th Cirp Sponsored Conference On Learn-		
		ing Factories (Clf 2018) - Advanced Engi-		
Cyber- Physical Systems and Education 4.0-	(Mourtzis et al.,	neering Education & Training For Manu-		
The Teaching Factory 4.0 Concept	2018)	facturing Innovation	2018	86
The core components of education 4.0 in	,	,,		
higher education: Three case studies in engi-	(Miranda et al.,			
neering education	2021b)	Computers & Electrical Engineering	2021	79
Remote and Virtual Labs for Engineering Ed-				
ucation 4.0 Achievements of the ELLIproject at	(Grodotzki et al.,	46th Sme North American Manufacturing		
the TU Dortmund University	2018).	Research Conference, Namrc 46	2018	65
Transformation or evolution?: Education 4.0,	(Bonfield et al.,			
teaching and learning in the digital age	2020)	Higher Education Pedagogies	2020	62
Education 4.0-Artificial Intelligence assisted				
Higher Education: Early recognition System		2018 Ieee 24th International Symposium		
with Machine Learning to support Students'	(Ionita Ciolacu et	For Design And Technology In Electronic		
Success	al., 2018)	Packaging (Siitme)	2018	50
	(González-Pérez			
Components of Education 4.0 in 21st Century	& Ramírez-Mon-			
Skills Frameworks: Systematic Review	toya, 2022b)	Sustainability	2022	40
		2017 Ieee 23 rd International Symposium		
Education 4.0 for Tall Thin Engineer in a Data	(Ciolacu et al.,	For Design And Technology In Electronic		
Driven Society	2017)	Packaging (Siitme)	2017	40
Rethinking Thai higher education for Thailand		Asian Education And Development Stud-		
4.0	(Buasuwan, 2018)	ies	2018	39
		Proceedings Of 2018 Ieee Global Engineer-		
	(Ramirez-	ing Education Conference (Educon) -		
Engineering Education 4.0-Proposal for a new	Mendoza et al.,	Emerging Trends And Challenges Of En-		
Curricula	2018)	gineering Education	2018	35

Source: Own processing based on WOS.

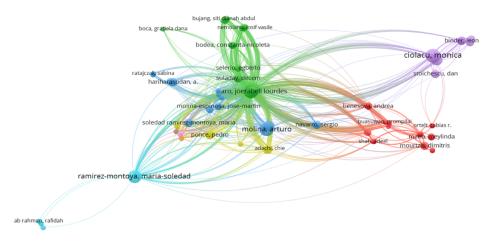


Figure 4. Bibliometric analysis by citations per author and clusters.

Source: Own processing in VOSviewer.

5. Conclusions

Education 4.0 is crucial for readying individuals and communities to confront the opportunities and challenges presented in the 21st century. Overcoming the hurdles associated with Education 4.0 is not solely a matter of advancing educational practices; it also serves as a mechanism to catalyze economic growth, foster innovation, advocate for equality, and address global issues. Education 4.0 is vital for addressing 21st-century challenges and opportunities, fostering economic growth, innovation, equality, and global problem-solving. Challenges in this context encompass access and infrastructure, pedagogical and teaching methods, quality assurance and security, technological integration, and equity and inclusion. Successfully addressing these challenges is crucial for the effective implementation of Education 4.0. Future developments in Education 4.0 foresee continued integration of advanced technology, emphasizing artificial intelligence, machine learning, virtual and augmented reality, and a focus on promoting digital literacy and critical thinking skills.

Funding: This research was funded by KEGA 001EU-4/2021 – Project of a study program in field of economics and management, which reflects conditions of digital age, appeal of sustainability of economic activity and global citizenship, VEGA 1/0623/22 Virtualization in people management– employee life cycle in businesses in the era of digital transformation and VEGA 1/0328/21 Post-pandemic business management: identifying temporary and sustainable changes in sequential and parallel management functions in the context of the COVID-19 pandemic.

References

- Adnan, A. H. M., Karim, R. A., Tahir, M. H. M., Kamal, N. N. M., & Yusof, A. M. (2019). Education 4.0 Technologies, Industry 4.0 Skills and the Teaching of English in Malaysian Tertiary Education. *Arab World English Journal*, 10(4), 330.
- 2. Ahmed, F., Tahir, M., Ali, Engr. S., & Enam, R. (2022). Strengthening the Bridge Between Academic and the Industry Through the Academia-Industry Collaboration Plan Design Model. *Frontiers in Psychology*, 13, 875940. https://doi.org/10.3389/fpsyg.2022.875940
- 3. Almeida, F., & Simoes, J. (2019). The Role of Serious Games, Gamification and Industry 4.0 Tools in the Education 4.0 Paradigm. *Contemporary Educational Technology*, 10(2), 120–136. https://doi.org/10.30935/cet.554469
- 4. Benešová, A., & Tupa, J. (2017). Requirements for Education and Qualification of People in Industry 4.0. *Procedia Manufacturing*, 11, 2195–2202. https://doi.org/10.1016/j.promfg.2017.07.366
- 5. Boca, G. D. (2021). Factors Influencing Students' Behavior and Attitude towards Online Education during COVID-19. *Sustainability*, 13(13), 7469. https://doi.org/10.3390/su13137469
- 6. Bonfield, C. A., Salter, M., Longmuir, A., Benson, M., & Adachi, C. (2020). Transformation or evolution?: Education 4.0, teaching and learning in the digital age. *Higher Education Pedagogies*, 5(1), 223–246. https://doi.org/10.1080/23752696.2020.1816847
- 7. Buasuwan, P. (2018). Rethinking Thai higher education for Thailand 4.0. *Asian Education and Development Studies*, 7(2), 157–173. https://doi.org/10.1108/AEDS-07-2017-0072
- 8. Caluza, L. J. B. (2020). Development of J48 Algorithm-Based Application in Predicting Teacher's Techno-Pedagogical Competence. *Mindanao Journal of Science and Technology, 18*(2). https://mjst.ustp.edu.ph/index.php/mjst/article/view/549
- 9. Ciolacu, M., Svasta, P. M., Berg, W., & Popp, H. (2017). Education 4.0 for tall thin engineer in a data driven society. 2017 IEEE 23rd International Symposium for Design and Technology in Electronic Packaging (SIITME), 432–437. https://doi.org/10.1109/SIITME.2017.8259942
- 10. Ellahi, R. M., Ali Khan, M. U., & Shah, A. (2019). Redesigning Curriculum in line with Industry 4.0. *Procedia Computer Science*, 151, 699–708. https://doi.org/10.1016/j.procs.2019.04.093
- 11. González-Pérez, L. I., & Ramírez-Montoya, M. S. (2022a). Components of Education 4.0 in 21st Century Skills Frameworks: Systematic Review. *Sustainability*, 14(3), 1493. https://doi.org/10.3390/su14031493

- 12. González-Pérez, L. I., & Ramírez-Montoya, M. S. (2022b). Components of Education 4.0 in 21st Century Skills Frameworks: Systematic Review. *Sustainability*, 14(3), 1493. https://doi.org/10.3390/su14031493
- 13. Grodotzki, J., Ortelt, T. R., & Tekkaya, A. E. (2018). Remote and Virtual Labs for Engineering Education 4.0. *Procedia Manufacturing*, 26, 1349–1360. https://doi.org/10.1016/j.promfg.2018.07.126
- Hartono, S., Kosala, R., Supangkat, S. H., & Ranti, B. (2018). Smart Hybrid Learning Framework Based on Three-Layer Architecture to Bolster Up Education 4.0. 2018 International Conference on ICT for Smart Society (ICISS), 1– 5. https://doi.org/10.1109/ICTSS.2018.8550028
- 15. Horváth, D., & Szabó, R. Zs. (2019). Driving forces and barriers of Industry 4.0: Do multinational and small and medium-sized companies have equal opportunities? *Technological Forecasting and Social Change*, 146, 119–132. https://doi.org/10.1016/j.techfore.2019.05.021
- 16. Chaka, C. (2020). Skills, competencies and literacies attributed to 4IR/Industry 4.0: Scoping review. *IFLA Journal*, 46(4), 369–399. https://doi.org/10.1177/0340035219896376
- 17. Cheng, Q., Lopez, F., & Hadjixenofontos, A. (2019). Integrating Introductory Data Science into Computer and Information Literacy through Collaborative Project-based Learning. 2019 IEEE Frontiers in Education Conference (FIE), 1–5. https://doi.org/10.1109/FIE43999.2019.9028683
- 18. Ionita Ciolacu, M., Fallah Tehrani, A., Svasta, P., & Binder, L. (2018). Education 4.0 Artificial Intelligence Assisted Higher Education: Early recognition System with Machine Learning to support Students' Success. https://doi.org/10.1109/SIITME.2018.8599203
- 19. Jamaludin, R., McKAY, E., & Ledger, S. (2020). Are we ready for Education 4.0 within ASEAN higher education institutions? Thriving for knowledge, industry and humanity in a dynamic higher education ecosystem? *Journal of Applied Research in Higher Education*, 12(5), 1161–1173. https://doi.org/10.1108/JARHE-06-2019-0144
- 20. Kamalov, F., Santandreu Calonge, D., & Gurrib, I. (2023). New Era of Artificial Intelligence in Education: Towards a Sustainable Multifaceted Revolution. *Sustainability*, 15(16), Article 16. https://doi.org/10.3390/su151612451
- 21. Maria, M., Shahbodin, F., & Pee, N. C. (2018). *Malaysian higher education system towards industry* 4.0 *Current trends overview*. 020081. https://doi.org/10.1063/1.5055483
- 22. Martin, J., Bohuslava, J., & Igor, H. (2018). Augmented Reality in Education 4.0. 2018 IEEE 13th International Scientific and Technical Conference on Computer Sciences and Information Technologies (CSIT), 231–236. https://doi.org/10.1109/STC-CSIT.2018.8526676
- 23. Meirbekov, A., Maslova, I., & Gallyamova, Z. (2022). Digital education tools for critical thinking development. *Thinking Skills and Creativity*, 44, 101023. https://doi.org/10.1016/j.tsc.2022.101023
- 24. Miranda, J., Navarrete, C., Noguez, J., Molina-Espinosa, J.-M., Ramírez-Montoya, M.-S., Navarro-Tuch, S. A., Bustamante-Bello, M.-R., Rosas-Fernández, J.-B., & Molina, A. (2021a). The core components of education 4.0 in higher education: Three case studies in engineering education. *Computers & Electrical Engineering*, 93, 107278. https://doi.org/10.1016/j.compeleceng.2021.107278
- 25. Miranda, J., Navarrete, C., Noguez, J., Molina-Espinosa, J.-M., Ramírez-Montoya, M.-S., Navarro-Tuch, S. A., Bustamante-Bello, M.-R., Rosas-Fernández, J.-B., & Molina, A. (2021b). The core components of education 4.0 in higher education: Three case studies in engineering education. *Computers & Electrical Engineering*, 93, 107278. https://doi.org/10.1016/j.compeleceng.2021.107278
- 26. Mourtzis, D., Vlachou, E., Dimitrakopoulos, G., & Zogopoulos, V. (2018). Cyber- Physical Systems and Education 4.0 –The Teaching Factory 4.0 Concept. *Procedia Manufacturing*, 23, 129–134. https://doi.org/10.1016/j.promfg.2018.04.005

- 27. Noh, S. C., & Karim, A. M. A. (2021). Design thinking mindset to enhance education 4.0 competitiveness in Malaysia. *International Journal of Evaluation and Research in Education (IJERE)*, 10(2), 494. https://doi.org/10.11591/ijere.v10i2.20988
- 28. Oke, A., & Fernandes, F. A. P. (2020). Innovations in Teaching and Learning: Exploring the Perceptions of the Education Sector on the 4th Industrial Revolution (4IR). *Journal of Open Innovation: Technology, Market, and Complexity*, 6(2), 31. https://doi.org/10.3390/joitmc6020031
- 29. Oliveira, K. K. D. S., & De Souza, R. A. C. (2021). Digital Transformation towards Education 4.0. *Informatics in Education*. https://doi.org/10.15388/infedu.2022.13
- 30. Prieto, M. D., Sobrino, A. F., Soto, L. R., Romero, D., Biosca, P. F., & Martinez, L. R. (2019). Active Learning based Laboratory towards Engineering Education 4.0. 2019 24th IEEE International Conference on Emerging Technologies and Factory Automation (ETFA), 776–783. https://doi.org/10.1109/ETFA.2019.8869509
- 31. Ramirez-Mendoza, R. A., Morales-Menendez, R., Iqbal, H., & Parra-Saldivar, R. (2018). Engineering Education 4.0: Proposal for a new Curricula. 2018 IEEE Global Engineering Education Conference (EDUCON), 1273–1282. https://doi.org/10.1109/EDUCON.2018.8363376
- 32. Richert, A., Shehadeh, M., Plumanns, L., Gros, K., Schuster, K., & Jeschke, S. (2016). Educating engineers for industry 4.0: Virtual worlds and human-robot-teams: Empirical studies towards a new educational age. 2016

 IEEE Global Engineering Education Conference (EDUCON), 142–149. https://doi.org/10.1109/EDUCON.2016.7474545
- 33. Salinas-Navarro, D. E., Garay-Rondero, C. L., & Calvo, E. Z. R. (2019). Experiential Learning Spaces for Industrial Engineering Education. 2019 IEEE Frontiers in Education Conference (FIE), 1–9. https://doi.org/10.1109/FIE43999.2019.9028580
- 34. Srivani, V., Hariharasudan, A., Nawaz, N., & Ratajczak, S. (2022). Impact of Education 4.0 among engineering students for learning English language. *PLOS ONE*, 17(2), e0261717. https://doi.org/10.1371/journal.pone.0261717
- 35. Valentín, A., Mateos, P. M., González-Tablas, M. M., Pérez, L., López, E., & García, I. (2013). Motivation and learning strategies in the use of ICTs among university students. *Computers & Education*, 61, 52–58. https://doi.org/10.1016/j.compedu.2012.09.008
- 36. van Laar, E., van Deursen, A. J. A. M., van Dijk, J. A. G. M., & de Haan, J. (2017). The relation between 21st-century skills and digital skills: A systematic literature review. *Computers in Human Behavior*, 72, 577–588. https://doi.org/10.1016/j.chb.2017.03.010
- 37. Zhu, Z.-T., Yu, M.-H., & Riezebos, P. (2016). A research framework of smart education. *Smart Learning Environments*, 3(1), 4. https://doi.org/10.1186/s40561-016-0026-2

Some trends in book publishing

Miroslav Tóth 1

1 Faculty of Business Management University of Economics in Bratislava, Bratislava, Slovak Republic; miroslav.toth@euba.sk

Abstract: In our article, we examine trends in the book market. The book market is a branch of the cultural and economic sector, which revolves around the production, distribution and sale of books. The main links in this chain are book publishers, writers, distributors, sellers and, of course, customers. Each of the actors of this market has its own mission. The purpose of the post is to select a few elements that we consider to be key themes and trends. Due to the specificity of this creative and cultural segment, we mainly examine the practical experience and opinions of experts. We analyze the main supporting themes, sort them and synthesize the knowledge gained. We focus on three specific problem areas: audio and e-books, as a progressive form of spreading the content of the work; self-publishing, which is a form of the author's business activity and includes his ability to assert himself on the market, and finally it is artificial intelligence (AI). This new tool helps creators create, review, provides alternative results, and more. As a result of the work, the finding that these three areas are among the carriers of the future success of the content creator - the writer and the publisher, they will simplify the access to the content due to the digital form of the content, training AI will improve the content, voice and visual side of the book. The book will thus change its material form, but will have richer written, spoken and graphic content.

Keywords: book publishing; book market; cultural industry; trends; audiobooks; e-books; self-publishing; artificial intelligence (AI)

Introduction

The cultural and creative economy is a natural environment for innovative ideas and the development and appreciation of creative potential. Creativity is the key to innovative and interdisciplinary responses to global and local challenges - whether economic or social. Creative industry refers to those parts of the economy that create economic value based on individual creative input or artistic talent. It is a sector built on the valorization of intellectual property. The definitional framework used by the European Commission is presented in the study Economy of Culture from 2006, and according to this definition the entire area is divided into the cultural sector and the creative sector. The cultural sector includes the field of traditional art and the field of cultural industry, which includes publishing. In the conditions of the Slovak Republic, this area includes literature and the book market (that is, writers, editors, translators, editors and publishers of non-periodical publications). (Ministry of Culture of the Slovak Republic, 2014, p. 4).

In our article, we focus on the book market. We understand the book market as an area of business that includes writers, publishers, distributors, sellers and customers (readers).

Books should help overall cultivation and personality development. Quality literature leads to better awareness and knowledge of the differences and similarities of the world and people around. At the same time, this knowledge and empathy leads to tolerance and a deeper perception of the environment. No less important is the importance of self-knowledge and looking at yourself from a different perspective. Books make it possible to cross the boundaries of everyday life and to educate creative and creative beings even through fantasy worlds (Hurná, 2019, p. 2).

Despite the stream of skeptical thoughts that the book is losing its original meaning in the social consciousness, that it is being displaced by the Internet, television programs and other media activities, books are read and continue to be read. Perhaps it is rather the opposite: as if in a deluge of superficialities and media nonsense, the reader is looking for and apparently finds good book titles, books not only with nice binding and graphic design, but also with quality content. At the same time, it should be noted that it is not easy to navigate in the publishing and reading space either, as

commercial pressures force publishers to think at least about profitability, not to mention profits from published titles (Jurík, 2021).

In the Report on the Future of the European Book Sector, Tomasz Frankowski (2023) highlights social access to books, support and promotion of better circulation of European books, as well as institutional support for the future growth of the book sector. Among the important initiatives is the call for an inclusive culture of reading, which is aimed at children and young people, because

- calls for more initiatives to promote reading in the Member States, such as the introduction of 'cultural vouchers', especially for young people and marginalized groups, which could facilitate the purchase of books;
- encourages Member States to develop an integrated national policy to promote literacy skills, including through cooperation between the book and education sectors, and calls on Eurostat to provide up-to-date and comparable data on reading habits, especially among children;
- calls for more support for children's books in particular, through the creation of a 'first book' program or similar initiatives at national level to encourage reading;
- emphasizes the importance of reading in early childhood, especially printed books, for the development of children's cognitive abilities and literacy;
- in this context, emphasizes the role of school libraries and trained librarians in providing guidance, facilitating access to knowledge and promoting reading habits.

The main goal of this post is to explore new trends in the book market. In addition, we will focus on sub-goals:

- the publication of books in previous years was mainly affected by the Covid 19 pandemic and the subsequent sharp rise in energy prices;
- draft of a new concept for the development of creative and cultural industries, which the Slovak Republic is currently working on;
- comparison of opinions on the development of the book market and expected changes in book publishing, their distribution and changes in customer behavior.

1. Theoretical background

Culture and the creative industry have direct and indirect effects on the economy, according to the government document Strategy of the Culture and Creative Industry of the Slovak Republic 2030 (Ministry of Culture of the Slovak Republic, 2023, p. 13). Added value is generated directly in them, they employ an economically active population, and cultural goods are imported and exported. The indirect economic footprint of culture and the creative industry would be even higher if the creation of added value in other sectors is also taken into account, for example in tourism, which generates demand for goods and services in other sectors of the economy as well. The outputs of creative work also provide inputs to a wide range of economic sectors in the form of content, inspiration, skills and abilities, intellectual capital and professional workers.

Based on reports from past periods, we can state that the Slovak book market realizes the production of domestic and foreign publishing houses either through sales in "brick and mortar" stores or through modern forms of sales through e-shops. Smaller publishers that specialize closely expect acquisitions. In the past, smaller publishing houses were incorporated under large publishing houses. The overall picture of the economic performance of the Slovak book market and e-shops with books is distorted by the fact that nowadays almost every publishing house has its own e-shop. Other titles are sold through second-hand booksellers, exchanges or special projects such as buying books in the store for coupons that can be used to buy another book in the store. Another factor is that many Slovaks are so fluent in foreign languages that they order e-books and books through foreign e-shops.

Despite the pressure of content from streaming platforms, many people have discovered the magic of reading. It is a reasonable way to spend time at home, for example in quarantine. The question is how the entry of new streaming platforms and the expanding database of films and series will affect the Slovak television and book market this year, e.g. with Czech subtitles. According to the Association of Publishers and Booksellers of the Slovak Republic, movies and series have an impact on book sales. Publishers will have to calculate with this and respond adequately, either by re-editions of older

editions of the book original or by publishing an edition with a film cover. This situation occurs thanks to awards in the form of film Oscars, the introduction of series adaptations on streaming channels and the subsequent or simultaneous publication of their book form. The same goes for movie blockbusters shown in theaters. Book sales are also influenced by new titles by popular authors, various manuals for self-help, weight loss, relationships and also biographies. In certain waves, books that reflect and explain current events are also successful (Turzo, 2022).

Simpson (2020) reflected on the public's attitude towards books and reading, customer behavior on the book market. From our point of view, some of the findings below are interesting. Not interested in reading, the book is a useless thing for a certain group of customers. Some people consider books to be valuable but boring necessities. This phenomenon is quite often fixed in school youth, especially if it is an obligation to read something. A customer's decision to spend money on an item of the same price. Books have to compete with a wide range of other items that cost about the same – or maybe more – but take less time to decide. Neither book always competes with another title for the customer's money.

Selecting and purchasing a book requires a large investment of time – whether you are a buyer in a bookstore or a consumer trying to choose between the titles you have selected. And the time one has to invest – read the ad, look at the cover, maybe read the first paragraph, look at the index, etc. – is inversely proportional to the required financial investment, since most books are sold at a relatively low purchase price. But e.g. choosing a new piece of clothing can take me a few seconds. On the other hand, a retailer often invests a lot of time in each customer—getting to know them, building a relationship, recommending titles they might like, and ordering what they don't have in stock tends to be a cost-effective way to make a living. Customers buy a book, like a specific title, only once. Each book is a different product.

A publisher can never be sure when books sell. However, the publisher cannot return them to the printer. This makes it difficult to finance the operation of the publishing company, because you never know when the product will actually sell. The books are extremely good value for money but low profit.

The bad situation in society, expensive energy, war, lack of money for basic human needs, all this affects art, including the impact on the book market - publishers, booksellers, distributors. The good news is that the Covid years increased the sales of books in developed countries, reports Dobrovodská (2022). According to a survey by the Federation of European Publishers (FEP), the total annual sales of book publishers from the EU and the European Economic Area reached approximately EUR 23.6 billion in 2021, which is more than in 2020. The number of newly published titles fell by 20,000, to 575 thousand. The countries with the largest production of new titles include the United Kingdom, Germany, Spain, Italy and France.

According to the available data of the Association of Publishers and Booksellers of the Slovak Republic from 2021, there are 1,553 publishing entities in Slovakia, of which 1,300 were actively engaged in activity, 241 entities have suspended or are no longer engaged in it, and twelve entities have terminated it. A total of 9,935 non-periodical titles were published, which is 1,097 less than the year before, of which 8,230 were books, i.e. 168 less than the previous year. The information on the original and translated literature is worth paying attention to.

The reading and literary community is trying to return to functioning before the pandemic, which is confirmed by book fairs starting up again in Europe and around the world. However, there is a significant jump in costs. The conditions for issuance are fundamentally changing. Slovak publishers are threatened by the rising prices of raw materials and energy, as a result of which production costs, royalties for collaborators, and increased competition from English-language books are rising. Although 2022 is not yet over, they can already say that it was one of the most challenging years. In order to return at least the production costs, it is necessary to sell a larger number of books from one title, on the other hand, the number of titles is growing. Market pressure will result in cutbacks in edition plans.

2. Methods and methodology

Our task is to review the available literature and resources related to the book market. We are mainly looking for information that comes from the business world, social organizations, academia, discussion forums and blogs. The source of such data is mainly the Internet and freely available sources.

We analyze the texts and look for common as well as different views on the possible development of the book market. The comparison will serve us to compare ideas about the future direction of the

book market, changes compared to the present. We sort the information obtained depending on the topic and the area in which changes are expected.

We synthesize knowledge and summarize knowledge in such a way as to find a common intersection of ideas. We assume that this is how we identify the most likely trends in the development of the book market.

3. Results

In this part of the work, we focus on the synthesis of opinions regarding trends in the book market in the future. 2020 was a year of unpredictable changes in all areas of our lives and in the world of writing and publishing books without exception. However, one of the main differences is that the publishing industry has been constantly changing for over a decade. The coronavirus pandemic has brought many industries into the digital world with an incredible leap. But for the publishing industry, many changes are never new. With the growth of e-books and digital markets, many readers have moved to digital land. Through self-publishing, many distribution processes moved increasingly into cyberspace long before the pandemic. That's why editors seem more willing to deal with its effects than any other industry. At least in some ways. In addition to the pandemic, other significant changes are still underway in the publishing industry, and these changes are expected to continue through 2023. It is becoming increasingly difficult for publishers to differentiate themselves in crowded markets. In addition to new technologies such as artificial intelligence and marketing campaigns, collaboration methods and platform building are also important trends for writers who put emphasis on their work (Book Marketeers, 2023).

3.1. Audiobooks and e-books

In recent years, this trend has intensified, the number of self-publishers and independent writers is growing, and the number of audiobooks, e-books and printed books published in this way is growing. (Book Marketeers, 2023, Bullen, 2022).

Audio is becoming an increasingly popular way of consuming media Content is not only readable, but also audible (Forbes Expert panel, 2023).

The most popular listening places are the car and the home. Growth in audiobook sales is also believed to be boosted by the use of smart speakers. E-books are becoming increasingly popular and many publishers are now releasing new titles in both print and digital formats. This trend was driven by the convenience of digital books and the availability of e-readers (C Simplify IT – Software, 2023).

The publishing industry has seen some significant changes in recent years – from readers switching to audiobooks and e-books, to supply chain issues and wholesale changes in retail distribution models. Audiobooks and e-books are available to the reader through smartphone applications. New technologies such as artificial intelligence narration and independent text-to-speech programs will make audiobook production easier and faster in the future (Publishing Trends, 2022).

Many authors see eBooks and audiobooks as a great opportunity to increase exposure and revenue. Technological progress makes it easier to get them. Digital media became available in public libraries (Flatt, 2023).

In line with other industries, publishing is constantly adapting to the ever-changing needs of its consumers. Technological advances have played a huge role in the evolution of publishing, leading to the growth of new book formats, increased social selling and new production methods. The global ebook market is expected to grow. Of all the book publishing formats available, audiobooks are the fastest growing. Worldwide, almost 10% of reading is done on digital devices (Talbot, 2023).

Similar to e-books, audiobooks have significantly impacted the publishing landscape in the last decade. Audiobooks are poised to overtake e-books. With the popularity of streaming music and podcasts, recorded books have also seen an increase. Looking at similar trends in e-books, we can and should assume that audiobooks will probably hit a natural ceiling in the coming years. While they may continue to grow, only a certain portion of book lovers are likely to start using audiobooks as a long-term alternative to physical copies. The new reality for publishers will be the fragmentation of the market - and sales. Publishers are under financial and operational pressure to maintain multiple revenue streams and manage their titles across a range of formats and channels (Perry, 2019).

3.2. Self-publishing

Another trend that has emerged in the publishing industry is the rise of self-publishing. Thanks to the availability of print-on-demand technology, authors can now publish their works without the need for a traditional publisher. This resulted in a flood of new books being published, making it harder for traditional publishers to establish themselves in the market (Book Marketeers, 2023).

Print-on-demand technology has changed the game in the publishing industry. With print-on-demand, publishers can print books as they are ordered, eliminating the need for large overheads. This resulted in lower printing costs, making it easier for publishers to release new titles without the need for large initial investments (C Simplify IT – Software, 2023).

Since 2010, the number of self-published e-books has been growing, many of them becoming best-sellers. The number of books published in this way also increased due to the pandemic. Authors do not have to worry about finding a publisher who deems their work worthy of publication. Instead, writers can easily publish their books online through various electronic publishing platforms (Harman, 2023).

Self-publishing will continue to benefit from a focus on the digital market, where authors face a much more level playing field in competition with traditional publishers and their distribution networks. In a crowded book market, authors without a built-in platform do not have a clear path to success. If readers have no reason to seek out a self-publishing book, the quality of the content won't matter because few people will see it. (Izzard Ink Publishing, 2023).

Self-publishing as we know it started a few years ago. Over the next ten years, it will develop into a mature, established alternative to the time-tested world of traditional publishing. The most successful authors will stay educated and stay ahead of the curve by working with relevant publishers and taking advantage of the pioneering publishing opportunities offered by emerging technologies. All they have to do to be successful is to stay informed about book publishing trends (Kolmar, 2023).

During the pandemic, readers stuck at home continued to embrace the e-book. The advantage is the ability to buy a book digitally, at any time of the day or night, and have the entire library on the device in your pocket. There's also the lower cost of e-books and some audiobooks compared to print books, which can be a significant factor in today's economy. The advent of online publishing platforms such as Amazon has made it easier for authors to publish their books without having to go through the trouble of securing a book contract with a traditional publisher. Independent and self-published titles now account for approximately 40 percent of commercially available books. Self-publishing – or doing so in collaboration with an independent publisher – allows more authors to pursue writing as their main activity and to have more control over their work (Wagner-Stafford, 2023, Bullen, 2022).

3.2. Artificial Intelligence (AI)

Artificial intelligence will be one of the biggest trends. There are many content creators looking for new ways to incorporate it into their operations. However, one thing to be aware of is that some new AI apps have a different level of authenticity than a real person and do not fact-check. It is important to have human supervision over the entire process (Forbes Expert panel, 2023).

However, AI analysis can also help authors determine whether their book is ready for publication and provide insight into the book's marketability. AI provides objective feedback, determines which other books have similar style and tone, and helps writers better understand readers. This is especially important because readers are often drawn to a specific style rather than a specific category or content, which is difficult for editors to detect. The analysis of artificial intelligence is fast and objective, perfectly complementing the assessment of experienced authors (Book Marketeers, 2023). Artificial intelligence can also be used in creating the visual content of the book. In addition, it can replace a person for spoken content (Noblit, 2023).

Artificial intelligence is used to perform several grammar and plagiarism checks and to detect the reading preferences of consumers around the world. AI algorithms help publishers decipher consumers' reading preferences based on their previous records. AI voice assistance is one of the trends in publishing The digital era we live in requires writers and publishers to be tech-savvy and savvy, they need to use the available technologies in the right direction. Being technically proficient becomes the main parameter of success (Harman, 2023).

During the pandemic, readers stuck at home continued to embrace the e-book. The advantage is the ability to buy a book digitally, at any time of the day or night, and have the entire library on the device in your pocket. There's also the lower cost of e-books and some audiobooks compared to print books, which can be a significant factor in today's economy. Authors can use AI tools to analyze what they've written so far and their plot outline to write the next few paragraphs. This can help them overcome writer's block. However, their key is to still edit whatever the AI has written (Wagner-Stafford, 2023).

AI will play a big role in audiobook narration. AI-narrated titles could soon bridge the gap between authors who can afford human narration and those who can't. AI narration still doesn't come close to the qualities and emotions of a human narrator, but it works quite well for some genres. And as long as the AI narration is clear up front, some readers will prefer AI audio to no audio at all. What this means for writers: AI narration won't replace human narrators anytime soon. However, AI storytelling is a cost-effective way to add another format that readers can enjoy. If you already have plans to work with a human narrator, don't cancel it. AI won't get you anywhere near that quality. (Noblit, 2023).

Publishers are changing the way users consume their information across screens. It is time to revolutionize the publishing industry by creating smarter production strategies based on the needs and preferences of readers with a stronger emphasis on digital trends (Changing Trends, 2023).

Artificial intelligence is a powerful marketing tool that allows booksellers to target readers with online advertising and personalized emails based on their web searches and past purchases (Publishing Trends, 2022). All capable of tracking and providing data on consumer behavior to publishers (Flatt, 2023).

4. Discussion and conclusions

The book market is an economic sector focused on the production, distribution and sale of books. This market covers a wide range of activities, including writing, publishing, printing, distribution and selling of books. The most important features are:

- creativity and value creation: The book market is a place for creativity and value creation through literary art and research. Authors create books that can educate, inspire, entertain and speak to readers:
- diversity: The book market is very diverse and includes different genres, topics and writing styles.
 Books are written for a variety of age groups and interests, allowing for a wide selection for readers.
 This includes fiction, nonfiction, textbooks, children's books, scholarly publications, historical works, and more;
- technological development: With the development of technology and digitization, the book market
 is changing. Electronic books (e-books) and audiobooks are gaining in popularity, changing the
 way books are published and consumed. Technological development: With the advent of digital
 technology and e-books, the book market is changing. which affects traditional printed book production and distribution The way books are published and consumed is also changing;
- education and culture: The book market plays an important role in the education and cultural enrichment of society by providing access to information, literature and ideas. Cultural value: Books have a significant impact on culture and society. They often engage in cultural discussions and have the ability to shape the opinions and values of individuals and society as a whole.

The book market is constantly changing and adapting to new technologies and trends. Despite digitization and the growing popularity of e-books, there is still a traditional paper book market that has its place and supporters. The book market has a significant influence on culture and society and an important role in the dissemination of literature and information. Overall, the book market is an important component of cultural and economic life, supporting creativity, education and the development of society through literature. Based on the investigation of selected elements of the book market (audio and e-books, self-publishing and artificial intelligence), we came to these findings, which have a significant impact on its development. We researched the opinions of various book market experts, sorted them according to content and selected the characteristics of these selected elements of the book market below.

Audiobooks and e-books have a significant impact on the development of the book market and are changing the way people consume literature. Below are some of the main aspects in which these formats the ongoing book market:

- availability and convenience: Audiobooks and e-books allow readers and listeners to access a large
 number of books regardless of their geographical location. The team expands the availability of
 literature and allows people to discover new titles conveniently through their devices. They are
 easily accessible over the internet and can be downloaded or streamed on various devices. In this
 way, it allows easy access to a wide variety of books and literature without the need to visit a
 bookstore;
- mobility: Audiobooks are especially suitable for those who have limited time to read, as they can
 be listened to on the way to work, exercise or other daily activities. E-books are easily portable and
 allow readers to access the entire book on one device;
- increased diversification of content: The book market has become more diverse thanks to the development of audiobooks and e-books. Authors and publishers now have the opportunity to publish their works in different formats and reach different audiences;
- innovation in content: Audiobooks allow you to add voiceovers, music and sound effects, creating a new way of experiencing a story. Some e-books also include interactive elements and multimedia elements, which increase reader engagement;
- self-publishing: Audiobooks and e-books offer the possibility of self-publishing your works without the need of traditional publishers. The team is paving the way for more independent authors to get their work to readers directly;
- globalization of the book market: Digital books allow publishers to commission and distribute their
 works worldwide without significant printing and distribution costs. This opens the door for books
 from different cultures and languages and contributes to the globalization of the book market;
- impact on traditional bookstores: The development of audiobooks and e-books can have an impact on traditional bookstores, as people may turn more to the digital format, which can affect the sales of traditional books. At the same time, however, many libraries and bookstores have also started offering books to keep up with the changes in the market.
- education and professional development: Audiobooks and e-books also have a significant impact on education and professional development, allowing access to educational material and professional literature in digital format.

Audiobooks and books have a positive impact on the team by increasing the accessibility, mobility and variability of literature. However, this does not mean that traditional books will lose their importance. Rather, the point is that digital formats and traditional books can coexist and share in the variety and diversity of the book market. It can be said that audiobooks and e-books are transforming the book market by changing the way people read and consume literature and opening the door to new opportunities for authors, publishers and readers.

Self-publishing, i.e. the possibility of publishing books independently without the need for traditional publishers, has a significant impact on the development of the book market. Self-publishing contributes to making the book market more diverse and dynamic:

- diversification of content: Self-publishing allows the author, who might otherwise be rejected by traditional publishers, to spread his works with an audience. The team brings a greater variety of genres, styles and voices to the market, giving readers more choices, catering to different tastes and preferences of readers;
- democratization of publishing: Self-publishing, the traditional gateway to the book market. This
 means that more authors from diverse backgrounds who might otherwise struggle to get a contract
 with a publisher can have access to publishing their work. This means greater diversification of
 authors and content;

- innovation and experimentation: Self-publishing allows you to experiment with different formats, structures and related rights because you are not limited by the conventions of traditional publishers. The team can develop literary creativity;
- faster publishing process: Authors who choose to self-publish can have their works on the market quickly. This faster pace of publication allows authors to get faster feedback from readers and the ability to iterate and improve their work more quickly;
- more author control: Self-publishing offers the author more control over the content, design and
 marketing of their books. They do not have to submit to the decisions of the publisher and can
 complement their author's identity more;
- impact on traditional publishers: Competition from self-publishing can motivate publishers to rethink their practices and improve their services for authors. They can also see self-publishing as a source of new talented authors;
- globalization of the market: Self-publishing enables quick access to the international market. Author's works can be distributed globally, which opens up new possibilities for the author and increases the chance of international success;
- increased competition and quality: Competition among self-publishing authors forces people to improve the quality of their work, which can lead to better books on the market.

Overall, self-publishing plays an important role in the development of the book market by adding diversity, democratizing the process, inspiring author creativity and changing the way authors and readers perceive the book market.

Artificial Intelligence (AI), which means artificial intelligence, has a significant impact on the development of the book market and the way books are created, published, sold and consumed. Here are some of the main aspects of this influence:

- personalized recommendations: AI and machine learning enable online bookstores and book reading platforms to analyze reader preferences and make personalized recommendations. In this way, readers discover new books that might interest them, which promotes book sales and distribution;
- automated writing: AI can be used to generate content, including books. This can be useful for
 content creators who want to quickly create books or other content. For example, in some cases AI
 can generate reports, manuals or technical documentation. For example, generative models can
 create short stories or texts based on a given theme or style. This may be for creating book content
 or for generating supplementary material such as annotations or short reviews;
- language analysis: AI can help book critics, reviewers and publishers analyze the content of books
 and identify trends in literature, which can influence the selection of books for publication and
 marketing strategies;
- authoring process: Authors can use AI to help with writing edits and format works. For example,
 there are grammar checkers and content generation tools that can be useful for book creation. AI
 tools can help with the editing and proofreading of book text. These tools can identify grammatical
 errors, stylistic flaws and other linguistic aspects;
- predictive market analysis: AI can help publishers and booksellers predict book demand based on trend data analysis, helping them decide which books to publish and how to distribute them. Trend prediction: AI can analyze data on book sales and reader reviews to identify patterns and trends in the book world. This information can be valuable for publishers when deciding which books to publish and what genres or topics are currently popular. AI is also used to optimize book distribution and marketing campaigns. This may include identifying target readerships, determining the optimal book price, and improving online advertising strategies;
- creation of audiobooks: AI can be used in the creation of audiobooks, for example, to generate voice recordings of book text, which increases the accessibility of books for readers with disabilities;
- language translations: AI machine translation systems improve accessibility of books to readers in multiple languages. This enables authors and publishers to distribute their works in the global market;

- fight against plagiarism: AI tools can help detect plagiarism and protect authors' intellectual property;
- virtual assistants for readers: AI can be used to create virtual assistants that help readers answer book searches, book questions, or even interact with book content (eg book chatbots).

Overall, AI is playing an increasingly important role in the book industry, helping to streamline processes, helping the reader experience and influencing the evolution of the book market by changing the way books are created, distributed and consumed. AI has the potential to change the way books are created, distributed, processed and consumed. These technologies can contribute to a more efficient and personalized book market, which can have a positive impact on authors, publishers and readers.

Funding: "This research was funded by Scientific grant agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic and the Slovak Academy of Sciences (VEGA), grant number 1/0582/22" and "The APC was funded by VEGA grant number 1/0582/22 - Dimensions of cross-sectoral entrepreneurship of cultural and creative industry entities in the context of sustainable development".

References

- 1. Book Marketeers. (2023). *The Top Book Publishing Trends Of 2023*. Retrieved September 27, 2023, from: https://bookmarketeers.com/the-top-book-publishing-trends-of-2021/
- 2. Bullen, S. (2022, October 7). What are publishers looking for in 2023? Retrieved September 27, 2023, https://www.thewritingroom.co.za/writingtips/what-are-publishers-looking-for-in-2023
- 3. C Simplify IT Software (2023, April 30). DevelopmentInsights into Publishing Industry Trends and Print on Demand. Retrieved September 27, 2023, from: https://www.linkedin.com/pulse/insights-publishing-industry-trends
- 4. Changing Trends in The Publishing Industry in 2023. (2023, February 7). Retrieved September 27, 2023, https://www.ninestarsglobal.com/blog/changing-trends-in-the-publishing-industry-in-2023/
- 5. Dobrovodská, K. (2022, December 18). *Vydavatelia stále bojujú s problémami aj prvý rok po covidovej kríze*. Čo *ich čaká?* Retrieved September 27, 2023, from: https://www.trend.sk/trend-archiv/vydavatelia-stale-bojuju-problemami-aj-prvy-rok-covidovej-krize-co-ich-caka
- 6. Forbes Expert panel (2023, February 3). 8 Big Trends In Publishing In 2023 (And How Marketers Can Leverage Them). Retrieved September 27, 2023, from: https://www.forbes.com/sites/forbesagencycouncil/2023/02/03/8-big-trends-in-publishing-in-2023-and-how-marketers-can-leverage-them/
- 7. Frankowski, T. (2023). *Report on the future of the European book sector*. European Parliament. Committee on Culture and Education, July 31, 2023. Retrieved September 27, 2023, from https://www.europarl.europa.eu/doceo/document/A-9-2023-0257_SK.html
- 8. Flatt, M. (2023, January 20). Book Publishing Trends. Retrieved September 27, 2023, https://prbythebook.com/book-publishing-trends/
- 9. Harman, M. (2023, April 29). 8 Key Publishing Trends in EdTech. Retrieved September 27, 2023, from: https://kitaboo.com/key-publishing-trends/
- 10. Hurná, I. (2019). *Význam kníh a čítania v súčasnej rodine*. Retrieved September 27, 2023, from https://itlib.cvtisr.sk/wp-content/uploads/docs/45-vyznam.pdf
- 11. Izzard Ink Publishing (2023). The top publishing trends of 2023 and beyond. Retrieved September 27, 2023, https://izzardink.com/publishing-trends/
- 12. Jurík, Ľ. (2021, April 24). *Náročné čítanie pre náročných čitateľov (Jozef Špaček: Pascalov tieň)*. Retrieved September 27, 2023, https://davdva.sk/narocne-citanie-pre-narocnych-citatelov-jozef-spacek-pascalov-tien/
- 13. Kolmar, Ch. (2023, June 27) Gripping Book Industry Statistics: How Many Books Were Published In 2022. Retrieved September 27, 2023, https://www.zippia.com/advice/us-book-industry-statistics
- 14. Ministerstvo kultúry Slovenskej republiky (2014). *Východiská stratégie rozvoja kreatívneho priemyslu v Slovenskej republike*. Retrieved September 27, 2023, from https://www.culture.gov.sk/wp-content/uploads/2019/12/Vychodiska-strategie-rozvoja-kreativneho-priemyslu-v-SR.pdf
- 15. Ministerstvo kultúry SR (2023). *Stratégia kultúry a kreatívneho priemyslu Slovenskej republiky* 2030. Retrieved September 27, 2023, from: www.strategiakultury.sk
- 16. Noblit C. (2023, January 3). *The Top 10 Publishing Trends for 2023*. Written Word Media. Retrieved September 27, 2023, from: https://www.writtenwordmedia.com/the-top-10-publishing-trends-for-2023/

- 17. Perry, P. (2019, September 12). *Publishing Industry Trends in 7 Charts*. Retrieved September 27, 2023, https://blog.submittable.com/publishing-industry-trends/
- 18. Publishing Trends That Booksellers Need To Be Aware Of (2022, August 30). Retrieved September 27, 2023, https://booknet.com.au/resources/2022-publishing-industry-trends/
- 19. Simpson, J. (2020, December 18). *Understanding the book market*. Writers & Artists. Retrieved September 27, 2023, from: https://www.writersandartists.co.uk/advice/understanding-book-market
- 20. Talbot, D. (2023, March 8). *What Impacts Book Publishing*. Retrieved September 27, 2023, https://wordsrated.com/what-impacts-book-publishing/
- 21. Turzo, J. (2022,. March 31). *Knižný trh formuje viacero faktorov*. RETAIL magazin. sk, RETAIL MEDIA Slovakia, s.r.o. Retrieved September 27, 2023, from: https://www.retailmagazin.sk/obchodnik/maloobchod/6166-knizny-trh-formuje-viacero-faktorov
- 22. Wagner-Stafford, B. (2023, February 15). *The Book Publishing Trends That Will Dominate in 2023*. Retrieved September 27, 2023, https://ingeniumbooks.com/publishing-trends-2023/

Digital technologies in relation to tax systems

Katarina Vavrová *

- ¹ University of Economics in Bratislava, Faculty of Business Management
- * Correspondence: katarina.vavrova@euba.sk

Abstract: The aim of the paper is to approach and analyze the relationship between the tax system and smart technologies. Explain the positive impact on the environment and business activity using innovative technologies. The first part of the contribution is focused on the industry 4.0 approach itself, describes the development of the industry, its principles. Subsequently, the key factors of Industry 4.0 are discussed. The paper describes the trend of technologies for ubiquitous production. Next, the paper describes trends in technology, and the second part of the paper is devoted to the Digital Economy and Society Index for the years under review. Concepts of implementation of Industry 4.0 elements. in each country are explored in the next part of the post. These are modern technologies that are gradually being introduced into common practice by more and more countries. Thanks to European countries such as Germany, Switzerland, or Scandinavian countries, which are characterized by a high share of industry in GDP, we can see how Industry 4.0 manifests itself and advances at a considerably fast pace. Finally, we will focus on comparing the impact of the fourth industrial revolution on tax systems.

Keywords: tax systems, Smart technologies, digital economy

Introduction

If we accept the hypothesis that industry in all its branches is the main element of economic development, then we accept that industrial revolutions in the past had an impact on the overall development of the world. The technologies of the industry 4.0 concept brought an innovative revolution not only in the field of industry as such, but also entered the life of every person, where they make the world around us intelligent. The term Industry 4.0 represents a network of intelligent technologies that use connectivity, intelligence, and work in real time, can communicate with each other and influence and control each other. The Digital Platform Revolution is an inspirational guide for leaders in transforming existing businesses (Parker et al., 2017). For the previously mentioned reasons, in the contribution we deal with the characteristics of the industry 4.0 concept and its principles of operation, applied technologies in the company and their subsequent impact on ecology about sustainability and competitiveness.

1. Theoretical background

The industrial revolution, which we are currently sharing, is characterized by the introduction of new technologies, and the concepts of their introduction are essential mainly for the so-called enterprises. value chain. It should be noted that the company's value chain consists of all its generated activities that bring added value. value chain. Within modular structured smart factories, CPS monitors physical processes, creates a virtual copy of the physical world, and makes decentralized decisions. Through the Internet connecting objects, CPS communicates and cooperates with itself and people in real time (Waterfield, 2018) and (Weyer et al.,2015).

Among the factors of the industrial revolution, we will focus on the following:

Radio frequency identification (RFID) is a sensor technology that is widely used to identify and
locate objects in industry. This technology makes it possible to enter small data such as wire production in the form of labels. The tags are sensitive to electromagnetic radio waves and allow identification according to the data stored in them. The advantage of RFID tags is the flexibility of use,
very small size, they can be reused, they can be read by an RFID reader when approached without
physical contact or visualization (AB&R, 2019).

- Internet of Things: The Internet of Things helps connect various mechanical devices to create a large-scale network that communicates data between devices and intelligent services for fast, ondemand business decisions (Gardner, 2018).
- Cloud computing: Cloud computing is the provision of computer services on demand over the Internet. Services such as servers, storage, databases, networks, software, analytics, intelligence, and others may be used on demand. This is the infrastructural support of services via the Internet. (Kaur et al., 2019). The Internet connecting objects, Big Data, and cloud computing together with AI are the empowering factors of Industry 4.0, which basically focuses on industrial automation. In recent years, information technology has greatly advanced due to cloud computing with ondemand self-service, ubiquitous network access, rapid elasticity, pay-as-you-go and location independent resource pooling. Clouds with the ability to manage infrastructure represent a vast space of easy-to-use and accessible virtualized resources such as various development platforms, applications, services, hardware that can be dynamically reconfigured to enable self-service, economies of scale and optimal resource utilization (Wu et al., 2013).
- High-speed wireless networks: A wireless network allows two or more devices to connect to each
 other and exchange data wirelessly. Wireless networks are obvious in connecting various Internet
 devices connecting objects to make network connectivity simple, cost-effective, and maintenancefree. Manufacturing plants are densely packed with machines where connecting each device via a
 wired network is not a common task.
- Big data analysis: big data analysis is a complex process of processing and analyzing data to provide meaningful insight or information hidden in a large data set. Big data analysis is very useful in obtaining business and informational insights (Reis et al., 2018).
- AI (Artificial Intelligence) and ML (Machine Learning) not only collect data, but also analyze it and
 turn it into information and insights that help create precise business or operational strategies. ML
 is an application of artificial intelligence that focuses machines on artificial learning and thus on
 intelligent decisions. ML algorithms allow a machine to learn and uncover deep information or
 insights embedded in data sets (Marr, 2023).
- Cognitive computing is a technology platform that uses AI in computing to make it smarter. Cognitive computing simulates human cognition to solve complex problems, especially problems that are ambiguous and uncertain. The computational model learns from experience and develops its decision-making capabilities (Reis et al., 2018).
- Additive manufacturing is often called 3D printing. It refers to building elements by depositing
 material layer by layer. This transformative industrial approach makes it possible to build objects
 that are much stronger and lighter. This technology helps to create many shapes, complex shapes
 without the need for welding or assembly of individual parts.
 - Trend technologies for production:
- Internet of Things connects several cyber-physical objects or things, such as devices, services, cars, farms, factories, even animals, to the Internet to improve manufacturing capability. These networked devices can communicate through standard protocols and share data in different environments through modems, routers, switches, and mobile stations. The integration of smart objects makes the system agile, intelligent, and networked, making the Internet of Things (IoE) the Internet of Everything (IoE), which consists of the Internet of Services (IoS), the Internet of Manufacturing Services (IoM), and the Internet of People (IoP) (Solanki & Nayyar, 2019).
- Cyber physical systems (CPS) are a technique for connecting, managing, and interacting between physical devices and computing applications that are tightly integrated with the Internet and its users. In a CPS, physical and software components operate at different spatial, behavioral, and temporal scales and are interconnected in many, ever-changing ways. The concept of CPS is a network of cooperating computing and physical devices. The data and information processing capability of mechatronics is gradually transforming the obsolete production level into an environment to realize elastic, reconfigurable, scalable, and network-supported collaboration between embedded devices and business process arrangements. Since CPS is a human-centric technology, communication with humans can be achieved through mobile devices such as smartphones, tablets, or wearable devices. Augmented reality technology can be unified with things at the time of

installation, operation, and maintenance of automation systems, increasing the productivity and competence of operators by providing various relevant information. Desktop-as-a-Service (DaaS): A customer can host their entire desktop computing environment with data storage and network communication equipment (Wang et al., 2016).

Web services

- A web service is a self-contained, virtually unified logical system that consists of software modules accessible over the Internet that perform duties, solve problems, or perform transactions for a user or application. The Internet of Services is an important support for Industry 4.0 and CPS (Reis & Franco, 2018) and (Hobbs, 2018).
- Smart Factory Web Architecture: Smart Factory Web Architecture (SFW) supports connectivity and work capabilities for physical resources to protect data and service integration in cross-site application situations. SFW includes factory equipment management, factory equipment data management and analysis, and a service interface. It provides an open API for the SFW portal, as well as for Enterprise Information System (EIS) applications, such as the Manufacturing Execution System (MES) or ERP system, can be involved in the SFW involving various devices, sensors, or control systems (Jung et al., 2017).
- The adoption of new industrial practices enabled by Internet of Things technologies, AI and ML in the design, planning, optimization of decision support systems throughout the manufacturing life cycle leads to the need for an intelligent knowledge management system to acquire, represent and extract manufacturing knowledge used for factory automation by machine interpretable way. Epistemology is a philosophy that decides what knowledge should be acquired, the process of acquisition, and how that knowledge can be delivered dynamically with omnipresence, context awareness, and omnipresence.
- An ontology is a method for representing manufacturing knowledge that can be used to configure, coordinate, and supervise a manufacturing system in a machine-interpretable way. The production ontology can be specified for the entire production life cycle (Leitao et al., 2005). Despite these developments, it is worth noting that Industry 5.0 will be an innovation of Industry 4.0 and not a completely new paradigm (Waterfield, 2018).

2. Methods and methodology

The following work procedure was used in the preparation of this contribution, which is intended to help clarify the current situation of the implementation of the fourth industrial revolution in selected countries of the European Union. The contribution is divided into the following scientific activities: analysis of theoretical starting points in the field of Industry 4.0; analysis of the impact of Industry 4.0 in selected countries of the European Union and comparison of the results between the selected countries with the average of the European Union; analysis of the approaches of selected countries of the European Union to the full implementation of the elements of Industry 4.0, which lead to the achievement of this goal by 2030. As part of the evaluation and comparison of the results between the selected countries and the average of the European Union, the methods listed in the available literary sources were used.

The following methods were used in the work: The method of analysis in determining the current situation in selected countries associated with the implementation of Industry 4.0 elements. The synthesis method, which was used when formulating the conclusions and goals of individual initiatives of selected countries until 2030. The comparison method was used when comparing the levels of implementation of Industry 4.0 elements in selected countries of the European Union with the average of European countries. of the Union in the field of Industry 4.0. Methods of induction and deduction, which were used in formulating general and partial conclusions to the established facts.

3. Results

Thanks to European countries such as Germany, Switzerland, or Scandinavian countries, which are characterized by a high share of industry in GDP, we can see how Industry 4.0 manifests itself and progresses at a considerably fast pace. An important part of this is the developed industry in these countries, but we assume that the governments of these countries also play a significant role in the advancement of Industry 4.0. Governments that have for many years focused on and considered it important to emphasize the development of engineering skills, lifelong learning and training, research and development, and investment in infrastructure. All the measures taken, and expenditures directed to these areas support the country's industry and help the economy better adapt to the conditions of the fourth industrial revolution. Many industrial companies are investing in the use of digital technologies and are dealing with digitization. Efforts are being made in many areas of economic and financial policy to enable Europe to take advantage of the opportunities offered by digitalization.

For tax policy, the digital revolution raises the question of whether the current regulations and procedures of the tax system will work in the new conditions or whether reforms are necessary. On the one hand, it is about the support of digitization, for example, the European Commission in its considerations on tax policy emphasizes that the creation of the Single Digital European Market has a high priority. On the other hand, it is important to ensure that companies in the digital economy are taxed appropriately. In the public debate in Europe, the focus is on the taxation of internationally active digital corporations. Some of these companies have drawn attention for spectacular tax avoidance strategies.

The European Commission has therefore proposed to introduce a sales tax for large companies in the digital economy as a short-term corrective measure. In the long term, he wants to change international tax rules. The concept of "digital business premises" plays a central role here. The problem of international tax avoidance plays a central role in the public debate on digitalization and taxes. Large American companies such as Google and Amazon are accused of largely avoiding proper taxation of their profits. Digital business models play a role for many of these companies. However, international tax avoidance is not only a problem of the digital economy. may be divided by subheadings. They should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

3.1. The impact of the introduction of new technologies

According to the results of the Digital Economy and Society Index (DESI) for 2021, Slovakia ranks 22nd among the 27 EU member states. Compared to 2020, it remains in the same place. Slovakia is just below the EU average. 54% of Slovaks have at least basic digital skills and 27% have above-average digital skills, compared to the EU average of 56% and 31%, respectively. The number of companies providing ICT training in 2020 was 16%, the EU average is 20%.

The share of ICT specialists in total employment also increased and reached the EU average. The overall use of fixed broadband in Slovakia steadily increased from 72% in 2019 to 78% in 2020. Slovakia has significantly improved the roll-out of superfast internet and progressed with very high capacity 5G network coverage, improving its 5G readiness score. 52% of SMEs have at least a basic level of digital intensity, which is below the EU average of 60%. 15% of businesses used at least two artificial intelligence (AI) technologies in 2020, compared to 25% in the EU. The number of companies using electronic invoices is 16%, which is significantly below the EU average of 32%. Most indicators for the area of digital public services are lower than the EU average, except for 68% of e-government users in 2020, compared to 64% in the EU (2021).

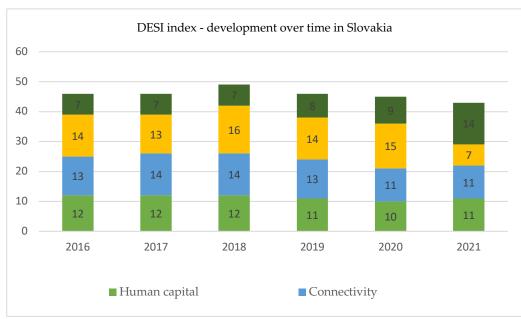
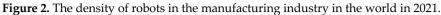
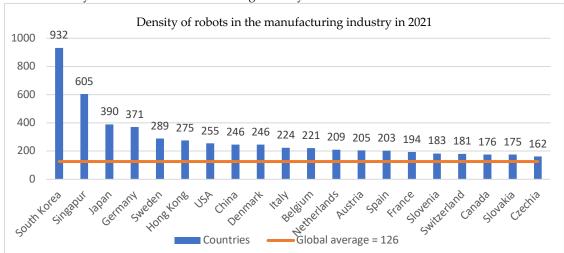


Figure 1. DESI index - development over time, Slovakia, years 2016 - 2021.

Source: own processing according to https://ec.europa.eu/newsroom/dae/redirection/document/80599

To compare the development of the implementation of Industry 4.0, we used the indicator of the density of the use of robotics and automation in industrial enterprises. This indicator is growing globally and accelerating all over the world. 126 robots per 10,000 employees is the new global average for the density of robots in manufacturing industries. By region, the average robot density is 134 units in Asia/Australia, 123 units in Europe, and 111 units in the Americas.





Source: own processing according to https://ifr.org/ifr-press-relaese/news/robot/density-nearly-doubled-globally Currently, we are increasingly encountering the term robotization of the production process. This is a trend where human labor is being replaced by robotic equivalents in industry. This development of the industry has its supporters and opponents at the same time.

Many economists are of the opinion that robots do a better job than humans in the manufacturing process. Robots don't get tired, they're not hungry, they're surgically precise, and best of all, they don't need a salary. A person receives a salary and pays taxes for the same work. By replacing a person with a robot, a situation arises in which the manufacturer does not directly give money to the robot, meaning that no taxes for the state result from this work.

https://ifr.org/down-

The top 5 most automated countries in the world are: South Korea, Singapore, Japan, Germany, and Sweden.

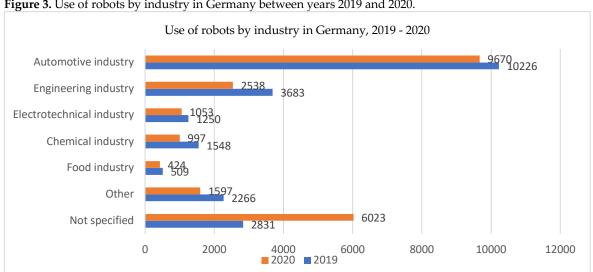


Figure 3. Use of robots by industry in Germany between years 2019 and 2020.

processing according to reports: loads/press2018/2021 10 28 WR PK Presentation long version.pdf

Source:

own

It can be concluded that the German robotics industry is recovering, driven mainly by strong overseas trade. The interesting thing is that not the domestic or European market. In the future, the demand for robots in Germany is expected to grow slowly, mainly due to the demand for low-cost robots in industry and non-traditional manufacturing.

IFR

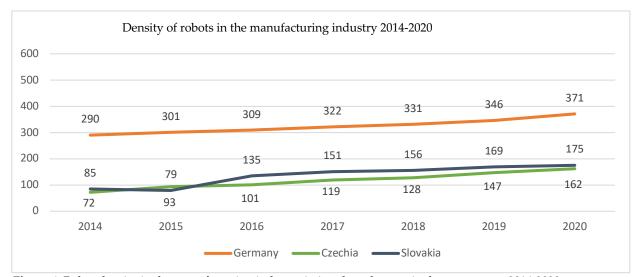


Figure 4. Robot density in the manufacturing industry in in selected countries between years 2014-2020. Source: own processing according to IFR reports: https://ifr.org/news/robot-density-rises-globally

In the graph of the density of robots in the manufacturing industry in selected countries of the European Union between 2014-2020, Germany is in the best position. We note that Germany is the European leader worldwide and is in the 4th position. Furthermore, we note that the Czech and Slovak Republics are in a similar place because they achieve similar values when introducing industrial robots into companies.

However, the current trend in the mentioned countries indicates constant progress and an increase in the ratio of the use of robots in companies. It is estimated that in the next 5 years, Slovakia and the Czech Republic will reach a value of over 200 industrial robots per 10,000 employees, and in Germany we estimate a value higher than 400 industrial robots per the same number of employees. Concepts for the implementation of Industry 4.0 elements in the countries we mentioned are also set to these forecasts.

3.2. The tax system in relation to digital platforms impact of the introduction of new technologies

The digital economy has brought many benefits to citizens and businesses. However, the rise of certain digital activities and new business models also poses an increasing challenge to existing tax systems. It is important that all sectors of our economies pay their fair share of taxes. Current taxation rules govern matters of international taxation. They are set to apply to businesses that have a physical presence in a certain country. The growing digitization of economies presents tax challenges, such as a reduction in tax revenues due to abusive tax evasion and tax avoidance. Tax rules must therefore be updated accordingly.

With the advent of new technologies and business models, many digital businesses have users and customers in countries where they do not have a physical presence. As a result of this fact, generate profits from interacting with users and customers using their data and contributions using intelligent technologies. As tax rules still presuppose a physical presence, profits from digital activities are often not taxed in the market jurisdiction (i.e., the country where their users and consumers are located).

From the knowledge we acquired in the previous chapter, we can evaluate that VAT largely affects the final price of goods and services. Since the amount of the VAT rate differs in each country, it can greatly influence the buyer's decision where to buy the goods and services. Standard VAT rates in the EU range from 17% to 27%. Luxembourg is among the countries with the lowest rate of 17%, while Hungary has the highest rate of 27%.

The VAT rate is related to the levies of this tax into the state budget. Consumers benefit from the new rules, or the use of e.g., e-shops would feel the changes in the legislation mainly in the fact that such an e-shop remits VAT, which is paid together with the price of the goods to the state budget in the state by the consumers of the goods.

However, the cancellation of exemption from value added tax for the import of shipments up to 22 euros from third countries brought a disadvantage for consumers. This applies mainly to AliExpress and eBay, where consumers are used to buying cheap goods and if the total value of their shipment did not exceed 22 euros, such goods were not subject to taxation. VAT is now applied to every shipment even if the value is lower than 22 euros.

We would like to note that base erosion and profit shifting (BEPS) due to multinational companies exploiting loopholes and inconsistencies between the tax systems of different countries affects all countries. Developing countries' higher reliance on corporate income tax means they suffer disproportionately from BEPS. As a result of globalization, business operates internationally, so governments must act together to address BEPS and restore confidence in domestic and international tax systems. BEPS practices cost countries USD 100-240 billion in lost revenue annually, equivalent to 4-10% of global corporate tax revenue.

More than 135 countries and jurisdictions in cooperation within the OECD/G20 Inclusive Framework on BEPS implement 15 measures to combat tax evasion, improve the coherence of international tax rules, or ensuring a more transparent tax environment and solving tax challenges arising from the digitization of the economy.

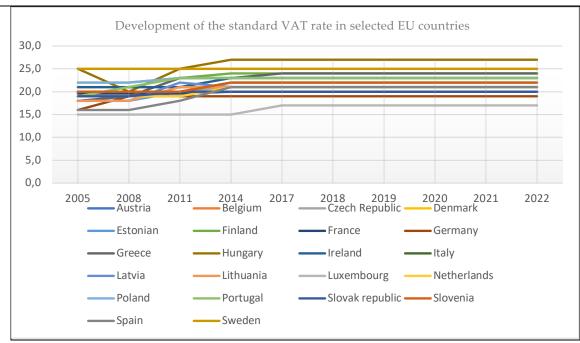


Figure 5. Development of the standard VAT rate in selected EU countries. Source: own processing based on OECD, (2022). CONSUMPTION TAX TRENDS 2022: VAT/GST AND EXCISE, CORE DESIGN FEATURES AND TRENDS. OECD Publishing. [online]. Available at: https://www.oecd-ilibrary.org/sites/6525a942-en/1/1/index.html?itemId=/content/publication/6525a942-en&_csp_=9be05a02fe0e4dbe2c458d53fbfba33b&itemIGO=oecd&itemContentType=book

4. Discussion

We follow the development in the field of digital technology especially about their use in industrial enterprises in Slovakia and subsequently in the EU countries. Thanks to European countries such as Germany, Switzerland, or Scandinavian countries, which are characterized by a high share of industry in GDP. Using their example, we can observe how the application of modern technologies manifests itself and how the digital economy advances at a considerably fast pace. An important part is the developed industry in these countries, but we assume that the governments of these countries also play a significant role in the progress of Industry 4.0. Governments that have focused on this for many years and consider it important emphasize the development of engineering skills, lifelong learning and training, research and development and investment in infrastructure. Many industrial enterprises are certainly investing in the use of digital technologies and are engaged in digitization. Efforts are being made in many areas of economic and financial policy to enable Europe to take advantage of the opportunities offered by digitalization. Since 2014, the European Commission has been monitoring the progress of member states in the digital field and publishing annual reports on the Digital Economy and Society Index (DESI), which we also pointed out in the post. Each year, the reports include country profiles to help Member States determine where action needs to be prioritized, and thematic chapters containing analysis of key areas of digital policy at EU level. The DESI index improves the methodology and considers the latest technological and political developments. The DESI indicators are now structured around four main areas of the digital compass: human capital, connectivity, integration.

5. Conclusions

Many economists hold the theory that businesses should pay a tax on robots. According to the theory, people replaced by robots should take on jobs that a robot could not handle. Work that uses empathy, feelings, such as caring for the elderly or teaching. This type of work is not paid from the production and sale of products, but from taxes. And the inflow of taxes to the state treasury would see a significant decrease with the arrival of robots. That's why you, for example, Bill Gates thinks there should be some kind of tax on robots. He did not specify what exactly. His section is not mandatory but can be added to the manuscript if the discussion is unusually long or complex.

References

- 1. AB&R. (2019). RFID. Retrieved from https://www.abr.com/what-is-rfid-how-does-rfid-work/ Deloitte. (2017). Industry 4.0 and the digital twin: Production meets its requirements. Retrieved from https://www2.deloitte.com/insights/us/en/focus/industry-4-0/digital-twin-technology-smart-factory.html.
- 2. European Commission. (2021a). 2030 climate & energy framework. Retrieved from https://ec.eu-ropa.eu/clima/eu-action/climate-strategies-targets/2030-climate-energyframework_en.
- 3. European Commission. (2021). Digital Economy and Society Index 2021: overall progress in digital transition but need for new EU-wide efforts. Retrieved from http:// <u>Digital Economy and Society Index 2021 (europa.eu)</u>
- 4. European Commission. (2021). Digital Strategy, Slovakia in the Digital Economy, and Society Index. Retrieved from https://ec.europa.eu/newsroom/dae/redirection/document/80599.
- 5. Gardner. (2018). CNC Intro The Key Concepts of Computer Numerical Control. Retrieved from https://www.mmsonline.com/articles/cnc-intro-the-key-concepts-of-computer-numerical-control.
- 6. Hobbs, A. (2019). *Complete Guide 10 Smart Factory Trends to Watch in 2019*. Retrieved from https://internetofbusiness.com/complete-guide-10-smart-factory-trends-to-watch-in-2019/International Federation of Robotics. (2021). Robot Density nearly Doubled globally, 2021. Retrieved from https://ifr.org/news/robot-density-rises-globally.
- 7. International Federation of Robotics. (2021). *Robot Density nearly Doubled globally*, 2021. Retrieved from https://ifr.org/ifr-press-releases/news/robot-density-nearly-doubled-globally.
- 8. International Federation of Robotics. (2021). *World Robotics* 2021. Retrieved from https://ifr.org/downloads/press2018/2021_10_28_WR_PK_Presentation_long_version.pdf.
- 9. International Federation of Robotics. (2017). *Robot density rises globally*. Retrieved from https://ifr.org/news/robot-density-rises-globally.
- Jung, J., Song, B., Watson, K., & Uslander, T. (2017). Design of Smart Factory Web Services Based on the Industrial Internet of Things. In Proceedings of the 50th Hawaii International Conference on System Sciences (pp. 5941-5946). http://doi.org/10.24251/HICSS.2017.716.
- 11. Kaur, A., Gupta, P., Singh, M., & Nayyar, A. (2019). Data Placement in Era of Cloud Computing: a Survey, Taxonomy and Open Research Issues. Scalable Computing: *Practice and Experience*, 20(2), 377-398. https://doi.org/10.12694/scpe.v20i2.1530.
- 12. Leitao, P., Colombo, A. W., & Restivo, F. J. (2005). ADACOR: A Collaborative Production Automation and Control Architecture. IEEE Intelligent Systems, 20(1), 58-66. https://doi.org/10.1109/MIS.2005.2
- 13. Marr, B. (2023). Vital Steps To Create A Digital Transformation Strategy. https://bernardmarr.com/9-vital-steps-to-create-a-digital-transformation-strategy/
- 14. Ministerstvo hospodárstva Slovenskej republiky (2016). *Návrh Koncepcie inteligentného priemyslu pre Slovensko*. Retrieved from https://www.slovlex.sk/legislativne-procesy/SK/LP/2016/830
- 15. Parker, G. G., Alstyne, M. W. V., & Choudary, S. P. (2017). Platform Revolution: How Networked Markets Are Transforming the Economy—and How to Make Them Work for You. W. W. Norton & Company.
- 16. Reis, J., & Franco, R. (2018). The Role of Internet of Services (IoS) on Industry 4.0. Through the Service Oriented Architecture (SOA). *In IFIP International Conference on Advances in Production Management Systems (APMS)*. Seoul, South Korea. http://doi.org/10.1007/978-3-319-99707-0 3
- 17. Solanki, A., & Nayyar, A. (2019). Green Internet of Things (G-IoT): ICT Technologies, Principles, Applications, Projects, and Challenges. *In Kaur, G., & Tomar, P. (Eds.), Handbook of Research on Big Data and the IoT,* 379-405. IGI Clobal
- 18. Wang, S., Wan, J., Li. D., & Zhang, Ch. (2016). Implementing Smart Factory of Industry 4.0: An Outlook. *International Journal of Distributed Sensor Networks*, 12(1). https://doi.org/10.1155/2016/3159805
- 19. Waterfield, P. (2018). Fine watches, craft beer and the psychology of Industry 5.0. *Enterprise IoT Insights. Retrieved* from https://enterpriseiotinsights.com/20180427/channels/fundamentals/the-psychology-of-industry-50-tag99.
- 20. Wu, D., J., Thames, J., L., Rosen, D., W., & Schaefer, D. (2013). Enhancing the Product Realization Process with Cloud-Based Design and Manufacturing Systems. *Journal of Computing and Information Science in Engineering*, 13(4), 041004. https://doi.org/10.1115/1.4025257.

Alternatives to a Program for Supporting the Development of Ethics

Jana Kissová ¹ Gabriela Dubcová ²

- ¹ Affiliation 1 (Faculty of Business Management, University of Economics, Bratislava, Slovak Republic); jana.kissova@euba.sk
- ² Affiliation 2 (Faculty of Business Management, University of Economics, Bratislava, Slovak Republic); gabriela.dub-cova@euba.sk

Abstract: The introduction of ethics into a business is typically a long-term and demanding process, requiring the engagement of all individuals and stakeholders within the company. Often, the foundation for the implementation and integration of ethics into a business is the widely used PDCA (Plan-Do-Check-Act) model. This is a general model suitable for effectively addressing everyday issues in various areas and for improving processes, systems, and activities. The model is applicable at all levels of the business and can be used to enhance various processes, which is why it is frequently utilized. The aim of this contribution is to clarify the possibilities and alternatives for supporting the development of ethics in businesses. Special attention is given to the ethical program as a key attribute of ethics development in businesses, while simultaneously presenting the current state of ethics implementation and the tools of the ethical program in Slovak businesses through a conducted questionnaire survey.

Keywords: supporting the development of ethics; sustainable development program; etical tools

Introduction

Entrepreneurship is an activity primarily aimed at achieving profit and establishing a successful position in the market. A good reputation and the success of a business are closely linked to the adherence to ethical standards and appropriate behavior. These are key pillars of ethics within the business sphere. The implementation and subsequent development of ethics require a responsible and creative approach tailored to the specific needs of the company.

The goal of this contribution is to clarify the possibilities and alternatives for promoting ethics in businesses. Special attention is given to the ethical program as a key attribute of ethics development in businesses, while also presenting the current state of ethics implementation and ethical program tools in Slovak businesses through a conducted questionnaire survey.

1. Theoretical background

Ethics represents a complex social phenomenon that extends its influence into many areas of societal life, making it inconceivable for economic success to be achieved without respecting human rights and ethical conduct. The issue of ethics has gained greater significance in today's context, particularly in the mentioned field, as it forms a solid foundation for relationships with partners, cooperation, and collaboration (Drličková, E. & Horňáková, R., 2008).

The integration of ethics into the various processes of a business involves a systematic process that requires the synchronization of all elements and continuous support from the organization's management (Kunz, V., 2012).

Ethics in business is often perceived merely as a repressive or cautionary tool, primarily used to address existing problems. Its primary preventive function is frequently underestimated in organizational practice (Fobel, P., 2013).

1.1. Alternatives to an Ethics Development Support Program

Businesses adopt an ethics development program when they have a clear idea of what they want to achieve, change, or where they want to go and, at the same time, need to plan closer collaboration in the implementation of their own vision (Remišová, A. 2015). In businesses, it is possible to gradually adopt and implement several programs that overlap in content and logically build upon each other. The choice of adopted programs depends on the specific enterprise and the conditions in which it carries out its business goals and activities. Author Remišová A. mentions three fundamental programs: the sustainable development program, the compliance program, and the ethical program.

The Sustainable Development Program

This program is classified as a long-term and breakthrough initiative affecting business plans and strategies. It originated at the global level and subsequently spread to the societal and corporate levels. It is among the significant strategies that have become the foundation for addressing global ecological and social issues on the planet. Over time, businesses have started paying more attention to environmental matters and the ways to protect it. Gradually, the environment has become a key value for European countries, which have incorporated it into their national legislation. It has also become part of action and strategic plans in successful business entities, demonstrating responsibility for environmental activity (Remišová, A. 2015).

Compliance Program

It represents a targeted and detailed elaboration of norms and procedures with the aim of correcting employee behavior within an organization to prevent legal violations and detect breaches of competition law (Ferrell, O.C. & Leclair, D.H. & Ferrell, L. 1998).

In general, it is not possible to create a compliance program suitable for all organizations. The intention is to create and implement a program that will prevent and detect law violations. To ensure its effectiveness, it must contain basic components. First and foremost, it requires appropriate organizational functioning, which is the true key to an effective compliance program. It is necessary to conduct an assessment and analysis of identified risks and their potential impact on the organization. Without risk assessment, it is impossible to determine specific areas to focus on. Subsequently, adequate rules should be adopted to eliminate potential risks, regular employee and managerial training should be implemented, and control mechanisms should be established (Banks, L. T. & Banks Z. F., 2020).

Creating an effective compliance program is an effective prevention for organizations against the incurring of criminal liability, which can jeopardize relationships with owners, shareholders, employees, and customers. Its importance should be recognized primarily by top management of the company, as well-implemented tools can provide management with effective feedback on the internal environment of the company (Bohoš, M. 2021).

Ethical Program

It represents a comprehensive system of logically interconnected ethical beliefs, values, rules, procedures, and methods of communication adopted by an organization to ensure the long-term and continuous development of ethics within its organizational culture. An organization adopts it with the aim of ensuring the development of business ethics internally and externally. In doing so, it gains numerous benefits, strengthens its reputation in society, enhances performance and productivity, and, not least, reduces the costs associated with addressing unethical behavior (Remišová, A., 2015).

In practice, the terms "business ethical program" and "ethics institutionalization" are often confused. If a business decides to have an ethical program, it means it is determined to apply a comprehensive and coordinated system of values, standards, and procedures for an indefinite period. The program holds strategic importance. In the case where a business has an ethical code or has established a reporting line for unethical or unlawful conduct, it cannot be considered a business with an ethical program but rather as a business that has institutionalized ethics (Remišová, A., 2015).

For the successful sustainable economy of Slovakia, it is essential for businesses to directly apply the principles of ethical management in practice, often referred to as the functioning ethical management of the business, which should include: a system of applied ethical minimum (legislation), a compliance program, and an ethical program (Figure 1).



Figure 1. Functioning Ethical Business Management

Source: own processing

Successful process leading to this is called the institutionalization of ethics, which involves implementing the concept of ethics through an ethical program, with the ultimate goal being a functioning ethical business.

1.2. Tools of the Ethical Program to Support Ethical Development

The ethical program can generally be understood as a starting point for desired behavior and also serves as its control within a business. However, this program does not promise the complete elimination of unethical behavior and actions but guides employees towards better understanding and adherence to ethical behavior norms.

The introduction of an ethical program into a business presupposes that the business considers ethics an important part of its culture. It signifies that it acts responsibly towards all stakeholders and strives to promote ethics throughout its economic activities (Remišová, A., 2011).

A well-designed and implemented ethical program provides employees and managers with information and guidance to make effective, efficient, and responsible decisions. Recent surveys have indicated that an effective ethical program comprises nine components (Johnson, W.K. & Abramov, Y.I., 2014):

- 1. Procedures and standards to guide the behavior of individual members of the organization and promote the expectations of all stakeholders.
- 2. Adequate systems and structures that ensure authority, accountability, sustainability, and a commitment to be held accountable.
- 3. Communication of standards, procedures, and expectations to the organization's members.
- 4. Programs for monitoring and controlling employee behavior.
- 5. Support and encouragement for members to seek advice and report concerns.
- 6. Special attention in recruiting employees, especially for sensitive positions such as finance and management.
- 7. Support and encouragement for employees to adhere to standards and procedures.
- 8. Regular assessments of program effectiveness.

Various measures are used to introduce and promote ethics within a business, which can be categorized into five main categories (Remišová, A., 2015):

- Documents and written materials,
- Channels of information flow,

- Entities and authorities,
- Forms of education,
- Mechanisms of control.

These categories encompass various forms of ethics institutionalization, with the most commonly used and widespread tool in the business sphere being the ethical code (Figure 2).

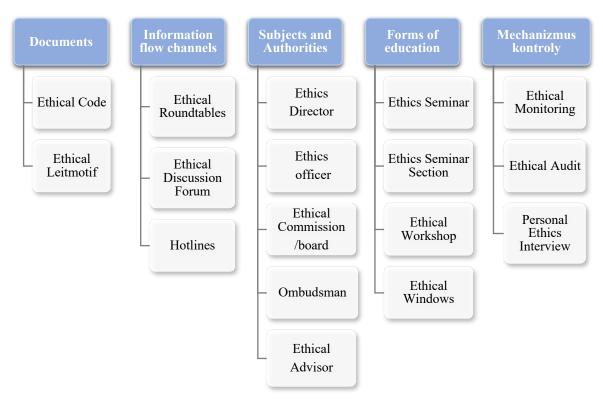


Figure 2. Forms of Ethics Institutionalization

Source: processed according to Remišová, A. (2011). Vademékum podnikateľskej etiky

The inclusion of the mentioned forms of institutionalization is not absolute and unconditional but is used to facilitate orientation in the complex system of the ethical program and provide a better overview. Additionally, the category of "education" can also be understood as a form of communication. (Remišová, A. 2015)

2. Methods and methodology

The main goal of the presented contribution is to clarify the possibilities and alternatives for promoting ethics in businesses. Special attention is given to the ethical program as a key attribute of ethics development in businesses, while also presenting the current state of ethics implementation and ethical program tools in Slovak businesses through a conducted questionnaire survey. Partial objectives related to approximating ethical behavior and the availability of information on the topic in the theoretical dimension, as well as assessing the current state in the practical dimension by identifying the ethical tools used in Slovak businesses, have contributed to achieving the main goal.

The subject of the study is a random sample of respondents - employees in businesses further identified by age, gender, education, job position, as well as a random sample of businesses with a focus on size, field of operation, and ownership form. A total of 62 respondents from various businesses operating in Slovakia participated in the survey. Women were in the majority based on gender (58.1%), respondents under 30 years old were the most numerous by age (41.9%), higher education of the second degree had the largest representation (41.9%), with administrative positions being the most common (61.3%). Concerning the identification of businesses, medium-sized companies predominated, most of them were in manufacturing, and domestic ownership dominated.

In the scientific contribution, general research methods and the specific method of questionnaire survey were used. Individual questions aimed at the goal are evaluated in the form of graphs, and the results are verbally interpreted accordingly.

3. Results

This section presents practical results on the investigated topic based on the conducted survey. The aim of the survey is to gain an overview of the importance of ethics in the workplace, its development, and the utilization of various ethical tools.

3.1 Results - the importance of ethics, its development, and the application of ethical tools in the business

The approach to ethical requirements by businesses is gradually changing, and ethics is becoming increasingly prominent in the public consciousness. The survey's intention is to explore the extent to which, in what forms, and in what manner ethics is present in the workplace. It also examines ethical issues and a company's ability to address them.

In the presented survey, the most important questions related to the research goal are outlined, with graphical representation and verbal interpretation for clarity.

Existence of Internal Ethical Regulations

At the beginning of the survey, we were interested in whether companies have internal regulations and standards related to ethics. Based on the responses obtained, it can be noted that the majority of respondents answered affirmatively (72.6%), indicating that they have established documents that define and delineate the behavior of their employees. 12.6% of respondents answered negatively, and 14.5% do not know if the organization has adopted any standards (Figure 3).

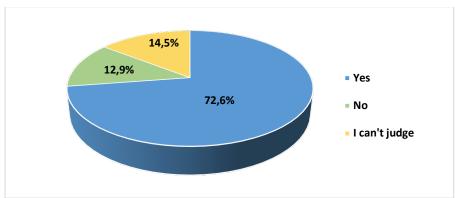


Figure 3. Existence of Internal Regulations and Rules Related to Ethics

Source: own processing

Familiarization with Ethical Standards

Another important piece of information was to determine whether employees were acquainted with the company's ethical standards upon starting their job position (Figure 4). Based on the responses obtained, it can be concluded that 61.3% of the respondents were familiar with them. The remaining 38.7% of the respondents were not familiar with them, and this could be due to the non-existence of these standards or the company not considering it necessary to inform its employees about them.

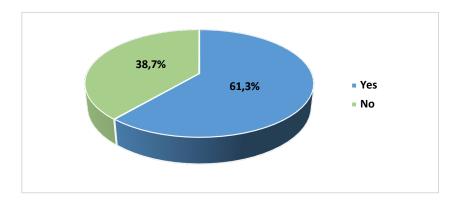


Figure 4. Familiarization with Ethical Standards

Source: own processing

Implementation of Ethical Tools in Businesses

The next question aimed to determine the main purpose of the survey, which is the application and implementation of ethical program tools in businesses. Since respondents could provide multiple answers in this case, the sum of responses does not correspond to the total number of respondents. Based on Figure 5, it can be seen that the ethical code is among the most commonly used ethical tools in businesses, confirmed by 35 respondents, representing 67.3% of the entire research sample. This was followed by the ethics officer, mentioned by 23 respondents, and the ethics advisor, mentioned by 18 respondents. Regarding forms of education, ethics seminars, seminar sections on ethics, and ethics workshops are prevalent. The remaining tools for implementing ethics into the organizational structure are used to a minimal extent (Figure 5).

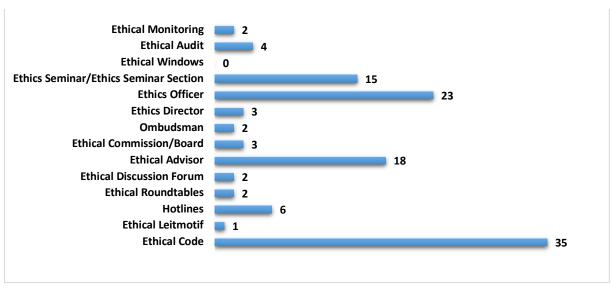


Figure 5. Applied Ethical Tools in Businesses

Source: own processing

Ethical Issues in the Workplace

In case respondents encountered unethical behavior in the workplace, they were also required to specify the particular problem. Since they could provide multiple options, the number of responses does not correspond to the number of respondents. Among the most common problems they encountered were unfair financial rewards, violation of ethical principles, favoritism towards certain employees, and sexual harassment. (Figure 6)



Figure 6. Ethical Issues in the Workplace

Source: own processing

Person/Committee Responsible for Ethics

We further attempted to determine whether there is a specific individual or committee in the companies where respondents work, responsible for addressing any arising ethical issues. Based on the graphical representation, we can see that 49 respondents answered affirmatively, representing 79% of all those surveyed. 17.7% of respondents expressed a negative stance, and two are unsure if such a person or committee exists in their company. (Figure 7)

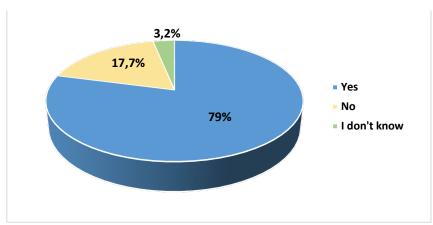


Figure 7. Person/Committee Responsible for Ethics

Source: own processing

Ethical Conduct Monitoring in the Company

We were interested in whether there are mechanisms in place within the company to monitor whether employees are being checked in their work or if someone within the company oversees the adherence to ethical principles and regulations. The results were relatively evenly distributed, with 22 of respondents indicating that they are unaware of any monitoring, 21 stating that they are monitored in their work, and 19 respondents reporting no monitoring by company management at all. (Figure 8)

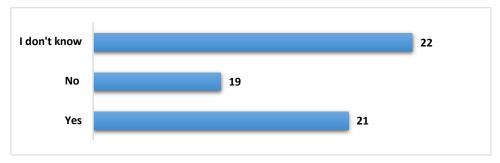


Figure 8. Ethical Conduct Monitoring in the Company

Source: own processing

Option to Report Unethical Conduct

We also inquired whether there is an option for anonymous reporting of unethical behavior, conduct, and complaints within the companies. The majority of respondents, 26, provided a positive response, stating that they have not yet used this option. 17 respondents do not have this option but would welcome it. 13 respondents do not have this option and do not consider it necessary. (Figure 9)

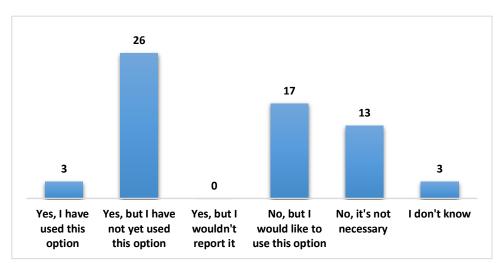


Figure 9. Option to Report Unethical Conduct

Source: own processing

4. Discussion

The implementation of ethical principles is essential in the development of ethics in businesses. When introducing ethical standards, companies can choose from various programs. The most common alternative is the implementation of an ethics program, which is the focus of the application section. Based on the conducted questionnaire survey, we have identified several important results. The surveyed questions focused on the most critical aspects for assessing the current state of support for the development of ethics in businesses.

At the beginning of the survey, we were interested in whether companies have established ethical standards. Most responses were positive, but there were 17 respondents who were unaware of workplace norms or the fact that their company had not implemented such norms. In cases where a company does not have these norms in place, there is a higher likelihood of ethical principles being violated,

resulting in significant economic losses that the company could prevent by paying more attention to employee ethics education.

In terms of the application of ethical tools for ethics implementation, companies most commonly use an ethical code (35 respondents). This is followed by other typical tools such as an ethics officer and an ethics advisor. Ethical hotlines, ethical audits, and monitoring were not found in any of the surveyed companies, which can be viewed negatively because implementing only an ethical code is insufficient. It is necessary to monitor and address employee behavior and actions, as ethical codes and other standards alone may not suffice.

Another important aspect of the survey was identifying the most common ethical problems. The most frequently mentioned issues were violations of ethical principles, unfair financial rewards, favoritism among employees, and information leakage. Upon closer examination, we found that the majority of ethical problems were associated with medium-sized companies with up to 250 employees, primarily domestically owned. The results are not positive, suggesting insufficient attention to ethics on the part of these companies and their pursuit of market standing through unethical means.

For the development of ethics in businesses, it is essential to have mechanisms in place for monitoring compliance with established regulations. Ethical monitoring, ethical control, and ethical audits are often used for this purpose. However, only 21 of the surveyed companies utilize these control mechanisms, with the majority choosing not to implement them.

In examining this issue, we recommend the following **measures for companies to improve the situation:**

- In an effort to prevent ethical problems, companies should introduce sanctions and provide ethics and morality training to their employees.
- Companies should have clearly defined principles to help guide employee behavior.
- To promote ethics within their organization, companies should implement mechanisms for monitoring compliance with established regulations.
- When addressing ethical issues, the option of anonymous reporting of ethical violations could assist companies in resolving problems.
- In cases of violations of company regulations, management should take appropriate actions and penalize employees to prevent recurring problems.

5. Conclusions

For the successful implementation of ethical principles, it is important for businesses to be able to find the right alternative program that is most suitable for them. They don't have to choose just one program; they can combine several of them.

In the application section, we focused on the ethical program and its tools, as it is one of the most common in businesses. The survey results in the observed companies indicate its gradual implementation, which still requires improvement in several areas as part of the development of ethics.

Funding: This research was funded by Creation of the adequate model of ethics and integrity conduct of institutions in the area of scientific-research activities on the basis international comparison and setup of related determining attributes for its effective implementation and functioning", VEGA no. 1/0836/21 – project share is 50 % and by "Strengthening the Position of Institutionalized Sustainable Development and Inclusion by Supporting Agenda 2030 Research and Education and Inclusive Diversity Behaviour", KEGA no. 019EU-4/2022 – project share is 50 %.

References

- 1. Banks, L. T. & Banks. Z. F. Corporate Legal Compliance Handbook: 3rd Edition [elektronický zdroj]. New York: Wolters Kluwer. 2020. Dostupné na: https://books.google.sk/books?id=h2vwDwAAQBAJ&printsec=frontcover&dq=corporate+legal+compliance+handbook&hl=sk&sa=X&redir_esc=y#v=onepage&q=corporate%20legal%20compliance%20hand-book&f=false
- 2. Bohoš, M. Compliance program ako štít pred trestnou zodpovednosťou firiem. Bratislava, 2021. Dostupné na: https://www.legisgroup.sk/blog/compliance-program-ako-%C5%A1t%C3%ADt-pred-trestnou-zodpoved-nos%C5%A5ou-firiem
- 3. Drličková, E. Horňáková, R. (2008). Podnikateľská etika. Zvolen: Technická univerzita, ISBN 978-80-228-1952-7.
- 4. Ferrell, O. C. Leclair, D. H. Ferrell, L. (1998). The Federal Sentencing Guidelines for Organizations. A Framework for Ethical Compliance. In *Journal of Business Ethics*, 17, 1998, p. 355.
- 5. Fobel, P. (2013). Organizačná etika a profesionálne etické poradenstvo. Banská Bystrica: Aprint, ISBN 978-80-89415-11-3.
- 6. Johnson, K. W. Abramov, I. Y. 2004. *Business Ethics. A Manual for Managing a Responsible Business Enterprise in Emerging Market Economies* [online]. Washington, D. C.: U.S. Department of Commerce. International Trade Administration, 2004, p. 66. [cit. 01. 12. 2014]. Dostupné na internete: http://ita.doc.gov/goodgovern-ance/adobe/bem_manual.pdf
- 7. Kunz, V. (2012). Společenská odpovědnosť firem. Praha: Grada Publishing, a.s., 2012. ISBN 978-80-247-3983-0
- 8. Remišová, A. (2011). Vademékum podnikateľskej etiky. Bratislava: Sprint dva, 2011. ISBN 978-80-89393-68-8.
- 9. Remišová, A. (2011). Etika a ekonomika. 3. prepracované a doplnené vydanie. Bratislava: Kalligram, 2011, 362 s. ISBN 978-80-8101-402-4.
- 10. Remišová, A. (2015). *Súčasné trendy podnikateľskej etiky. Od teórie k praxi*. Bratislava: Wolters Kluwer, 2015. ISBN 978-80-8168-214-8.

Comparison of the Competitiveness of the BRICS Countries and the USA

Lenka Kalusová 1* and Marián Smorada 2

- ¹ Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia; lenka.kalusova@euba.sk
- ² Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia; marian.smorada@euba.sk
- * Correspondence: lenka.kalusova@euba.sk

Abstract: The competitiveness of countries is an important factor influencing the performance of the economy. The paper deals with the comparison of the competitiveness of the developing countries included in the BRICS group. We compare the competitiveness of the BRICS countries with one of the most developed economies in the world, the USA. When evaluating the competitiveness of the BRICS countries and the USA, we use several different methods and indexes that are constructed annually by important world institutions (such as the World Bank). From a large number of indices, we chose the global index of sustainable competitiveness, the global index of innovation, the corruption perception index and others for the evaluation of our selected countries. Our research shows that among the BRICS countries, China's economy is the most competitive, but according to the results of the indices chosen by us, its competitiveness is weaker than that of the USA.

Keywords: competitiveness, BRICS countries, USA

Introduction

There are significant differences between the performance of the economies of individual countries of the world. On the one hand there are countries that can be described as developed countries, on the other hand there are so-called developing countries. In the paper, we focused on researching the competitiveness of developing countries that are grouped in the BRICS group (Brazil, Russia, India, China and South Africa). The aim of the paper is to evaluate the competitiveness of the BRICS countries as representatives of developing countries, which, however, have a significant position in the world markets and to compare their competitiveness with the competitiveness of the USA as a representative of the developed world economy.

1. Theoretical background

Delgado et al. (2012) define competitiveness as "the expected level of output per working-age individual that is supported by the overall quality of a country as a place to do business." As the authors emphasize, the basic drivers of competitiveness are 36 pillars - social infrastructure and political institutions, monetary and fiscal policy, and the microeconomic environment. As Berger (2008) states, the governments of many countries focus on the strategy of national competitiveness in order to promote economic development. However, according to this author, there is no acceptable national competitiveness strategy, there are only certain concepts. Kao et al. (2008) define competitiveness as "a measure of the relative ability of a nation to create and maintain an environment in which enterprises can compete so that the level of prosperity can be improved". As we can see, in the literature we can come across several definitions of the concept of competitiveness. As Kharlamova and Vertelieva (2013) state, the reasons for the difference in the definitions of competitiveness are the complexity, the complex character as well as the systematic understanding of the category. These different definitions also result from several dimensions of competitiveness - we can talk about the competitiveness of regions, states, industries, companies or products (Vida et al., 2009). Given the focus of the paper, we will take a closer look at competitiveness at the country level.

The competitiveness of countries is defined by several authors in different ways, which is also reflected in different approaches to the evaluation of countries. Aiginger (2006) defines competitiveness as the ability of a country or region to create prosperity. According to Thompson (2004), the

competitiveness of a nation can be understood from a narrow perspective (cost conditions determined by exchange rates) and a broader perspective (includes institutional and systemic circumstances of the economy). Phusavat et al. (2012) point to intellectual capital as a factor influencing performance and productivity. The influence of direct foreign investments on the competitiveness of countries was assessed by the authors Gugler & Brunner (2007). Carayannis and Grigoroudis (2016) investigated the relationship between smart specialization as a key element of the innovation policies of individual countries and increasing regional and national competitiveness. The study by the authors Herciu et al (2011) brings interesting results. The subject of the study was determining the influence of cultural dimensions such as individualism, masculinity, uncertainty avoidance, etc. on national competitiveness. According to the authors, the research results point to the fact that cultural dimensions play an important role in national competitiveness. An earlier study by Moon and Choi (2001) reached the same conclusions.

Developing countries are, in most cases, countries that are former colonies and that began to gain their independence only after the Second World War. This is a large group of countries. As Baumgartner (2015) states, their common characteristics include an underdeveloped economy that is unilaterally oriented, monoculturally focused on exports, poorly developed industry and insufficient infrastructure. It is precisely all these factors that cause the competitiveness of developing countries to be at a very low level on world markets. Chukwuemeka (ACMC, 2022) adds that these countries are still in the early stages of industrial development. However, as Baumgartner (2015) states, even within developing countries there are countries that have an important function/significant position within the world economy and that belong to the most advanced economies in the world. Among such countries we could also include the countries referred to as BRICS, i.e. Brazil, Russia, India, China and South Africa. These are countries that have several competitive advantages over other countries - Russia, Brazil and South Africa have large reserves of mineral resources, China and India compete on world markets with cheap labor. In addition, almost all the mentioned countries (with the exception of Brazil) have invested intensively in recent decades (Radulescu et al., 2014). These economies have experienced much faster growth rates than developed economies over the past two decades. As Truman (2006) states, the BRICS countries show several common features, namely:

- these are developing countries, which, however, have high economic performance and high potential.
- these are countries of high importance for the world economy,
- their importance is so high that they can influence the management of the world economy.

However, these countries are also characterized by significant differences, among which we could include e.g. very high public debt as a percentage of GDP, environmental problems as an obstacle to sustainable growth, growing income inequality as well as high levels of unemployment (Olawumi, 2019).

The USA is a developed country with a high economic performance. It achieves a high GDP per capita. The US economy is one of the strongest economies in the world. Among other things, it is characterized by a high level of innovation, has a high level of industrial development, good infrastructure, a high level of literacy of the population due to good access to education, social inequality is lower compared to developing countries. It is a politically stable country.

2. Methods and methodology

The aim of the paper is to compare the competitiveness of the countries Brazil, Russia, India, China and South Africa as representatives of developing countries, which, however, have a significant position in world markets and to compare their competitiveness with the competitiveness of the USA as a representative of the developed world economy. When comparing, we use both the country's position in the given ranking and also display the total number of points achieved. When evaluating the competitiveness of the mentioned countries, we use several different indexes. We present the composition of a specific index evaluating the competitiveness of countries directly in the results of the work. We choose only a brief description of the composition of the index, as the scope of the contribution does not allow a detailed analysis of the construction of the indices even with the assigned weights in the final evaluation.

The information needed to process the literature search was obtained mainly from scientific articles from journals registered in the Web of Science and Scopus databases. We obtained the information

necessary to process the practical part from annual reports published by institutions that deal with the compilation of country competitiveness rankings.

When processing data, general information processing methods were used, such as analysis and synthesis - which were used both in the theoretical part of the contribution and in the practical part, the method of comparison, which we used both in the theoretical part when comparing the views of the authors on the definition of the competitiveness of countries, as well as in the practical part when comparing the points achieved and the location countries in individual rankings assessing the competitiveness of countries. We used the method of correlation analysis when determining the dependence between the achieved point evaluations between the BRICS countries and the USA within the evaluation of the International Institute for Management Development. In accordance with foreign research (Sogorb - Mira, 2005), we consider a strong connection if $|\operatorname{rxixj}| \ge 0.8$. For better clarity, we have chosen a tabular display.

3. Results

Competitiveness can be measured through several indices. From this large number of indices, we have selected several country evaluation indices that directly measure competitiveness, or they are aimed at measuring indicators that significantly affect the competitiveness of countries. We included the IMD world competitiveness ranking, global sustainable competitiveness index, corruption perception index, index of economic freedom, international property rights index, prosperity index and global innovation index among the indices we examined. In Table 1, we show the evaluation of the competitiveness of selected countries through the ranking of the country and the point evaluation. The table also shows the total number of evaluated countries.

Table 1. Rating of countries based on selected indices for 2023.

Country	Bra	zil	Ch	ina	Inc	lia	number of
Index	ranking	points	ranking	points	ranking	points	countries
IMD World Competitiveness Ranking	60	42.09	21	82.1	40	64.63	64
Global Sustainable Competitiveness Index*	46	47.1	31	51.1	120	39.3	180
Corruption Perception Index*	94	38	65	45	85	40	180
Index of Economic Freedom	127	53.5	154	48.3	131	52.9	176
International Property Rights Index	83	4.467	50	5.336	62	5.072	129
Prosperity index	66	60.07	54	62.15	103	53.66	167
Global Innovation Index*	54	32.5	11	55.3	40	36.6	132
Country	Russia		USA		South Africa		number of
Index	ranking	points	ranking	points	ranking	points	countries
IMD World Competitiveness Ranking	45**	56.35**	9	91.14	61	40.19	64
Global Sustainable Competitiveness Index*	51**	49.2**	30	51.2	138	37.6	180
Corruption Perception Index*	137	28	24	69	72	43	180
Index of Economic Freedom	125	53.8	25	70.6	116	55.7	176
International Property Rights Index	103	3.935	14	7.525	55	5.192	129

Prosperity index	77	58.5	19	77.44	75	58.67	167
Global Innovation Index*	47	34.3	2	61.8	61	29.8	132

^{*} The rating is given for 2022, 2023 is not yet available.

Source: Own processing on the basis of data from statistical yearbooks.

The International Institute for Management Development - IMD (IMD World Competitiveness Booklet 2022, 2022) has been publishing the World Competitiveness Booklet every year since 1989. It is a comprehensive report on the evaluation of the competitiveness of selected 64 economies of the world. When compiling the ranking, IMD takes into account 333 competitiveness criteria, which are selected on the basis of comprehensive research and analysis. These criteria are grouped into 4 basic parts, within which areas are evaluated:

- economic performance (economy, international trade, international investments, employment and inflation),
- government efficiency (public finances, tax policy, institutional framework, business legislation and social framework),
- business efficiency (productivity and efficiency, labor market, finances, management procedures, attitudes and values),
- infrastructure (basic infrastructure, technological infrastructure, scientific infrastructure, health and environment, education).

Within the mentioned ranking, China achieves the best position among the BRICS countries - it took 21st place out of 64 evaluated countries. On the contrary, Brazil (60th place) and South Africa (61st place) are in the last places of the ranking. The USA, as a strong developed economy, was ranked 9th. It should be recalled that Russia is not in the World Ranking of Competitiveness or in the Global Index of Sustainable Competitiveness in 2022. This is because the evaluation institutions cannot yet reliably reflect the consequences of the war against Ukraine, which is why Russia was not included in the ranking in 2022 or 2023. In Table 2, we present the evaluation of the examined countries for the last 11 years, i.e. for the years 2013-2023.

Table 2. Ranking of countries in the World Competitiveness Ranking for 2013 – 2023.

Country/year	2013	2014	2015	2016	2017	2018	2019	2020	2022	2023
Brazil	51	54	56	57	61	60	59	56	59	60
China	21	23	22	25	18	13	14	20	17	21
India	40	44	44	41	45	44	43	43	37	40
Russia	42	38	45	44	46	45	45	50	45*	45*
USA	1	1	1	3	4	1	3	10	10	9
South Africa	53	52	53	52	53	53	56	59	60	61

^{*} The figure is for the year 2021, from 2022 it is not possible to obtain relevant data.

Source: Own processing on the basis of data from statistical yearbooks.

The best position - 1st place, the US economy was in this ranking for several years in a row (years 2013, 2014, 2015 and 2018). It significantly deteriorated in the year when the covid-19 pandemic broke out, i.e. in 2020, when it fell to 10th place. In the current period, she improved by one rank. The second most competitive economy within the examined countries is China, whose position in the ranking oscillates around 20th place. In 2018 and 2019, we can observe a significant improvement in its competitiveness, in 2020 it reached 20th place again. According to the ranking of the International Institute for Management Development, Russia and India have similar competitiveness. Their position in the ranking oscillates around the 45th place. In India, we can observe an improvement in the ranking of its competitiveness in 2022 (37th place). In the case of Russia after the outbreak of the war in Ukraine, the institute does not have enough information to process the competitiveness assessment, so the table contains data for the last assessed year, 2021. Since 2019, the last places in the ranking have been closed by the countries of Brazil and China, when the competitiveness assessment gradually worsens.

^{**} The figure is for the year 2021, from 2022 it is not possible to obtain relevant data.

On graph no. 1 we show the basic pillars of the world ranking of competitiveness. As part of the evaluation of the individual pillars in the economic performance pillar, the USA took 2nd place, the second country with the best economic performance among the countries monitored by us was China (8th place). The USA also received a very good position in the evaluation of infrastructure. On the contrary, the USA got the worst rating for government efficiency. On the opposite sides of the ranking are Brazil and South Africa with poor ratings in all monitored areas.

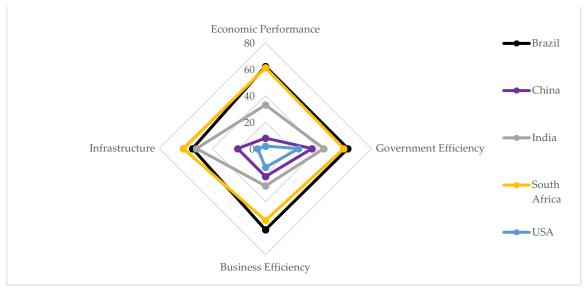


Chart 1. The main pillars of the world ranking of competitiveness of the BRIC countries and the USA. Source: Own processing on the basis of data from IMD World Competitiveness Booklet 2023

We investigated whether we can find any trends and correlations in the evolution of the rating of the BRICS countries and the USA. Table 3 shows the result of the correlation analysis of the point evaluation of the BRICS countries and the USA in the World Competitiveness Ranking.

Table 3. Correlation matrix of the ranking of countries in the World Competitiveness Ranking for the years 2013-2023

	Brazil	China	India	Russia	USA	South Africa
Brazil	1.0000					
China	-0.5155	1.0000				
India	0.0905	-0.1333	1.0000			
Russia	0.4609	-0.3246	0.0276	1.0000		
USA	0.3126	-0.1612	-0.4287	0.5594	1.0000	
South Africa	0.2796	-0.3138	-0.4212	0.4621	0.9311	1.0000

Source: Own processing on the basis of data from statistical yearbooks.

As we stated above in the methodology of the work, we consider a strong connection if $|rxixj| \ge 0.8$. Our presented results show that there is a strong link only when evaluating the competitiveness of the USA and South Africa. If there is a better US competitiveness rating, South Africa also has a better competitiveness rating. We did not find any close relationships between the individual BRICS countries when assessing competitiveness.

In terms of competitiveness, it is important that countries can maintain their competitive advantage and position on the global market for a long time. Another index evaluating competitiveness that we have chosen is the Global Index of Sustainable Competitiveness. Sustainable competitiveness is "the ability to create and maintain inclusive wealth without diminishing the future ability to maintain or

increase current levels of wealth. (The Global Sustainable Competitiveness Index 2022, 2022) " The Global Sustainable Competitiveness Index consists of the following basic pillars:

- natural capital natural environment, including the availability and level of depletion of natural resources,
- efficiency of resources efficiency of use of available resources, assessment of competitiveness with limited resources,
- social capital health, safety, freedom, etc.,
- intellectual capital the ability to create wealth and jobs through innovation and value-added industries in global markets,
- economic sustainability the ability to create wealth through a sustainable economy,
- governance performance providing a framework for sustainable competitiveness.

In the case of the index of sustainable competitiveness, the best position of the countries evaluated by us is the USA - 30th place, followed by China - 31st place. Brazil and Russia also have a relatively good position within the ranking, which are in the third of the countries with the best level of sustainable competitiveness. In this regard, South Africa received the worst rating, which ranked as low as 138th, with a score of only 37.6 points.

Developing countries, including the BRICS countries, are often characterized by a relatively high level of corruption, weak protection of creditors' rights, or low economic freedom. For this reason, we have also included the corruption perception index, the index of economic freedom and the international property rights index in the indices by which we evaluate countries.

Transparency International publishes the Corruption Perceptions Index every year. It evaluates the perception of corruption in 180 countries, with a rating scale ranging from 0-100, where 0 represents a very corrupt country, on the other hand, a point rating of 100 is assigned to a country with maximum transparency. The Corruption Perceptions Index is calculated from 13 different data sources provided by 12 different institutions (Transparency International, 2023). The Index of Economic Freedom is published by the Heritage Foundation (2023). A total of 175 countries were evaluated in the monitored period of 2022 (the year 2023 is not yet available). The index is constructed in such a way that it includes the results of the evaluation of 12 quantitative and qualitative factors, which are divided into 4 basic pillars:

- the rule of law (property rights, integrity of the government, effectiveness of the judiciary),
- size of government (government spending, tax burden, fiscal health),
- regulatory efficiency (freedom of business, freedom of work, monetary freedom),
- market openness (freedom of trade, freedom of investment, financial freedom).

According to the results obtained by the BRIC countries, it is clear that corruption is still a big problem in developing countries. The worst results in this regard were achieved by Russia, which ranked 137th in the ranking.

The Property Rights Alliance publishes an international property rights index. A high degree of protection of property rights plays an important role in assessing the competitiveness of the economy. For the year 2023, a total of 129 countries were evaluated, creating 98% of the world's gross domestic product and participating in 94% of the world's population. The index highlights the central role of property rights in creating a prosperous and competitive economy. Among other things, the index also examines "the relationship between property rights and other economic and social indicators of well-being, including gender equality, illicit trade, innovation, economic competition, research and development, human development, the fight against corruption (IPRI Countries, 2022)." The USA shows a high level of property rights - 14th place. The assessment of other countries is significantly worse. Of the BRICS countries, China is ranked best (50th place), while Russia (103rd place) has the worst rating. China received a relatively good score, especially in the pillars of trademark, patent protection and protection of intellectual property rights. Conversely, the worst rated areas are copyright protection and political stability. Russia, as the worst-rated country from the BRIC group, achieves relatively good results in the areas of trademark and patent protection, on the contrary, it has very poor ratings in the pillars of corruption control and the rule of law.

The Prosperity Index is compiled by the Legatum Institute Foundation. The index assesses prosperity, which it defines as a state where "all people have the opportunity to prosper by fulfilling their unique potential and playing their part in strengthening their communities and nations" (Prosperity

Index, 2023). The Prosperity Index is based on three domains containing several pillars and within them more closely defined evaluated areas. The main three assessed domains and their pillars are:

- inclusive society safety and security, personal freedom, government, social capital,
- openness of the economy investment environment, business conditions, infrastructure and access to the market, quality of the economy,
- empowered people living conditions, health, education, natural environment.
- In the index of prosperity, China again ranked best among the BRICS countries (54th place), India achieved the worst rating (103rd place).

Since innovation is one of the decisive pillars of ensuring and maintaining the competitiveness of countries on global markets, the last index we decided to evaluate is the global innovation index. The global innovation index began to be reported in 2007. The overall rating of countries is composed of the rating of two sub-indexes that have the same weight, namely the innovation output sub-index and the innovation input sub-index. A total of 81 indicators are evaluated within them (Dutta et al., 2022). Among the BRICS countries, China has the best innovation potential - 11th place out of a total of 132 evaluated countries with a score of 55.3.

4. Discussion

The countries grouped in the BRICS group (Brazil, Russia, India, China and South Africa) are countries with a high rate of economic growth. Although these are developing countries, they have high innovation potential. The results of our research show that China in particular, despite being a developing country, can compete on world markets with developed world economies as well. We found that within the BRICS countries they have the most important position, they are the most competitive economy among these countries. On the contrary, the weakest countries in the field of competitiveness are Brazil and South Africa. In addition, after the start of the war in Ukraine, the position of Russia gradually worsened in the rankings we monitor. This is a natural development given the facts that have happened in the last two years. Despite the fact that in the framework of the evaluation of the competitiveness of the BRICS countries (with the exception of China and India), these countries are at the bottom of the ranking, their influence on the events in the world markets is often undeniable. As the BRICS countries themselves state, they make up 43% of the world's population, occupy 30% of the world's territory and 25% of the world's economic output (Raghuramapatruni, 2015). In addition, as stated by Ndzendze (2022), the position of some BRISC countries in FDI is changing. While in the past they were recipients of foreign direct investments, they are currently sources of FDI. As stated by Ghosh et al. (2009), all BRICS countries are trying to orientate their industry towards products that have higher added value and also towards high-tech products. Instead of trying to put more funds into research and development. In addition, this year the BRICS countries agreed to expand their grouping and invited 6 new countries to join their bloc, namely Argentina, Egypt, Iran, Ethiopia, Saudi Arabia and the United Arab Emirates. These countries should join the group as early as January 1, 2024. The main effort of the BRICS countries is to gradually strengthen the group's influence through such expansion, and thereby better defend their interests on the global market. We can assume that by expanding the number of countries included in the BRICS group, their already high influence on world markets will increase even more and a block of countries will be created that will be one of the decisive players on the world market.

5. Conclusions

In the paper, we focused on the evaluation of the competitiveness of 5 developing countries, Brazil, Russia, India, China and South Africa. Despite the fact that these countries belong to the group of developing countries, they are countries that are global players in world markets and have a significant position in the world economy. We compared the competitiveness of these countries with another important world economy belonging to developed countries, namely the USA. We found that the USA is the most competitive economy in the framework of the comprehensive evaluation of the competitiveness of the mentioned countries. However, just behind it is the economy of China. As for the other countries of the BRIC group, their competitiveness is at a significantly lower level.

In addition to a global view of competitiveness, we also monitored the evaluation of the BRICS countries and the USA through indices evaluating an important factor affecting the competitiveness of countries. Such a factor is e.g. the innovation potential of the country, which we evaluated through the global innovation index. We found that both the US and China have high innovation potential.

A comprehensive assessment of the competitiveness of the BRICS countries was not entirely possible due to the current situation regarding Russia. Several institutions dealing with the assessment of the competitiveness of countries could not fully estimate all the consequences caused by the sanctions against Russia due to the war in Ukraine, therefore the data for 2022 and 2023 were not reported for Russia, Russia was excluded from the ranking. In the tables, we have therefore indicated the rating and placement of Russia in the given ranking in 2021. Considering the current world events, we assume that Russia would achieve a significantly worse rating than in 2021 and would be placed on the lower rungs of the rankings.

Funding: "This research received no external funding."

References

- ACMC, E. S. C. (2022). Characteristics of Developed and Developing Countries. Bscholarly. Retrieved September 23, 2023, from https://bscholarly.com/characteristics-of-developed-and-developing-countries/.
- 2. Aiginger, K. (2006). Competitiveness: From a Dangerous Obsession to a Welfare Creating Ability with Positive Externalities. *Journal of Industry, Competition and Trade, 6*(2), 161–177. https://doi.org/10.1007/s10842-006-9475-6
- 3. Baumgartner, B. (2015). Postavenie rozvojových krajín vo svetovom hospodárstve. *Studia commercialia Bratislavensia*, *8*(31), 329-339.
- 4. Berger, T. (2008). Concepts of National Competitiveness. *Journal of International Business and Economy*, 9(1), pp. 91–111.
- 5. Carayannis, E., & Grigoroudis, E. (2016). Quadruple Innovation Helix and Smart Specialization: Knowledge Production and National Competitiveness. *Foresight and STI Governance*, 10(1), 31–42. https://doi.org/10.17323/1995-459x.2016.1.31.42
- 6. Delgado, M., Ketels, Ch., Porter, M. E., & Stern, S. (2012). The determinants of National Competitiveness. Working paper 18249. Retrieved September 23, 2023, from https://www.nber.org/papers/w18249.
- 7. Dutta, S., Lanvin, B., León, L. R., & Wunsch-Vincent, S. (2022). Global Innovation Index | What is the future of innovation-driven growth? *Global Innovation Index*. Retrieved September 20, 2023, from https://www.globalinnovationindex.org/Home.
- 8. Erlanger, S., Pierson, D. & Chutel, L. (2023). Iran, Saudi Arabia and Egypt Invited to Join Emerging Nations Group. *The New York Times*, Retrieved September 23, 2023, from https://www.nytimes.com/2023/08/24/world/europe/brics-expansion-xi-lula.html.
- 9. Ghosh, J., Havlik, P., Ribeiro, M., & Urban, W. (2009). Models of BRICs' Economic Development and Challenges for EU Competitiveness. Research report. Retrieved September 26, 2023, from https://www.econstor.eu/handle/10419/204131.
- 10. Gugler, P., & Brunner, S. (2007). FDI Effects on National Competitiveness: A Cluster Approach. *International Advances in Economic Research*, 13(3), 268–284. https://doi.org/10.1007/s11294-007-9091-1
- 11. Herciu, M., Ogrean, C., & Belascu, L. (2011). Culture and national competitiveness. *African Journal of Business Management*, 5(8), 3056–3062.
- 12. IMD World Competitiveness Booklet 2023. (2023). Retrieved September 25, 2023, from https://www.imd.org/centers/wcc/world-competitiveness-center/rankings/world-competitiveness-ranking/2023/.
- 13. IPRI Countries. (2022). Retrieved September 16, 2023, from https://www.internationalproper-tyrightsindex.org/.

- 14. Kao, Ch., Wu, W.-Y., Hsieh, W.-J., Wang, T.-Y., Lin, Ch., & Chen, L.-H. (2008). Measuring the national competitiveness of Southeast Asian Countries. *European Journal of Operational Research*, 187 (2), pp. 613–628.
- 15. Kharlamova, G., & Vertelieva, O. (2013). The International Competitiveness of Countries: Economic-Mathematical Approach. *ECONOMICS & SOCIOLOGY*, 6(2), 39–52. https://doi.org/10.14254/2071-789X.2013/6-2/4
- 16. Ndzendze, B. (2022). BRICS Countries' Competitiveness in the 4IR: Findings from Three World Economic Forum Indicators. *The Political Economy of Intra-BRICS Cooperation*, pp. 115–135.
- 17. Olawumi, A. D. (2019). Human Capital Development and Economic Growth in BRICS Countries: Controlling for Country Differences. *Journal of Economics and Behavioral Studies*, 11(4(J)), 1–17. https://doi.org/10.22610/jebs.v11i4(J).2912
- 18. Phusavat, K., Comepa, N., Sitko-Lutek, A., & Ooi, K.-B. (2012). Intellectual capital: National implications for industrial competitiveness. *Industrial Management & Data Systems*, 112(6). https://doi.org/10.1108/02635571211238491
- 19. Prosperity Index (2023). Legatum Prosperity Index 2023. Retrieved September 16, 2023, from https://www.prosperity.com/rankings.
- 20. Radulescu, I. G., Panait, M., & Voica, C. (2014). BRICS Countries Challenge to the World Economy New Trends. *Procedia Economics and Finance*, 8, 605–613. https://doi.org/10.1016/S2212-5671(14)00135-X
- 21. Raghuramapatruni, R. (2015). Revealed Comparative Advantage A Study on BRICS. *Arabian Journal of Business and Management Review*, 5(5), pp. 1–7.
- 22. Sorogb Mira, F. (2005): How SME Uniqueness Affects Capital Structure: Evidence from a 1994 1998 Spanish Data Panel. *Small Business Economics*, 25(5), 447–457. DOI:10.1007/s11187-004-6486-8
- 23. The Global Sustainable Competitiveness Index. (2022). Retrieved September 16, 2023, from https://solability.com/the-global-sustainable-competitiveness-index/the-index.
- 24. The Heritage Foundation (2023). 2023 Index of Economic Freedom. Retrieved September 16, 2023, from //www.heritage.org/index/about.
- 25. The World Bank. (2023). Retrieved September 216, 2023, from https://data.worldbank.org/.
- 26. Thompson, E. R. (2004). National Competitiveness: A Question of Cost Conditions or Institutional Circumstances? *British Journal of Management*, 15(3), 197–218. https://doi.org/10.1111/j.1467-8551.2004.00415.x
- 27. Transparency International. (2023). Corruption Perceptions Index: Explore the results. Transparency.Org. Retrieved September 16, 2023, from https://www.transparency.org/en/cpi/2022.
- 28. Truman, E. (2022). Implications of Structural Changes in the Global Economy for its Management. Retrieved September 20, 2023, from https://www.piie.com/sites/default/files/publications/papers/truman0306.pdf.
- 29. Vida, M., Kadár, G., & Kadárová, J. (2009). Analýza faktorov konkurencieschopnosti slovenských podnikov. *Transfer inovácií*, 13, 133–136.

Media, Culture and Publishing: Assessing the Current State of the Sector in Slovak Republic

Vladimír Hojdik 1, Jakub Kintler 2

- ¹ Faculty of Business Management, University of Economics in Bratislava, Slovakia, vladimir.hojdik@euba.sk
- ² Faculty of Business Management, University of Economics in Bratislava, Slovakia, jakub.kintler@euba.sk
- Correspondence: vladimir.hojdik@euba.sk

Abstract: This research delves into the concentration trends within Slovakia's media, culture, and publishing sector, scrutinizing their effects on the competitive nature of businesses in this field. By employing pivotal indices such as market share, concentration ratios, and the Herfindahl index, the study delves into the financial dynamics of companies in this sector, evaluating the degree of industry concentration to gauge its competitive stance in the Slovak economic area. The methodological approach encompasses mathematical and statistical evaluations, data processing and the deployment of advanced concentration measures. These methods are key to measuring essential factors that capture the competitive environment of the sector, with a special focus on media, culture, and publishing. The procedure entails an analysis of market shares of the entities, followed by the computation of concentration ratios that reflect the leading company market influence. The Herfindahl index is utilized as the aggregate indicator of market concentration. Ultimately, this paper seeks to deepen the understanding of the competitive dynamics within Slovakia's media, culture, and publishing sector, providing valuable insights for stakeholders and policy designers, and highlighting its importance within the larger economic spectrum. The distilled insights from this study encourage further contemplation on the sector strategic importance within Slovakia overall economic structure.

Keywords: media, culture and publishing industry, industrial organization, market share, Herfindahl index

Introduction

The creative and cultural industries are delineated by a pronounced reliance on human capital, accentuating the centrality of creativity, skills, and individual talents in molding the production of goods and services. Integral to these industries is a heightened focus on intellectual property, encompassing copyrights, trademarks, and patents, as the intrinsic worth of products is intricately linked to innovative creative expressions. Encompassing a diverse array of sectors such as visual arts, literature, music, design, etc., these industries thrive on innovation, creativity, and the preservation and dissemination of cultural heritage. Collaboration across disciplines is commonplace, fostering a dynamic environment where diverse skills converge to produce innovative and multifaceted projects. The subjectivity and aesthetic valuation inherent in artistic and cultural products, coupled with their potential for global resonance and exportation, contribute substantively to their socio-economic impact, effecting the revitalization of urban locales and exerting influence on societal dynamics. Often comprised of numerous small and medium-sized enterprises, creative and cultural industries play a crucial role in shaping the identity and quality of life in societies, with the ongoing integration of digital technologies further influencing the creation, distribution, and consumption of cultural products.

1. Theoretical background

Industry concentration, also referred to as market concentration, measures the extent to which a large share of economic activity (such as sales, assets, or employment) is consolidated among the top companies within a particular market or industry (Bessen, 2020). The Organisation for Economic Cooperation and Development (2003) recognizes the importance of measuring market or industry concentration based on industrial organizational economics, which suggests that higher levels of concentration may lead to monopolistic tendencies, inefficient resource distribution, and reduced economic

effectiveness. Therefore, industry concentration is an indicator of the market power exerted by the leading companies.

An increase in market concentration is generally associated with a decrease in competitive intensity and operational efficiency, while it tends to enhance market control by the dominant company. Monitoring these developments is critical for businesses and regulatory authorities. Antitrust agencies, in particular, play a crucial role in observing these trends to maintain fair competition and prevent anticompetitive behavior or monopolistic distortions (FTC, 2010). This paper investigates the concentration within the Slovak media, culture and publishing sector, a branch of the creative industry.

The creative industry encompasses business domains where the most crucial component of the transformative process is human capital. The outcome of these entrepreneurial activities is a specific product or provided service, with the product potentially possessing an intangible nature akin to that of a service. A significant distinguishing factor setting businesses in this sector apart from others is the emphasis on human capital and its creativity, as it constitutes the essence (both tangible and intangible) of the delivered product. In recent years, several authors have endeavored to define the creative industry and businesses that, by their nature, more or less fulfill the prerequisites for their classification into this group of entrepreneurial activities. The United Nations Conference on Trade and Development defines creative industries as industries that are based on creation, production and distribution of goods and services that use creativity and intellectual capital as primary inputs focused on but not limited to arts (UNCTAD, 2008). The United Kingdom department for Digital, Culture, Media, and Sport defines creative industries as those industries that are based on individual creativity, skill, and talent, with the potential to create wealth and jobs through the generation and exploitation of intellectual property (DCMS, 2001). According to the Cultural times report by EY, UNESCO defines cultural and creative industries as those whose purpose in produce, promote, distribute or commercialize goods, services and activities of a cultural, artistic or heritage-related nature (EY, 2015).

According to the all previous definitions, we can state that there is a wide range of activities, which can be count as an output of the cultural and creative industries. Cultural times report group activities created by culture and creative industries into the 11 sectors include advertising, architecture, different types of arts, books, gaming, movie, music, publishing and broadcasting, among others (EY, 2015).

Advertising is paid, owned, and earned mediated communication, activated by an identifiable brand and intent on persuading the consumer to make some cognitive, affective or behavioral change, now or in the future (Kerr, Richards, 2020). Architecture is the art of creating the best living conditions for humans by building spaces that elicit emotions (Quseda-García, Valero-Flores, Lozano-Gómez, 2023). Art is seen as a phenomenal entity constituted by multiple meaning perspectives, each of which has a figure representing it author, spectator, patron, collector, curator, connoisseur, critic, historian, typologist, theorist, aesthetician, and metaphysician (Kolev, 2023). Books are medium for recording information, which can have printed, digital or both forms.

Kretchmar defines games and gaming as an attempt, through effort, chance, or both solve a natural or constructed problem. Where relationships between its means and ends provide valid challenges; where inherent constraints together with any imposed limitations and interpretive understandings, specify the goals and means permitted for reaching those goals; and where these specifications and permissions are accepted in order to encounter, for either one's use or enjoyment, the problem thereby created (Kretchmar, 2019). Music is a social and cultural construct based on musicality (Currie, Killin, 2016). Movie/film in general, we can consider as a means of pleasure and entertainment (Kickova, 2021).

The intellectual assets and the creativity driving the publishing and printed media are broadly expressed in the form of literary production translated into all kinds of books (novels, poetry, educational, professional, etc.) and the printed media translated into all kinds of news circulated as newspapers, magazines, etc (UNCTAD, 2008). Broadcasting is an information dissemination process in communication networks whereby a message, originated at any node of a network, is transmitted to all other nodes of the network (McGarvey, Rieksts, Ventura, Ahn, 2015). For the purposes of this research paper, we will consider broadcasting as a tool for the easy dissemination of information from the producer to a wide range of consumers via radio, television or other media.

In this paper, we will be closer analyzing media, culture and publishing sector branch of the Slovak creative industry. According to the statistical classification of economic activities NACE Revision 2, the media, publishing and culture sector includes activities that can be classified under printing and

printing-related services such as the printing of newspapers, books, periodicals, business forms, greeting cards and other materials, and related support activities, e.g. bookbinding, plate preparation and plate scanning services, also publishing of books, newspapers, magazines and other periodicals, dictionaries, directories, and other products such as photographs, engravings, postcards, travel and flight schedules, and forms, posters and reproductions of works of art. This sector also includes the production of movies, including their digital distribution, for direct exhibition or for television broadcasting, and other support activities, including the purchase and sale of distribution rights to movies and radio and television broadcasting.

2. Methods and methodology

The aim of this paper is to assess the state of the Slovak media, culture, and publishing sector, with an emphasis on market concentration insights. The research methodology is divided into general and specific techniques to provide a thorough examination.

The study begins with general methods such as systematic analysis, comparative evaluation, and synthesis to establish key concepts, offering an overview of the sector's current state in Slovakia and setting the stage for in-depth analysis.

The core of the research involves detailed mathematical and statistical techniques, with data processing carried out via MS Excel. The study then applies essential indicators relevant to this inquiry, including market share, concentration ratios, and the Herfindahl index (Bikker & Haaf, 2002).

These rigorous methods yield vital statistics reflecting concentration levels in the sector. Initial calculations focus on the percentage market shares of the firms, based on their total revenues. Further analysis determines the concentration ratio, followed by the Herfindahl index computation, both critical in gauging competitive intensity across industries.

The data obtained provide the groundwork for interpreting market concentration trends among Slovak media, culture, and publishing entities. This methodical approach affords a nuanced view of the market dynamics and competitive pressures that influence the sector's configuration.

3. Results

This section encapsulates the empirical research conducted, delineating the methodologies employed in calculating market share, concentration ratios, and, ultimately, the Herfindahl index. The research cohort comprises enterprises formally registered within the media, culture and publishing sector in the Slovak Republic. All quantitative evaluations have been executed utilizing data from the fiscal year 2021, owing to the unavailability of comprehensive data sets for all industry participants for the subsequent year, 2022. This temporal parameterization ensures the analytical consistency and data integrity necessary for the robust assessment of sectoral dynamics and competitive paradigms.

3.1. Description of used indicators

The assessment of industry concentration metrics is crucial for understanding the level of competition in a market, which allows regulatory bodies to monitor how businesses compete in different economic sectors (MacKay & Phillips, 2005). There are several methodologies suggested in academic research for measuring industry concentration. This study zeroes in on absolute concentration measures, specifically the concentration ratio and the Herfindahl index that are based on the market share calculations. These measures, which are calculated using the total revenues of companies, help in estimating market shares that are essential for computing both the concentration ratio and the Herfindahl index.

(1) Market Share

Market share is a fundamental measure of market concentration, representing a company's share of total industry sales, thus providing a basis for comparing its performance against other companies in the market. This metric is calculated using a specific formula (Fendek & Fendeková, 2008):

Market Share of Company = Total revenues of the Company / Total Revenues of Whole Industry Market share is quantified in two ways: as a relative figure between 0 and 1, and as a percentage from 0 to 100%. The current analysis adopts the percentage-based representation of market share for greater analytical clarity and precision.

(2) Concentration ratio

The concentration ratio represents the total market share held by the top firms in given industry. The method for calculating the concentration ratio is specified as follows (Fendek & Fendeková, 2008):

CRk for k companies = Cumulative Market Share of k companies

1 and n, and the concentration ratio CR_k is expressed either as a number between 0 and 1 for relative calculations, or between 0 and 100 for percentage outcomes. Conventionally, the concentration ratio is determined for the top market players, usually the top three, five, or ten firms, known as CR₃, CR₅, and CR₁₀, respectively. Some research also considers the CR₄ and CR8 indices, which account for the four and eight largest market players, respectively (Herfindahl, 1950; Hirschmann, 1964; Rhoades, 1993; Nauenberg et al., 1997). In this study, the concentration ratio is presented in percentage terms to enhance the clarity of interpretation and maintain consistency in measurement.

(3) Herfindahl index

The Herfindahl index, an advanced measure, assesses the absolute concentration within an industry and is alternatively known as the Herfindahl-Hirschman Index in the academic field. It is highly regarded for its analytical accuracy. This index calculates the impact of each firm's revenue on the total industry concentration by squaring the market share of each company and summing these squared figures (Cavalleri et al., 2019).

The index's mathematical formula is as follows (Fendek & Fendeková, 2008):

$$HI = S_{1^2} + S_{2^2} + S_{3^2} + \dots S_{n^2}$$

where

n refers to the number of companies in the market,

S refers to the market share for a company (expressed as coefficient between 0 and 1).

The Herfindahl index (H) ranges from 1/n to 1. The lower bound, H = 1/n, reflects an equal distribution of market shares among firms, while the upper bound, H = 1, indicates a monopoly. To adjust for industries with varying numbers of firms, H is often normalized by multiplying by a standard factor, commonly 10,000, for practicality and ease of interpretation.

The adjusted H informs industry concentration assessments, guided by benchmarks established by the US Federal Trade Commission (2010). It classifies industry as non-concentrated for H < 1500, moderately concentrated if H is from interval <1500,2500>, and highly concentrated for H \ge 2500.

Originally devised by O. C. Herfindahl in the mid-20th century, and building on the work of A. O. Hirschman, the Herfindahl index has become a mainstay in economic analysis, despite terminological disparities in the literature. Its utility spans various industries, including banking, automotive, biomass, tour operating, power energy, and manufacturing (Aijde & Ajileye, 2015; Williams et al., 1994; Rianto & Awwaliyah, 2019; Rolim et al., 2019; Hojdik, 2020; Kaszynski et al., 2023). Nonetheless, its application is best suited to geographically specific markets, as extending its use to international markets could lead to distorted analytical outcomes.

3.2. Indicators quantification

Market share, a critical measure of a company's performance within its industry, is calculated from the revenue data, as shown in Table 1. This table features the percentage-based market shares of the top ten entities in Slovakia's media, culture, and publishing sector. These statistics not only reflect the economic significance of each company within the industry but also shed light on the level of competition within the sector.

Table 1 Market share of ten strongest companies in analysed sector in 2021, based on total revenues

Rank	Company	Total Revenues	Market Share (%)
1	Markíza – Slovakia , s.r.o.	110 758 036	9.68
2	Slovenská produkčná a.s.	92 333 561	8.07
3	Slovenská Grafia, a.s.	76 384 759	6.68
4	Neografia, a.s.	36 633 882	3.20
5	News and Media Holding a.s.	32 272 282	2.82
6	TBB, a.s.	25 267 060	2.21

7	Petit Press, a.s.	22 231 613	1.94
8	MAC TV, s.r.o.	22 113 384	1.93
9	MAFRA Slovakia, a.s.	15 697 152	1.37
10	FPD Media, a.s.	14 395 965	1.26

Source: finstat.sk

The concentration ratio in any sector mirrors the market shares owned by the leading companies. In the context of Slovakia's media, culture, and publishing industry, Table 2 illustrates the concentration ratios for 2021, calculated from the firms' revenues over the defined time frame.

Table 2 Concentration ratio for Slovak Media, Culture and Publishing industry in 2021

Concentration ratio	Value (%)
CR3	24.43
CR5	30.46
CR10	39.18

Source: own calculations

The last part of the study involves the calculation of the Herfindahl index, an essential tool for gauging industry concentration. The number of firms in the sector was initially identified as 4,767 (n = 4,767), indicating a significant level of market participation. This large figure accentuates the importance of utilizing the Herfindahl index as an effective measure. Its relevance tends to decrease in markets with fewer companies, which often implies an oligopolistic condition. The Herfindahl index for Slovakia's media, culture, and publishing sector, based on earlier calculations, is recorded in Table 3.

Table 3 Herfindahl index for Slovak Media, Culture and Publishing industry in 2021

Herfindahl index	Value
H (index)	0.0250435
H (multiplied)	250.435

Source: own calculations

4. Discussion

The media, culture, and publishing sector in Slovakia exhibits a competitive balance rather than being overshadowed by any one company. Revenue is fairly distributed among the various players, avoiding a lopsided market. In 2021, the leading company captured a 9.68% market share, indicative of a healthy competition but not dominance. The second company held 8.07%, and the third secured 6.68%, with even the tenth-ranked company, despite a modest 1.26% share, demonstrating the sector's competitive nature. Further insight shows that in 2021, there were 5,726 businesses within the sector, with 4,119 reporting positive revenue, highlighting a dynamic and competitive marketplace.

The CR₃ ratio, reflecting the market share of the top three companies, is 24.43% in Slovakia's media, culture, and publishing sector. Broadening the scope, the CR₅ ratio is 30.46%, and the CR₁₀ shows the top ten companies hold 39.18% of the market. This indicates low market concentration without veering into oligopoly. The Herfindahl index further assesses concentration levels. For 2021, the index stood at 250.435, after applying the standard multiplier. According to Federal Trade Commission (2010) guidelines, the sector is categorized as 'non-concentrated' since the index is below the 1500 benchmark. This is supported by criteria that consider a Herfindahl index below 1800 as indicative of a non-concentrated market. These figures mark the Slovak media, culture, and publishing sector as one with low concentration. The industry is marked by the activity of almost six thousand firms, with no single company dominating the market. This ensures a vibrant competitive landscape favorable for all businesses.

5. Conclusions

The research verifies that the Slovak media, culture, and publishing sector is characterized by vigorous competition and is not influenced by a small group of dominating firms. The analysis of pertinent indicators supports the classification of this sector as non-concentrated. This finding is based not only on the quantitative measures but also on two main qualitative observations: the high number of businesses exceeding 5,000, and the equitable distribution of market influence among the competitors.

According to the Herfindahl index's guidelines, the Slovak media, culture, and publishing sector is distinctly identified as a non-concentrated industry. This suggests robust competition and a propitious environment for businesses. Predicting the industry future is complex, as it faces numerous challenges that may redefine its structure. Digital transformation is at the forefront, requiring a shift from traditional models to digital platforms, which impacts content strategy, distribution, and monetization. This shift is compounded by declining print sales and advertising revenue, as digital media offers cheaper or free alternatives.

Another major challenge is the rapidly changing consumer preferences, with a growing demand for on-demand, personalized content accessible across multiple devices. This change necessitates a strategic adaptation in content delivery and audience engagement

Competition from global digital platforms like Google, Facebook, and Netflix is also significant, dominating both advertising markets and setting trends in content consumption. These platforms present a formidable challenge for traditional media and local publishers. Content piracy remains a persistent issue, leading to substantial revenue losses. Moreover, the industry faces various regulatory challenges, including data protection, privacy, and the spread of misinformation, requiring careful navigation of diverse and often stringent regulations.

Cultural and political pressures also impact the industry, with concerns over censorship, government control, and threats to journalistic independence. Lastly, sustainability and ethical concerns, particularly regarding environmental impact and content diversity, are increasingly prominent. In essence, the industry is grappling with a rapid evolution driven by technological disruption, evolving market dynamics, and consumer preferences, necessitating innovative and adaptable strategies for survival and growth.

Funding: This research was funded by research grant VEGA 1/0582/22, entitled "Dimensions of cross-sectoral entrepreneurship of cultural and creative industry entities in the context of sustainable development".

References

- 1. Aijde, F. M. & Ajileye, J. O. (2015) Market concentration and Profitability in Nigerian Banking Industry: Evidence from Error Correction Modeling. *International Journal of Economics, Commerce and Management* 3, 1-12.
- 2. Bessen, J. (2020). Information Technology and Industry Concentration. *Journal of Law & Economics* 63, 531-556 DOI: 10.1086/708936
- 3. Bikker, J. A. & Haaf, K. (2002). Competition, concentration and their relationship: an empirical analysis of the banking industry. *Journal of Banking and Finance* 26, 2191-2214 DOI:10.1016/S0378-4266(02)00205-4
- 4. Cavalleri, M. C., Eliet, A., McAdam, P. (2019). Concentration, market power and dynamism in the euro area. *ECB Working Paper Series, Discussion Paper No.* 2253, European Central Bank DOI:10.2866/379250
- 5. Currie, A., Killin, A. (2016). Musical pluralism and the science of music. *European Journal for Philosophy of Science*. 6, 9-30. doi:10.1007/s13194-015-0123-z
- 6. DCMS. (2001). Creative industries mapping documents 2001. https://www.gov.uk/government/publications/creative-industries-mapping-documents-2001
- 7. EY. (2015). Cultural times: The first global map of cultural and creative industries 2015. https://europaregina.eu/wp-content/uploads/2023/04/cul-tural_times._the_first_global_map_of_cultural_and_creative_industries.pdf

- 8. Federal Trade Commision. (2010). Horizontal Merger Guidelines.
- 9. Fendek, M. & Fendeková, M. (2008). Mikroekonomická analýza. Iura Edition, Bratislava, 2008.
- 10. Finstat.sk (2023). Database of Slovak Businesses and Organizations. Available at https://www.finstat.sk>
- 11. Herfindahl, O. C. (1950). Concentration in Steel Industry: Unpublished Ph.D. dissertation, Columbia University, USA.
- 12. Herfindahl, O. C. (1964). Copper Costs and Prices: 1870-1957. Baltimore, The John Hopkins Press, 1964.
- 13. Hirschmann, A. O. (1964). The Paternity of an Index, American Economic Review 54, 761-762.
- Hojdik, V. (2020). Evaluation of Slovak Automotive Industry Competitiveness Based on Market Concentration Indicators. SHS Conferences 83: Current Problems of the Corporate Sector 2020: 17th Scientific Conference. – Paris: Edition Difussion Presse Sciences. DOI: 10.1051/shfconf/20208301022
- 15. Kaszyński, P., Komorowska, A., & Kamiński, J. (2023). Revisiting Market Power in the Polish Power System. *Energies*, *16*(13), 4856. DOI: http://dx.doi.org/10.3390/en16134856
- 16. Kerr, G., Richards, J. (2020). Redefining advertising in research and practice. *International Journal of Advertising*, 40 (11), 1-24. DOI: 10.1080/02650487.2020.1769407
- 17. Kicková, A. (2021). Cinematography and education. The Czechoslovak school film 1918-1937. HISTORICKÝ ČASOPIS. 69 (1), 83-97. DOI: 10.31577/histcaso.2021.69.1.4
- 18. Kolev, I. (2023). Defining Art as Phenomenal Being. Arts. 12 (3), DOI: 10.3390/arts12030100
- 19. Kretchmar, S. (2019). A Revised Definition of Games: An Analysis of Grasshopper Errors, Omissions, and Ambiguities. *Sport, Ethics and Philosophy*, 13 (3-4), 277-292. DOI: 10.1080/17511321.2018.1561748
- 20. MacKay, P., Phillips, G.M. (2005). How Does Industry Affect Firm Financial Structure? *The Review of Financial Studies*, *18*, (4) DOI: 10.1093/rfs/hhi032
- 21. McGarvey, R., G., Rieksts, B., Q., Ventura, J. A., Ahn, N. (2015). Binary linear programming models for robust broadcasting in communication networks. *Discrete Applied Mathematics*. 204, 173-184. DOI: 10.1016/j.dam.2015.11.008
- 22. Nauenberg, E., Basu, K., Chand, H. (1997). Hirshmann-Herfindahl Index Determination under Incomplete Information, *Applied Economics Letters*, 4 (10), 639-642 DOI: 10.1080/758533291
- 23. OECD. (2018). Infrastructure Investment (Indicator). DOI: 10.1787/b06ce3ad-en
- 24. Rhoades, S. (1993). The Herfindahl-Hirshmann index, *Federal Reserve Bank of St. Louis*, 52 (3), pp. 188-189.
- 25. Rolim, Z. E. L., Oliveira, R. R., Oliveira, H. M. (2019). Industrial Concentration of the Brazilian Automobile Market and Positioning in the World Market, Working Paper DOI:10.13140/RG.2.2.11210.11207
- 26. Rianto Al Arif, M. N., Awwaliyah, T. B. (2019). Market share, concentration ratio and profitability: Evidence from Indonesian Islamic Banking Industry. *Journal of Central Banking Theory and Practice*, 2, 189-201 DOI: 10.2478/jcbtp-2019-0020
- 27. UNCTAD. (2008). Creative economy report 2008. http://unctad.org/en/docs/ditc20082cer_en.pdf.
- 28. Quesada-García, S., Valero-Flores, P., Lozano-Gómez, M. (2023). Towards a Healthy Architecture: A New Paradigm in the Design and Construction of Buildings. *Buildings*. 13 (8), 2001. DOI: 10.3390/buildings13082001
- 29. Williams, D. M. L., Molyneux, P., Thornton, J. (1994). Market Structure and Performance in Spanish Banking. *Journal of Banking and Finance*, 18, 433-443 DOI:10.1016/0378-4266(94)90002-7

Time Prediction of Reaching the Next Bitcoin Top and Bottom Based on Analyses of Previous Cycles

Peter Badura*

- ¹ Faculty of Business Management, University of Economics, Bratislava, Slovakia; peter.badura@euba.sk
- * Correspondence: peter.badura@euba.sk

Abstract: The first public cryptocurrency ever created was Bitcoin. The entire later blockchain proof of work technology, used by other cryptocurrencies, is still based on Bitcoin's main principles. With blockchain, all transactions are stored in consecutive blocks. The confirmation of transactions is in charge of the so-called miners and they get rewards for their work. The reward is halved once in every few years - which is called "halving" event. The goal of our paper was to analyze the previous halving events to date and make a prediction when Bitcoin could reach its next price top and bottom in the future. Our main methods used were analysis and comparison of previous Bitcoin price cycles. The results of our research show that there was a pattern between the halving and Bitcoin price tops and bottoms. The cycle shows clear signs of repeating behavior that made it possible to predict when the price of BTC topped and bottomed. Based on our findings we do believe that after the next halving, Bitcoin will reach its new price top around October - November 2025. We also predict that Bitcoin will reach a new bottom of the given cycle around October - November 2026.

Keywords: bitcoin; cycles; prices; halving; prediction; tops; bottoms;

Introduction

Blockchain technology is one of the latest and very interesting innovations that can be used in several areas – decentralized and traditional finance being some of them. For now, blockchain technology is primarily used in the world of cryptocurrencies. The first public cryptocurrency that was created and is still the most widespread is Bitcoin (BTC). It therefore has the largest community of miners and users. Miners are such entities (people or companies) which dedicate their computing power to confirming transactions and storing them as a chain of consecutive blocks, so the transactions could not be tempered with later. For such work, they receive a reward in the given cryptocurrency. As for Bitcoin, the reward for miners started with 50 Bitcoins for each confirmed block, but it dropped by half around every 4 years (each 210,000 Bitcoin blocks, while each block takes around 10 minutes to create). This event is called "halving" and it is generally believed that it has a big long-term impact on the price of Bitcoin (as the price needs to increase to compensate the lower reward for miners).

In our paper, we decided to focus on the deeper analysis of whether it is possible to predict the tops and bottoms of the BTC price - in connection with the halving events (either with the halving that has already taken place or the one which is upcoming). If it were possible to predict the exact moments when the BTC price is at the top and when it is at the bottom, it would be possible to plan purchases and sales at the most favorable moments.

1. Theoretical background

Despite Bitcoin's popularity among researchers and authors was slowly rising, it used to be not so common to pay attention to the halving events (maybe because there were only three halvings so far). Anyway, it seems like more and more researchers start to realize its importance for the Bitcoin blockchain security and its price, too. As Pan, L. et al. state (2020) "The mechanism of Bitcoin halving has become more and more recognized by the public and has gradually become a daily topic. From the previous two halving events, the amount of discussion before the halving was greater than that after the halving, but at the third halving, the topic of interest after the halving still only increased, and the law of Bitcoin halving became more and more familiar to the public."

Prasad, E. in his paper (2022) draws attention to the huge bitcoin price volatility, especially the drop in price after the last halving happened and advises to focus more on the technology than Bitcoin itself: "Bitcoin and its peers have set off a technological revolution that will transform money, finance, and society. However, the future of cryptocurrencies as financial assets is far from certain – as can be seen from Bitcoin's halving in value in six months since November 2021; the total value of all cryptocurrencies fell from \$3 trillion to \$1.3 trillion over this period. Rather, it is the underlying technology that enables cryptocurrency – the blockchain – that is likely to prove its true legacy." The fall of Bitcoin price is not a coincidence and is a well-known fact among researchers who pay attention to the Bitcoin price cycles.

As Chan, J., Y. et al. state (2023): "Bitcoin price chart and past studies showed that the halving event impacted Bitcoin price in specific manners that formed the Bitcoin halving cycle." The same authors in the same study did also find out that: "Bitcoin halving cycle is well-defined in terms of price volatility and timing and is also independent (not correlated) to the stock market."

Similar conclusion about market inefficiency and thus possibility to time the market around halving dates was made by Phiri, A. (2022): "We also present novel evidence suggesting that overall market efficiency in Bitcoin markets has been progressively diminishing across the Bitcoin halving dates in which the supply of the cryptocurrency is consecutively halved in four-year cycles."

It is quite clear that the halving event does affect the price of Bitcoin, but authors cannot agree completely upon the question whether the halving price has immediate or later and long-term effect.

Authors Fantazzini, D. and Kolodin, N. (2020) state, that: "The bitcoin halving happens once approximately every four years and cuts the block reward (and thus the future cash flows of miners) in half. The cost-of-production model does not account for this effect, but miners are aware of it and anticipate it. This is why the market price does not change significantly near the times of halving".

On the other side Eksi, Z. (2022) stated: "The only way to compensate Bitcoin miners for their "loss" is an immediate price increase of Bitcoin. Hence, after each halving event, a significant price increase is expected at some future point. For this reason, we suggest to initiate long Bitcoin trades after each halving event."

We do generally agree and believe that the halving event does not necessarily mean any significant change in price at the moment when it happens, but the long-term effect of halving on the price and creating repeating price cycles seems to be undeniable for everyone.

2. Goal, methods and methodology

The main goal of our paper is to estimate when Bitcoin could reach its next price top and bottom, once the nearest halving happens.

Main methods used within our research were analysis and comparison. Bitcoin data were obtained from Coingecko.com website in .csv format. The range of BTC data was since April 28th, 2013 until September 28th, 2023 as daily Close prices. Bitcoin (as well as every cryptocurrency) is traded every day, 24 hours, so the file contains 365 (or 366) trading days within each year.

The data were processed in MS Excel - mostly to arrange them into separate columns and to be able to visualize them - e.g. the moments of halvings, tops and bottoms.

3. Results

Figure 1 shows Bitcoin prices since April 28th, 2013 until September 28th, 2023. It marks all the tops (T1, T2, T3), bottoms (B1, B2, B3) and halvings (H2, H3) within the time period. First BTC halving (H1) could not be marked on the chart as it happened in 2012 while our data range is only since 2013.

Prices were displayed using logarithmic scale.



Figure 1. Bitcoin price, halving moments (H), tops (T) and bottoms (B) (using logarithmic scale)

Source: Own processing based on data downloaded from Coingecko.com

Arrows which point down mark the tops of the cycle while arrows which point up do mark the cycle bottoms. Black circles mark the moments of BTC halving (moments when the reward for confirming new BTC transactions went down by 50 %).

Data before April 28th, 2013 were not available, thus the chart does not display the first Bitcoin halving which happened on November 28th, 2012. Table 1 contains all Bitcoin halvings which happened so far plus other important information about them.

Table 1. Bitcoin halving dates and information

Halving	Date	Block number	BTC rewards
First halving	November 28th, 2012	210,000	50 BTC -> 25 BTC
Second halving	July 9th, 2016	420,000	25 BTC -> 12.5 BTC
Third halving	May 11th, 2020	630,000	12.5 BTC -> 6.25 BTC
Fourth halving	April 17 th , 2024 *	840,000	6.25 BTC -> 3.125 BTC

^{*} This is only estimation and can change by several days.

Source: Own processing based on data from Swanbitcoin.com/bitcoin-halving-dates

As can be seen from Table 1, next Bitcoin halving is expected to happen on April 17^{th} , 2024 (at the block 840,000 exactly). The reward for finding/confirming a new block will drop from 6.25 BTC to 3.125 BTC.

The following Table 2 contains key points from the chart (Figure 1) with all the most important information extracted and summarized.

Table 2. Key moments, dates, prices

Key points	Date	Price
1st BTC halving (H1)	November 28th, 2012	\$ 12.35
1st top (T1)	November 30th, 2013	\$ 1,127.45
1st bottom (B1)	January 14 th , 2015	\$ 172.15
2 nd BTC halving (H2)	July 9 th , 2016	\$ 660.69
2 nd top (T2)	December 16th, 2017	\$ 19,665.39
2 nd bottom (B2)	December 15th, 2018	\$ 3,216.63
3 rd BTC halving (H3)	May 11th, 2020	\$ 8,752.62

Key points	Date	Price
3rd top (T3)	November 9th, 2021	\$ 67,617.02
3 rd bottom (B3)	November 22 nd , 2022	\$ 15,814.34
4 th BTC halving (H4)	April 17 th , 2024	*

^{*} Not known yet.

Source: Own processing based on BTC data from Coingecko.com and Swanbitcoin.com/bitcoin-halving-dates

First of all, we would like to find out whether there was any relation between the tops, bottoms and halving dates - as for the number of days between them. We have made Table 3, which summarizes the dates between these key points.

Table 3. Key moments, dates, prices

'	H1	T1	B1	H2	T2	B2	Н3	T3	В3	H4
H1										
T1	367									
B1	777	410								
H2	1,319	952	542							
T2	1,844	1,477	1,067	525						
B2	2,208	1,841	1,431	889	364					
Н3	2,721	2,354	1,944	1,402	877	513				
Т3	3,268	2,901	2,491	1,949	1,424	1,060	547			
В3	3,646	3,279	2,869	2,327	1,802	1,438	925	378		
H4	4,158	3,791	3,381	2,839	2,314	1,950	1,437	890	512	

Source: Own processing based on BTC data from Coingecko.com and swanbitcoin.com/bitcoin-halving-dates

This analysis and comparison in Table 2 and Table 3 led to several interesting findings. We will analyze them deeper in the following subsections.

3.1. Price bottoms after and before halving

We find it very interesting that there is a clear pattern in price bottoms reached after the previous and before the upcoming halving. As shown in the Table 4 the price had stopped falling and reversed the trend 512 - 542 days before the next halving came (which makes it short 30-days range).

Table 4. Price bottoms after and before halving

	H1	T1	B 1	H2	T2	B2	Н3	T3	В3	H4
H1										
T1										
B1	777									
H2			542							
T2										
B2				889						
Н3						513				
T3										
В3							925			
H4									512	

Source: Own processing based on BTC data from Coingecko.com and Swanbitcoin.com/bitcoin-halving-dates

The bottom was reached around 1.5 years before the next BTC halving. In the first case, the first bottom (B1) at \$ 172.15 was reached 542 days before second halving (H2). In the second case the second bottom (B2) at \$ 3,216.63 was reached 513 days before third halving (H3). In the third case the third bottom (B3) at \$ 15,814.34 was reached 512 days before the fourth halving (H4).

In the last case we need to add, that the fourth halving (H4) will take place only in April 2024, so it is still possible, that Bitcoin can drop below the current bottom of \$ 15,814.34, but based on the previous cycle patterns we don't expect this to happen. Instead, we do believe that the bottom of the current cycle has already been reached and the price will only get higher.

As for the relation between price bottoms and previous halving, the interval ranges from 777 to 925 days (148 days range) – this dependence seems to be less strong than it is with bottoms and upcoming halving.

3.2. Price tops after and before halving

We see another clear pattern in price tops (reached after the previous and before the upcoming halving). It seems that the price has reached the top and reverse the trend around 900 days before the next halving comes. Table 5 displays the information in a clearer way.

H1 H2 **T2 B2 T1 B1 H3** T3 **B3** H4 H1 **T1** 367 **B1** H2 952 T2 525 **B2 H**3 877 **T3** 547 **B3** H4 890

Table 5. Price tops after and before halving

Source: Own processing based on BTC data from Coingecko.com and Swanbitcoin.com/bitcoin-halving-dates

Historically the tops were reached around 3 years before the next BTC halving. In the first case, the first top (T1) at \$ 1,127.45 was reached 952 days before second halving (H2). In the second case the second top (T2) at \$ 19,665.39 was reached 877 days before third halving (H3). In the third case the third top (T3) at \$ 67,617.02 was reached 890 days before the estimated time for fourth halving (H4).

In the last case we need to add again, that the fourth halving will take place only in April 2024, so it is still possible that Bitcoin can reach a new top before H4 - but we consider this to happen to be very unlikely.

What we find interesting is that the tops seem to be connected more to the upcoming halvings, not to the previous ones. The range of days when price tops were reached before upcoming halvings is 877 – 952 days (75 days range), while the range of tops after the already realized halvings is 367 – 547 days (180 days range) – as can be seen in Table 5 (despite the last two differences of 525 and 547 days are pretty short ranged and should be kept an eye on in the future).

3.3. Relation between price bottoms and price tops

Another pattern which we found in the cycle was the relation between tops and bottoms. The price had reached the bottom around 380 days (364 - 410 days) after the previous top was reached. Table 6 displays the information in a clear way.

H₁ **T1 B1** H2 **T2 B2 H3** T3 **B3** H4 **H1** ---**T1 B1** 410 H2 **T2** 1,067 **B2** 364 **H3 T3** 1,060 **B3** 378

Table 6. Relation between price bottoms and price tops

Source: Own processing based on BTC data from Coingecko.com and Swanbitcoin.com/bitcoin-halving-dates

Historically each bottom was reached around 364+ days after the previous top. In the first case, the first bottom (B1) was reached 410 days after the previous top (T1). In the second case the second bottom (B2) was reached 364 days after the previous top (T2). In the last case the third bottom (B3) was reached 378 days after the previous top (T3). The range of 46 days is pretty short again.

We can also see that the first bottom (B1) was reached 1,067 days before the next top (T2). Bottom 2 was also reached 1,060 days before next top (T3). Sadly, in this case we do not have longer data (older than April 2013), so we cannot add one more time difference – which might definitely confirm any strong relationship between the bottoms and following tops. Anyway, the difference of 1,060 - 1,067 days seems to be very interesting and if confirmed on the future data, it could predict the next price top very well.

3.4. Relations between price tops only and price bottoms only

We found also very interesting relation between tops only / bottoms only. Table 7 displays the findings and relations we are pointing to.

H2 **T2 H3** H₁ **T1 B1 B2** T3 **B3** H4 H1 ---**T1 B1** H2 **T2** 1,477 **B2** 1,431 **H3 T3** 1,424 **B**3 1,438

Table 7. Price tops and price bottoms

H4

Source: Own processing based on BTC data from Coingecko.com and Swanbitcoin.com/bitcoin-halving-dates

The second BTC price top (T2) was reached 1,477 days after the previous top (T1). The third BTC top (T3) was reached 1,424 days after the previous one (T2). That makes it only 53-day range, which is interestingly short.

As for the price bottoms - the second BTC bottom (B2) was reached 1,431 days after the previous B1 and the third one (B3) 1,438 days after B2. Again - that makes it again a very short range of only

7 days, which doesn't seem to be just coincidence. Moreover, all these Top - Top and Bottom - Bottom differences did happen within 1,424 - 1,477 days range.

Our conclusion on this is clear. Each halving takes 210,000 blocks. Each block takes around 10 minutes to confirm. That makes it around 1,458 days for each next halving. Our findings that there were 1,424 - 1,477 days between tops and 1,431 - 1,438 days between bottoms found a clear relation and dependence on the halving itself. Thus, this is a clear proof how the halving affects the price cycle of a bitcoin.

4. Discussion and Conclusions

Our research led to several important findings. Based on the BTC cycles, halvings, price tops and bottoms, we do believe that the price top and bottom for the current cycle was already reached. Despite there are some researchers stating that BTC can reach a new bottom of \$10,000-12,000, we don't believe in such scenario. In our opinion, the current bottom of \$15,814.34, from November 22^{nd} , 2022 is the one which will continue to apply and the price will not fall any deeper.

We did also confirm clear relation between the halvings day range (roughly 1,458 days), bottom-bottom day range (1,431 - 1,438 days) and top-top day range (1,424 - 1,477 days).

Another interesting finding was that many of the key points in BTC price took time between November and January. As a matter of fact, 7 out of 10 key points happened in the mentioned period. While the halving cannot be changed (it is connected to the block number), it was only the 1st halving which happened in November and following halvings took place in different months. This makes it even more interesting, as 6 out of the 7 events (which happened in November – January) are not connected to halving but to the price itself – T1, B1, T2, B2, T3, B3. This means that price tops and bottoms always occurred only in the mentioned timeframe.

Following Table 8 shows all our estimations of the following price top and bottom occurrence. This estimation and prediction is based on our analysis of the previous price cycles (Table 4, 5, 6, 7).

Table 8. Key findings – next price top and bottom time range prediction

Key point title	Note	Next BTC Top	Next BTC Bottom
Top after halving	367 – 547 days after H	Apr 2025 - Oct 2025	
Bottom after halving	777 - 925 days after H		Jun 2026 - Oct 2026
Top after bottom	1,060 - 1,067 days after B	Oct 2025	
Bottom after top	364 - 410 days after T		Oct 2026 - Dec 2026
Top after top	1,424 - 1,477 days after T	Oct 2026 - Nov 2025	
Bottom after bottom	1,431 - 1,438 days after B		Oct 2026

Source: Own processing based on our research findings

Based on the summary of our findings in Table 8 we conclude that the next BTC price top will probably come around October - November 2025 while the next BTC price bottom around October - November 2026.

Our paper brought several interesting findings. We found out that the price cycle shows signs of repeating behavior and thus it was (and probably will continue to be) possible to predict the months when next BTC price tops and bottoms will be reached.

We need to emphasize one more time that it is still possible to create higher top or lower bottom before the 4th halving happens. It would require a black swan event (like quantum computer able to break the Bitcoin cipher) or very positive news on the other side (like spot Bitcoin ETF funds approved by SEC) which could possibly invalidate our cycle theory. For now it remains just a possibility but we do not expect this (new higher top or new lower bottom) to happen before H4.

In our following paper we would like to focus on the percentage gains and losses these tops and bottoms might mean - thus, how much an investor could earn or save by buying and selling at the right points in time.

Funding: This research did not receive any external funding.

References

- 1. Coingecko.com (2023). *Bitcoin USD (Historical Data)*. https://www.coingecko.com/en/coins/ bitcoin/historical_data?start=2013-04-28&end=2023-09-28#panel> [accessed September 29th, 2023].
- 2. Eksi, Z., Schreitl, D. (2022). Closing a Bitcoin Trade Optimally under Partial Information: Performance Assessment of a Stochastic Disorder Model. *Mathematics*, 10, 157. https://doi.org/10.3390/math10010157.
- 3. Fantazzini, D Kolodin, N. (2020). Does the Hashrate Affect the Bitcoin Price? *Journal of Risk and Financial Management*. 13(11):263. https://doi.org/10.3390/jrfm13110263.
- 4. Chan, J., Y. et al. (2023). The Bitcoin Halving Cycle Volatility Dynamics and Safe Haven-Hedge Properties: A MSGARCH Approach. *Mathematics* 2023, 11(3), 698; https://doi.org/10.3390/math11030698.
- 5. Pan, L., Feng, L., Jiayin, Q. (2020). Adaptive Evolution Mechanism of Blockchain Community Based on Tokenbased Halving Event. *Chinese Automation Congress (CAC), Shanghai, China, 2020,* pp. 6140-6144, doi: 10.1109/CAC51589.2020.9326532.
- 6. Phiri, A. (2022). Can wavelets produce a clearer picture of weak-form market efficiency in Bitcoin? *Eurasian Econ Rev* 12, pp. 373–386. https://doi.org/10.1007/s40822-022-00214-8.
- 7. Prasad, E. (2022). After the fall: Bitcoin's true legacy may be blockchain technology. *Bulletin of the Atomic Scientists*, 78:4, pp. 187-190, DOI: 10.1080/00963402.2022.2087371.
- 8. Swanbitcoin.com (2023). *Bitcoin Halving Dates* 2024: *Top Events to Watch Out For.* https://www.swanbitcoin.com/bitcoin-halving-dates/ [accessed September 29th, 2023].

Further professional on-the-job training of employees in post-pandemic times and a period of transformations

Marta Matulčíková 1, Tatiana Hrivíková 2

- ¹ Faculty of Management University of Economics in Bratislava, Slovakia; marta.matulcikova@euba.sk
- ² Faculty of Applied Languages, University of Economics in Bratislava, Slovakia; tatiana.hrivikova@euba.sk

Abstract: The purpose of this paper is to characterize the theoretical underpinnings of types of on-the-job training and to examine the relationship that exists between the amount of time employees spend on training and the changes in performance as assessed by line managers. The theoretical part provides the characteristics of the types of further professional on-the-job training. These characteristics form the basis of the empirical research. In the empirical research, we identified the time that individual employees (manual workers in construction companies) spend on training activities compared to how line managers evaluate the training outcomes. Descriptive statistics was used in the statistical processing of the collected data and the hypotheses were tested by calculating Pearson's correlation coefficient. As a result, it was concluded that correlation between time spent on training activities was confirmed only for induction training. For other types of training, the relationship between time spent on training and the post-training outcomes was not confirmed. We found that our results were consistent with the assertion of training experts that the lower the qualification of employees, the less they engage in training.

Keywords: on-the-job training; green skills; technologies; digital skills

Introduction

Various changes in society influenced by conditions of the covid period, the digital transformation of the economy, increasing demands for green transformation, and the need to develop green skills decisively influence the changes in approaches to human resources in individual organizations. More than before, not only expertise is required, but specific personality traits grow equally important. The continuous development of new technologies, advances in technology support and highlight the need for continuing professional education, including on-the-job training. The need for human resource development is becoming the responsibility of line managers, individual training managers, and other human resource professionals. Through developing corporate training strategies and formulation of training policies, they become collectively responsible for the performance of individual employees, departments, and the whole enterprise. Filling in specialist positions by experts requires either carefully organized recruitment and selection or rational and planned training. The aim of human resources management is therefore, to make optimal use of the potential of human resources while maximizing the value of the investment into them. The largest investment that is made in human resources, apart from health care, both in the national economy and corporate level is training. The pressure to increase the efficiency and the benefits of training activities undertaken are constantly growing. Not only the induction training period but also one's whole active working life requires purposeful and targeted training in line with the needs and requirements of the labor market.

1. Theoretical background

Line managers and HR managers address the issues related to improving employee performance, consider the criteria for performance evaluation and how to set them in order to fill a given job position with a person who not only has the optimal qualifications but also the ability to behave in a way that achieves the best possible result. Research confirms that an individual's performance in a particular activity is not always only a matter of the qualifications acquired in formal education, but that it is essential to create the conditions and opportunities for permanent lifelong learning. The training

activities prepared and implemented must be in line with the needs of the labor market and the complexity of work activities (Trexima, 2023).

Vocational training in adult education needs to be viewed from a broader perspective. It includes the core areas of learning orientation (European Commission, 2023):

- I. Education that serves as a substitute for school dropouts (this refers to those groups of citizens who, for various reasons, did not receive education in their youth and have little opportunity to enter the labor market due to their lack of qualifications); it is education linked to raising the level of education of an individual.
- II. Induction training, the aim of which is to integrate, train and retrain newly recruited employees.
- III. Further qualification training aimed at professional development and at improving the qualifications acquired so far.
- IV. Re-qualification training used to gain the opportunity to apply if the existing qualification does not correspond to the needs of the labor market.

As adult education encompasses several types of learning (BOZPO, 2023), which cannot be dealt with fully in this paper; we will characterize and analyze only further qualification training. Based on the list of the above-mentioned areas of education, it is clear that the employers play an important role in the management of continuing education, as they analyze and identify the educational needs of employees and plan their training activities. If training is to fulfil its progressive developmental role, it must be proactively oriented, taking into consideration the future social and corporate development and forecasts of scientific and technological development (European Commission, 2016). Educational planning should respect the current needs of the labor market and prepare human resources for the performance of work activities in the long term, though it is true that most enterprises organize training only to cover the current needs of employees and achieve their current performance.

The focus of the paper is on further on-the-job training of employees, where increasing qualifications, innovation of qualifications, broadening and deepening qualifications can be included (European Union, 2013). The following types of training are the most commonly encountered ones in companies:

- **induction training** to perform the simplest work activities. Lower managers, supervisors, experienced employees, as well as human resources professionals, and training specialists are permanently engaged in training activities. Even if there were no specialists in the field, experts who have been performing certain work activities for a long time would be used to provide initial instruction and practical advice on how best to perform the work activities.
- specific vocational training focused on skills development (Bersin, 2018) based on the demands of performing particular jobs or job roles. These job performance requirements are contained in the occupational register of the National Occupational Classification System. The occupational register needs to be updated and revised at certain intervals in the light of the development of new technologies and technical conditions. Competency models are being developed in enterprises. A competency model is usually a detailed description of behavior and actions in different situations including a lot of specific information and reflects the most common problems and their solutions. It is used as a description of outstanding personal performance and a yardstick against which an organization can measure its performance. The essence of competency modelling is to develop a model of ideal performance that reflects the specifics of the enterprise and is based on expected and observable behaviors, not on employee characteristics. Specific vocational training is based on specifications of employee requirements, including performance criteria (task inventory), standards, required competencies, qualification and personality prerequisites, physical and health prerequisites for the performance of the job contained in company job catalogues (Tank, 2023).

- development of key competences development of competencies that are not job-specific. The need for key competencies, also known as generic qualifications, has arisen as a result of rapid technological, social and organizational change. Key competencies encompass the whole spectrum of qualifications but are not just narrowly vocational; they are a superstructure above qualifications. Key competencies include the skills, attitudes, knowledge, values, personality traits and personality characteristics that enable a person to act appropriately in different work and life situations. Teaching methods, based mainly on an active approach and less on the quantity of knowledge acquired, should contribute to promoting their development (EDU, 2022).
- **specialization training** designed to acquire special knowledge and skills in connection with new technical and technological innovations and changes in the content of job descriptions. It is a means of developing an interdisciplinary approach in vocational education. In the context of job performance, it is necessary to define the needs and levels of further training, not only in relation to job performance but also with some idea for the performance of other jobs (Prasad Das, Guliti Buba, 2019).
- periodic examination and renewal of competencies resulting from legislation entitles individuals to perform specific activities defined by law, including the periodicity of renewal of competencies (Act No. 311/2001 Coll., the Labor Code, as last amended by Act No. 63/2018 Coll., the Labor Code, Xun, Zhiyvuan, Zhenhan, Sivu, 2023).

Each of these types of training requires continuous lifelong learning in the recent era of change and anticipated breakthroughs. There has never been a period of time in which something has not changed. However, the characteristic of the present is the increasing unpredictability of the factors that force change and the increasing speed with which it is necessary to react to change and adapt to the conditions of development. We are in a state of permanent change, and the breathing space between changes is getting smaller and smaller. It is particularly important to translate change into training in good time to prepare high-quality human resources in advance. There is no time to wait for change in further on-the-job training. The employees must be prepared for the changes and then work in the changed conditions.

2. Methods and methodology

It can be observed in companies that the more qualified the human resources are, the more they are engaged in training, its preparation, implementation, and subsequent evaluation. Considering this fact, we conducted empirical research where we focused on the length of employee training in hours for each type of training. We studied the satisfaction of the respondents i.e., line managers, with the changes achieved after training. The data were collected in May and June 2023. Each of the above-mentioned types of training is represented in the companies with specific thematic focuses. The research involved 106 respondents - line managers in medium-sized enterprises. The respondents were selected from Section - F Construction (Division 41 - Construction of buildings), according to the statistical classification of economic activities. The object of the research were manual workers and the selection of respondents was done deliberately in order to be able to obtain the most accurate information.

In the empirical research, we gathered information on the thematic focus of the above types of training. On the one hand, manual workers perform a number of routine tasks. At the same time, there is a high demand in terms of innovation and rationalization of work with high requirements for the use of information and communication technologies. The different types of training activities carried out in enterprises have been included in 5 five basic types of training (induction, specific vocational training, development of key competencies, specialization training, and renewal of competencies and periodic examinations). Periodic examination and renewal of competencies are usually included in the compulsory part of training, only rarely do enterprises attach more importance to it beyond the scope of the law. For the individual training activities, we focused on average length in hours per employee per year. We created a set of 7 time slots from which the respondents selected only one for each type of training.

Table 1. Time slots for the individual training activities.

Value of the answer	Average number of hours per employee per annum
1	< 5 h
2	6-12 h
3	13-19 h
4	20-27 h
5	28-34 h
6	35-40 h
7	>41 h

Source: Results of empirical research

The research was carried out using questionnaire method. The questionnaire was distributed electronically but also physically, due to the low digital literacy of the respondents. The training activities were divided into the following basic groups.

Table 2. Forms of on-the-job training.

Type of training activity	Characteristics
Induction	Vocational skills according to job classification
mauction	provided by practical instruction.
	Professional knowledge according to the job
	classification provided by team training
	(knowledge of production, technologies, prod-
Specific vocational training	ucts - possibilities of their innovation, im-
	provement of individual processes, etc.) as de-
	fined in the occupational register of the Na-
	tional Occupational Classification.
Development of key compe-	Communication skills, conflict prevention and
tencies	resolution, critical thinking, digital skills.
	New economic activities create new jobs so
	new skills profiles, qualifications and training
	frameworks will be needed. Examples are
Specialization training	'Green Skills' within certain green jobs, envi-
	ronmental awareness, and the skills needed for
	wind turbine operators, solar panel installers,
	etc.
Renewal of competencies and	Compulsory (statutory) and voluntary on-the-
periodic examinations	job training

Source: Results of preliminary research

Companies spend a lot of both time and money on employee training. Their expectation is that the implementation of individual training activities should bring positive results for the company, should be a source of changes in work performance, which would result in an increased performance of individuals, teams, work teams, departments, and the whole company. We sought respondents' views on the impact of training outcomes.

The training outcomes were disaggregated and rated by respondents across the 5 types of training listed above - induction, specific vocational training, key competency development, specialization training, and periodic review and refreshment of competencies. Respondents rated the results achieved on a scale of 0-5. The individual levels had the following characteristics, as shown in Table 3.

Table 3. Respondents' evaluation of the training outcomes.

Assessment	Assessment Characteristics
0	No changes noted

1	Improved performance of individual workers
2	Improved performance of employees carrying out
	the same type of work (across workplaces and de-
	partments)
3	Improved job performance evident in teams
	where at least one employee has been trained
4	Improvements in work performance evident in
	departments, company units, etc.
5	Improvements in work performance evident
	throughout the company

Source: Results of empirical research

After formulating the research model, which we developed with the participation of selected respondents in the pre-survey, a questionnaire survey was conducted. The aim of the research was to determine the amount of time each type of learning activity took in hours and the related learning benefits that respondents described in their answers.

Based on the theoretical background, we formulated the hypotheses:

First hypothesis:

H0: the number of hours devoted to induction training will have no impact on the change in work results.

H1: the number of hours devoted to induction training will have an impact on the change in work results.

Second hypothesis:

H0: the number of hours devoted to specifically vocational training will have no impact on change in work results.

H1: the number of hours devoted to specifically vocational training will have an impact on change in work results.

Third hypothesis:

H0: the number of hours devoted to the development of core competencies will have no impact on change in work results.

H1: the number of hours devoted to the development of key competences will have an impact on the change in work results.

Fourth hypothesis:

H0: the number of hours devoted to specialized training will have no impact on change in work results.

H1: the number of hours devoted to specialized training will have an impact on the change in work results.

As periodic review and renewal of competencies is mandatory it must be carried out within the required timeframe regardless of the results.

Statistical data processing is performed in Excel and Jama (Hanák, 2016). The aim of this paper is to characterize the theoretical background of the types of corporate training and to find out the relationship that exists between the amount of time employees spend on training and the changes in performance assessed by line managers. The statistical evaluation of the empirical research is the basis for making suggestions towards better preparation and organization of training activities in further on-the-job training.

3. Results

While conducting the empirical research, we pursued a research objective conceived more broadly compared to the objective of the paper – which is to characterize the theoretical underpinnings of types of on-the-job training and to identify the relationship that exists between the amount of time employees spend on training and the changes in performance as assessed by line managers. Using descriptive statistics, we calculated the modus for each type of training and the most frequently reported length of time respondents spend on training.

Table 4. Implementation of further on-the-job training.

Types of on-the-job training	Modus - lengths of employee training time
Induction	4
Specific vocational training	1
Development of core com-	1
petencies	
Specialization training	1
Periodic review and re-	2
newal of competencies	

Source: Results of empirical research

Based on the research results, we can state that most of the time is devoted to induction training. The modus operandi for induction is an interval ranging from 20 to 27 hours on average per employee per year. For mandatory training, i.e., the periodic review and renewal of competencies, the time spent is between 6 and 12 hours on average per employee per year. Other types of training are given up to 5 hours per employee per year on average. We confirmed the idea when choosing the object of our empirical research, that the lower the education, the less time is devoted to training. Future requirements related to the development of digital and green skills are developed at a very low level.

In the subsequent statistical calculations, we focused on testing the stated hypotheses.

Table 5. Calculation of Pearson's correlation coefficient for induction training.

Evaluation of the results of changes after training	Type of training activity Induction training	
Evaluation of the results of changes after Induction Training	Pearson's de Df p-value	r 0.524 104 <.001

Source: The jamovi project (2022). *jamovi*. (Version 2.3) [Computer Software]. Retrieved from https://www.jamovi.org.

Based on the Pearson correlation coefficient calculations, it can be concluded that there is a moderately strong correlation between the training outcome ratings and the number of training hours of the induction training for employees working in the construction industry (r = 0.524). In this case, we accept the alternative hypothesis.

Table 6. Calculation of Pearson's correlation coefficient for specific vocational training

Evaluation of the results of	Type of training activity
changes after training	Specific vocational training

Evaluation of the results of changes after Specific vocational training

Pearson's r -0,066

Df 104

p-value 0.505

Source: The jamovi project (2022). *jamovi*. (Version 2.3) [Computer Software]. Retrieved from https://www.jamovi.org.

In specific vocational training, there is no relationship between the number of hours devoted to training and the post-training assessment of outcomes. We accept the null hypothesis. The same results were identified concerning the development of core competencies and specialization training (Table 7, Table 8).

Table 7. Calculation of Pearson's correlation coefficient for development of core competencies.

Evaluation of the results of	Type of training	activity
changes after training	Development Core competencies	
Evaluation of the results of changes after Development Core competencies	Pearson's r - (Df p-value	0.130 104 0.183

Source: The jamovi project (2022). *jamovi*. (Version 2.3) [Computer Software]. Retrieved from https://www.jamovi.org.

Table 8. Calculation of Pearson's correlation coefficient for specialization training

Evaluation of the results of	Type of training activity	
changes after training	Specialization training	
Evaluation of the results of changes after Specialization training	Pearson's Df p-value	r 0.158 104 0.105

Source: The jamovi project (2022). *jamovi*. (Version 2.3) [Computer Software]. Retrieved from https://www.jamovi.org.

Among the employees working manually in the construction industry, the greatest attention is paid to induction training. In this case, we also confirmed the relationship between the length of training time and the results - the changes in performance that employees achieve after training. Alas, much less attention is paid to other training activities though, mandatory training is carried out within the prescribed requirements.

4. Discussion

The transformation of the economy to Industry 4.0 and the requirements for ecologization and a green economy will require the improvements of training even for low-skilled employees. Employees, especially those in the older age categories, may be expected to participate in a continuous training process. Changes in performance requirements will also require changes in existing work practices. All the studied training activities that were carried out in the construction companies were organized only by the companies. It can be expected that in the future, these enterprises will also have to cooperate with educational institutions in the preparation of training activities to ensure that training-course design and implementation are carried out in a systematic way and with positive results. A systematic approach involves careful identification of training needs and matching of objective and subjective qualifications to work requirements and processes. It is important to prepare the content of training based on a responsible pragmatic analysis. Finally, it is only the implementation of tailored trainings that allows the evaluation of the training results.

The success of employee training cannot be achieved only by increase in the number of hours of training. Success lies in correctly identifying the training needs of employees and based on that, the design of the training with the participation of experts in the field, educators, and methodologists, so that the content of the training is understandable to the trainees. The training should not only eliminate current shortcomings in work performance but should also be in line with the future needs and development objectives of the enterprise.

Funding: The research paper is in accordance with the aims and focus of the primary research project VEGA 1/0328/21. Post-pandemic business management: identifying temporary and sustainable changes in sequential and parallel management functions in the context of the COVID-19 pandemic.

References

- 1. BOZPO, (2023) preventívne a ochranné služby: Mimoriadna situácia v súvislosti s COVID-19 sa skončí 15. septembra. Dostupné na internete: https://www.boz.sk/
- 2. EDU Trainings. *Rozvíjame odborníkov zajtrajška*. [internetový zdroj]. 2022. [cit. 2023-05-18]. Dostupné na: https://edutrainings.sk/
- 3. European Commission, (2023) European Education Area Quality education and training for all. Dostupné na internete: https://education.ec.europa.eu/education-levels/adult-learning/adult-learning-initiatives
- 4. European Commission (2016) Oznámenie komisie Európskemu parlamentu, Rade, Európskemu a sociálnemu výboru a výboru regiónov nový program v oblastí zručností pre Európu. Spolupráca na posilnení ľudského kapitálu, zamestnateľnosti a konkurencieschopnost. Dostupné na internete: https://www.minedu.sk/data/att/10781.pdf
- 5. Európska únia (2013): Stratégia Európa 2020. EkoFond zapojil do prípravy projektu Build-up Skills Slovakia, Národná politiku odborného vzdelávania robotníkov v oblasti stavebníctva.
- 6. Bersin, J. (June 3, 2018). A New Paradigm for Corporate Training: Learning In The Flow of Work. Updated July 8, 2018
- 7. Hanák, R. (2016). Dátová analýza pre sociálne vedy. Vydavateľstvo Ekonóm, Bratislava, 2016, ISBN 978-80-225-4345-3.
- 8. Tank, N. (2023). Training and Education in Construction Industry. https://www.linkedin.com/pulse/importance-training-education-construction-industry-niteshtank.
- 9. Trexima, (2023). Ročný výkaz o pracovných podmienkach a nákladoch na podnikovú sociálnu politiku 2023. Dostupné na internete: https://zbery.trexima.sk/anonymous/ispp

- 10. Prasad Das, D., Guliti Buba, M. (2019). Role of Training on Employees Performance and Organizational Effectiveness. (MBA). International Journal of Mechanical Engineering and Technology (IJMET), Volume 10, Issue 01, January 2019, pp. 600611, Article ID: IJMET_10_01_061. School of Management, KIIT University, India. Publication Indexed in Scopus http://iaeme.com/Home/issue/IJMET?Volume=10&Issue=1ISSN Print: 0976-6340 and ISSN Online: 0976-6359.© IAEME.
- 11. Xun Liu, Zhiyuan Xue, Zhenhan Ding and Siyu Chen. (2023). Current Status and Future Directions of Construction Safety Climate: Visual Analysis Based on WOS Database. *Sustainability* 2023, *15*(5), 3911; Special Issue Civil and Hydraulic Engineering Safety. https://doi.org/10.3390/su15053911

Psychological determinants of occupational accidents in the context of current changes in the working environment

Natália Matkovčíková 1, Nadežda Jankelová 2

- Affiliation 1 (Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia); natalia.matkovcikova@euba.sk
- ² Affiliation 2 (Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovakia); nadezda.jan-kelova@euba.sk

Abstract: The submitted contribution identifies and describes selected psychological determinants of occupational accidents in the context of current changes (home-office, work tools, multicultural company environment) in the working environment and deals with their elimination and prevention. The research sample consisted of employees from small and medium-sized companies randomly selected, operating in Slovakia. The research used online-questionnaire method and basic scientific methods: method of descriptive and content analysis, methods of synthesis, comparison, classification and mathematical-statistical methods. An analysis of the research results showed that the respondents' research sample pointed to higher values of the psychological determinants from each group as unlimited working time employee, fear of technical failures and communication barriers between employees. When assessing the working environment, it is essential for companies to consider current changes and pay attention to the psychological determinants of occupational accidents and their elimination and prevention.

Keywords: occupational safety and health; occupational accident; work-environment

Introduction

Over the last period, the working environment has undergone significant changes caused by the Industrial revolution 4.0 and 5.0 in connection with the onset and use of information, communication and digital technologies in the work process, globalization processes, climate changes but also the coronavirus pandemic, the war in Ukraine, or the economic crisis are changing working environment. Current changes in the work environment affect employees, change their psychological state and when grouped together, can contribute to the occurrence of work accidents and occupational diseases. As a result of the action of psychological determinants in the work environment there is currently an increase in primarily mental and emotional demands and requirements placed on employees, their abilities and skills or adaptation and regulatory mechanisms, which poses a danger of damage to the employee's health. These new conditions of the working environment point to the need to change the content and structure of ensuring the safety and health of employees at work, including working conditions aimed at supporting (maintaining) and preventing not only the physical, but especially the mental health of employees.

Among the three most significant changes in the current working environment, which affect the psychological determinants of the occurrence of occupational accidents, we can include home-office work (§52, paragraph 2 of the Labor Code), which the employer has acquired the right to order due to the prevention of the emergence and spread of viral diseases during the COVID pandemic -19 (NLI, 2021). This form of work is still used in companies today and brought many negatives for employees in addition to advantages. The psychological determinants of home-office work include a change in the organization of work and the organization of working time in the home environment, unlimited working hours (the employee must always be available outside of working hours), not using free time for mental hygiene, fear and concern about whether the employee has done the work well, a loss of interpersonal (face-to-face) communication, a decline in cooperation/collective solutions to work tasks, the impossibility of consulting a work task with a superior/colleagues or a loss of social relations. In the

area of changing work tools, among the psychological determinants we can include the transition to online communication, the fear of technology failures (connections), changes in the control of work tools (ICT, automation) or the transition to touchless control, which brings increased demands on employees for micro-coordination of movements. The third most significant change in the work environment, which affects the psychological determinants of the occurrence of occupational accidents is the work of employees in the multicultural environment of companies. Companies employ a workforce from different cultures, with a different value system (which may not be aligned with the organization's values), have a different work pace or a different lifestyle. Other determinants include a disjointed corporate culture, elements of chaos in the work environment, communication barriers or difficulty in creating teams and it appears that this trend will continue.

The mentioned psychological determinants of occupational accidents in the context of current changes in the working environment are characterized by high demands on employees' adaptation processes. As shown by company practice, the orientation of the safety and health protection of the company's employees to the issue of analyzing the sources and causes of work accidents and occupational diseases of a physical nature is no longer sufficient. It is essential for companies to focus on the analysis of the sources and causes of work accidents and occupational diseases in the field of emerging psychological and somatic disorders, syndromes and addictions, their effective prevention and elimination in the work environment. And this is because of the negative impact not only on the performance of the employee, the work group, or the company as a whole, but also the increased costs of companies for employee absences, their incapacity for work, early retirement and also for the entire society.

1. Theoretical background

As a result of many changes that have been reflected in the working environment, there is an increase in the occurrence of various psychosomatic disorders among employees as a result of long-term stress or frustration in the working environment, which in many cases become the cause of occupational accidents and occupational diseases, not only among employees who suffer from them but also among employees who work with them in the company (Matkovčíková et.al., 2021). The European Agency for Safety and Health at Work (EU-OSHA) reports that more than 3,000 fatal occupational accidents, more than 230,000 occupational injuries with bodily and approximately 180,000 deaths of employees from occupational diseases occur annually in the working environment of European companies (Lieck et al., 2023). The importance of psychological determinants in the context of current changes in the working environment, which are among the two main causes of occupational accidents and diseases, was also pointed out by the European Commission (Nielsen et.al., 2021).

The latest trends and developments in the researched area in the conditions of companies operating in the EU are indicated by the authors Lieck et.al. (2023), who state that the number of employees who have to deal with such determinants in their work environment as demanding clients, long working hours, or poor communication on workplace in the tourism, entertainment, education, public transport, social work, health and care sectors - all sectors with a high focus on customer and client-oriented work. Among the key determinants that currently contribute to the emergence of psychosomatic disorders in the working environment are also increasing work intensity, high demands on the employee, stress at the workplace or work-life imbalance (Kordošová, 2023). According to Wynne et.al. (2014) mental health problems and disorders arising in the work environment can contribute determinants such as work pace, control, bullying, unemployment, job security or type of employment contract. At the same time, the authors point out that these determinants do not have to act in isolation at all.

The authors Aydin – Barin (2020) investigated the perception of psychological determinants (job demands, work environment, work control, employee support) and OSH climate (management perspective and rules, colleagues and OSH training) by employees. The results of their research point out that employees develop a high sense of belonging in the workplace, positive attitudes and perceptions of safety through managers who have a human approach to occupational health and safety activities and show a sensitive approach to participation. The participation of employees in OSH activities creates a healthy OSH climate at the workplace and reduces the impact of psychological determinants in the work environment.

Current changes in the working environment show that indicators of well-being and satisfaction in the working environment have an impact on the occurrence of occupational accidents. The concept

of well-being not only concerns the provision of optimal working conditions at the workplace but is also related to occupational safety. Sectors with high physical demands and a high customer and client orientation and professions with a lower level of skills show a lower level of well-being and satisfaction according to Lieck et.al. (2023). Capecchi et al. (2023) investigated the relationship between employee well-being and psychological and physical determinants of occupational accidents. Research findings confirm that both types of determinants have a substantial impact on employee health and safety, although psychological determinants appear to be more prominent.

The effective prevention and elimination of occupational accidents in the working environment is represented by the OSH management system in individual companies. Howard et al. (2022) found that large companies assess and take into account changes in the work environment more regularly than small companies, almost half of companies consider the management of psychological determinants of occupational accidents more difficult than physical determinants and it was also shown that most European companies did not take into account the impact of the onset of digital technologies in working environment for employees in its health and safety policy program. The results of the study Beck - Lenhardt (2019) indicate that to improve the current situation, it would be beneficial to increase the use of professional OSH experts in companies and strengthen the advisory and control capacities of OSH inspection bodies in the field of psychological determinants. As stated by the National Labor Inspectorate in Slovakia (2023) in the report on occupational accidents for 2022, this year labor inspectors plan to pay more attention to the quality control of the output materials from the investigation of occupational accidents, especially to the correct determination of the source and cause, as their knowledge is essential for accepting preventive measures and prevention of the repetition of similar accidents in the future.

Part of the OSH management system is the adoption of measures to eliminate the psychological determinants of occupational accidents in the context of the mentioned changes in the working environment. The most frequently adopted measures within European companies include work reorganization with the aim of reducing work demands and job pressure, confidential counseling for employees or the creation of a conflict resolution procedure (Irastorza, 2015). The modernization of EU legislation in the field of health and safety is also related to measures for elimination and prevention, which created a critical framework for the prevention of health and safety risks from the mid-1980s. The European Union, member states, governments and social partners have agreed on these legal regulations and the member states have transposed them into their national legal regulations, including Slovakia, thus contributing to improving the level of safety and health protection at work and reducing the occurrence of occupational accidents.

The latest European strategic framework for health and safety at work for the years 2021-2027 emphasizes the current changes in the working environment. Member States, european and international organizations provide comprehensive and diverse guidance and support to companies, covering different types of OSH-related issues and proposing practical preventive measures (Lieck, 2023). Kordošová (2023) points out that in the field of assessing the psychological determinants of occupational accidents in the context of current changes in the working environment, there is no comprehensive system of methods and assessors in practice cannot adequately describe and evaluate these determinants and risks and there are also no detailed programs for reducing the burden of determinants for the needs of company practice. According to Kordošová (2021) the Slovak Republic lacks a national procedure – a program for assessing and evaluating psychological determinants and risks. Companies use for example the ISSA manual and methodology and methodologies resulting from available legislation.

2. Methods and methodology

The aim of the research was to identify and describe selected psychological determinants of occupational accidents in the context of current changes (home-office, work tools, multicultural company environment) in the working environment of small and medium-sized companies operating in Slovakia. The research sample consisted of 162 employees from small and medium-sized companies randomly selected, operating in Slovakia. The questionnaire distribution and data collection were carried out electronically. The research used basic scientific methods - method of descriptive and content analysis, methods of synthesis, comparison, classification and mathematical-statistical methods. The results obtained by the questionnaire method on the sample of respondents enabled us to formulate the following

findings and to compile the following figure. Figure 1 shows selected psychological determinants of occupational accidents in the context of current changes in the working environment.

3. Results

From Figure 1 we can see the values of selected psychological determinants of occupational accidents in the context of current changes in the working environment of small and medium-sized companies operating in Slovakia. These three groups of psychological determinants (home-office, work tools, multicultural environment of companies) proved to be significant in the research questionnaire. The higher the Group Median - Gm value, the higher the value of a single determinant.

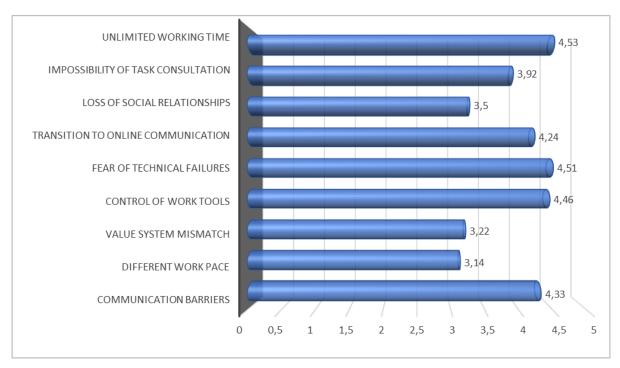


Figure 1. Psychological determinants of occupational accidents in the context of current changes in the working environment

Source: Own elaboration

An analysis of the research results showed that the respondents' research sample pointed to higher values of the following psychological determinants of occupational accidents in the context of current change (home-office) in the working environment: Unlimited working time - Gm = 4,53, Impossibility of consulting the work task - Gm = 3,92, Loss of social relationships - Gm = 3,5. The research sample also pointed to higher values of the following psychological determinants of occupational accidents in the context of current change (work tools) in the working environment: Transition to online communication - Gm = 4,24, Fear of technical failures - Gm = 4,51, Changes in the control of work tools - Gm = 4,46. Figure 1 also shows higher values of the psychological determinants of occupational accidents in the context of current change (multicultural environment of companies) in the working environment: Value system mismatch - Gm = 3,22, Different work pace - Gm = 3,14 and Communication barriers - Gm = 4,33.

4. Discussion

In the research questionnaire, three groups of psychological determinants of occupational accidents in the context of current changes in the working environment (home-office, work tools, multicultural environment of companies) proved to be significant. The research sample pointed to higher values of the following psychological determinants of occupational accidents in the context of current change (home-office) in the working environment: unlimited working hours (the employee must always be available outside of working hours), the impossibility of consulting a work task with a superior/colleagues and a loss of social relations of employee. Higher values were also achieved by the psychological

determinants of the occurrence of work accidents in the context of the current change (work tools): transition to online communication, the fear of technology failures (connections) and changes in the control of work tools (ICT, automatization). The respondents pointed to higher values of the following psychological determinants of occupational accidents in the context of current change (multicultural environment of companies) in the working environment: mismatch/inconsistency of the value system of the employee and the company, different work pace and communication barriers between employees.

With regard to the results of the research, we suggest that employers with home-office according to NLI (2021) evaluate the working time of employees (online and offline), ensure contact between the manager and employees, regular communication regarding work tasks, contact with colleagues through means of audiovisual communication or employee rotation (enable employees to work even from the workplace in order to ensure mental hygiene by changing the working environment). In connection with the change in the control of work tools in the work process, we recommend that companies provide employees with technical support and help in solving ICT problems and ensure training and education of employees in connection with the control of new work tools in the work process. In the multicultural environment of companies, we suggest that companies set the methods of the selection process so that the employee's value system is in line with the company's values and corporate culture, the possibility of choice and flexibility in the work pace of employees, or the setting of a culture of feedback with the aim of removing communication barriers in the company.

According to Nielsen et.al (2021), an effective systematic approach to the changes taking place in the work environment with an emphasis on the psycho-somatic area is contained in the steps of the OSH management system, primarily thorough preparation, assessment, action plan, taking measures and their subsequent evaluation. Among the effective measures that can be implemented by the company is the reorganization of work in order to reduce work demands and pressure in employment or confidential counseling for employees. According to Kordošová (2021), effective preventive measures include clear management, balanced division of work tasks, employee participation, development of qualifications, information and feedback. However, as practice shows, many companies and especially micro and small companies are often unable to completely fulfill more complex tasks in the field of prevention due to a lack of resources or expertise (Lieck et.al., 2023). For this reason, space is opened for further research and the proposal of a comprehensive approach in this area.

5. Conclusions

When assessing the working environment, it is essential for companies to take into account current changes and challenges and to pay attention to the psychological determinants of the occurrence of work accidents and occupational diseases in the field of emerging psychological and somatic disorders, syndromes or addictions and their elimination and prevention. The article identifies and describes selected groups of psychological determinants of occupational accidents in the context of current changes in the working environment and deals with issues of their elimination and prevention in the working environment of companies operating in the Slovak Republic. Among the three most significant changes in the current working environment, which affect the psychological determinants of the occurrence of occupational accidents, we can include home-office work, work tools and the multicultural environment of companies. As a result of the action of the mentioned psychological determinants in the working environment, there is an increase primarily in psychological and emotional demands and requirements placed on employees, their abilities and skills or adaptation and regulatory mechanisms, which represents the danger of damage to the employee's health. The paper draws attention to the psychological determinants of occupational accidents in the context of current changes in the working environment and their impact on occupational health and safety. The stated determinants affecting employees, which arose as a result of many changes in the world of work, have a fundamental impact on employees and should be incorporated and applied in the policy and OSH management system of every company, regardless of its size or sector.

Funding: This research was funded by VEGA Project No. 1/0010/23 - Adaptability of corporate culture - a factor supporting resilience and sustainability of enterprises in Slovakia in the post-covid period.

References

- 1. Aydin, N. B. & Barin, N.E. (2020). The Effect of the Perception of Safety Climate at Workplace on Psychosocial Risk Factors. Business [online]. 2020, 8(4), 240-265 [cit. 2023-09-28]. ISSN 21482586. https://search.ebsco-host.com/login.aspx?direct=true&db=eoh&an=2008035&scope=site
- Beck, D., & Lenhardt, U. (2019). Consideration of psychosocial factors in workplace risk assessments: findings from a company survey in Germany. International Archives of Occupational and Environmental Health [online]. 2019, 92(3), 435-451 [cit. 2023-09-28]. ISSN 03400131. https://search.ebscohost.com/login.aspx?direct=true&db=eoah&an=48469457&scope=site
- 3. Capecchi, S., & Cappelli, C., & Curtarelli, M., & Di Iorio, F. (2023). Synthetic indicators to analyze work-related physical and psychosocial risk factors: evidence from the European Working Conditions Survey. Quality and Quantity [online]. 2023, (Preprints), 1-23 [cit. 2023-09-28]. ISSN 00335177. https://search.ebsco-host.com/login.aspx?direct=true&db=eoah&an=62316095&scope=site
- Irastorza X. (2015). Summary Second European Survey of Enterprises on New and Emerging Risks (ESENER
 European Agency for Safety and Health at Work EU-OSHA: 2015. ISBN 978-92-9240-696-7. doi:10.2802/372342 https://osha.europa.eu/sites/default/files/esener-ii-summary-sk.pdf
- 5. Lieck, L., & Anyfantis, I., & Irastorza, X., et.al. (2023). Occupational safety and health in Europe: state and trends 2023. European Agency for Safety and Health at Work EU-OSHA: 2023. PDF ISBN 978-92-9479-936-4. doi: 10.2802/788385. https://osha.europa.eu/sites/default/files/Summary_OSH_in_Europe_state_trends.pdf
- 6. Howard, A., & Antczak, R., & Albertsen, K. (2022). Third European Survey of Enterprises on New and Emerging Risks (ESENER 2019): Overview Report How European workplaces manage safety and health. European Agency for Safety and Health at Work EU-OSHA: 2022. PDF ISBN 978-92-9479-674-5. https://osha.europa.eu/sites/default/files/esener-2019-overview-report.pdf
- 7. Kordošová, M. (2023). Psychosociálne riziká a BOZP. *In Bezpečnosť práce v praxi*. 7/2023. https://www.pracov-nepravo.sk/sk/casopis/bezpecnost-prace-v-praxi/psychosocialne-rizika-a-bozp.m-1297.html
- 8. Kordošová, M. (2021). Vypracovanie programov a zavedenie mechanizmov použiteľných pre psychosociálne riziká na pracovisku I.etapa. Správa z výskumnej úlohy. Bratislava: Inštitút pre výskum práce a rodiny, 2021. file:///C:/Users/nmatk/OneDrive/Po%C4%8D%C3%ADta%C4%8D/vyprac_programov_a_zaved_mechanizmov_psychosoc_rizika_kordosova_2021.pdf
- Matkovčíková, N., & Szarková, M., & Beláňová, B. (2021). Mental Health and Occupational Health and Safety in Human Resource Management in the Stage of the Industrial Revolution 4.0 and Development Trends. Reviewers: Kristína Králiková, Zdenka Macková. 1st Edition. České Budějovice: Vysoká škola evropských a regionálních studií, 2021. 138 p. [13,27 AH]. VEGA 1/0447/19 (70%), VEGA 1/0309/18 (30%). ISBN 978-80-7556-085-8.
- 10. National Labor Inspectorate. (2023). Správa z úlohy č. 23 402 z Plánu hlavných úloh Národného inšpektorátu práce na rok 2022. Rozbor pracovných úrazov, ochorení súvisiacich s prácou a závažných priemyselných havárií v organizáciách v pôsobnosti inšpekcie práce za rok 2022. https://www.ip.gov.sk/wp-content/up-loads/2023/04/SPRAVA_PU_za_rok_2022-1.pdf
- 11. National Labor Inspectorate. (2021). Homeoffice a BOZP. NIP, 2021. https://www.ip.gov.sk/homeoffice-a-bozp/
- 12. Nielsen, K., & Jørgensen, M.B., & Malgorzata Milczarek, L.M. (2021). Zdraví zamestnanci, prosperujúce podniky praktická príručka na zabezpečenie dobrých podmienok na pracovisku: riešenie problému psychosociálnych rizík a poškodení podporno-pohybovej sústavy v malých podnikoch. European Agency for Safety and Health at Work EU-OSHA. PDF ISBN 978-92-9479-427-7. https://osha.europa.eu/sites/default/files/SK%20EC_GUIDE_STRESS_MSD%20WEB%20TE0218850SKN_002.pdf
- 13. Wynne, R., & De Broeck, V., & Vandenbroek, K. et.al. (2014). Podpora duševného zdravia na pracovisku. Usmernenie k uplatňovaniu komplexného prístupu. Európska komisia. Európska únia, 2017. PDF ISBN 978-92-79-66312-3, doi:10.2767/647232, file:///C:/Users/nmatk/Downloads/KE0417232SKN%20(2).PDF.

Post-pandemic management function of organizing

Juraj Mišún 1

¹ Faculty of Business Management, University of Economics in Bratislava, Slovak Republic; juraj.misun@euba.sk

Abstract: The Covid-19 virus pandemic has affected the business world in almost every country in the world and caused many significant changes. Since the management revolution that separated ownership from management, executives have been responsible for running the business. A pandemic of this magnitude, last seen 100 years ago, has also affected the various functions of management through which managers effectively and efficiently achieve the goals of any organization. Through two questionnaire surveys in 2022 and 2023, we tracked changes in the various management functions and their sustainability. This paper focuses on the function of organizing and the results are that organizing as a management function has undergone certain changes due to the impact of the Covid-19 pandemic, with online meetings and the reduction of face-to-face contact, as well as the transition to a hybrid form of work, are more likely to be permanent.

Keywords: management functions; manager; organizing; changes caused by the Covid-19 pandemic

Introduction

Human history is littered with pandemics, many of which killed millions of people. The worst pandemic was the Black Death (14th century), which killed an estimated 30 to 60 percent of the population of Europe alone (Wade, 2020). Although the Old Continent was hit by the bubonic plague several times, it was always able to recover from the pandemics and was the most advanced part of the world in the long run. Historically, the second most severe pandemic occurred over a century ago and was misnamed the Spanish flu because Spain was neutral during World War I and was able to report the severity of the pandemic caused by the H1N1 virus (Terry, 2020). As reported by Worobey, Han & Rambaut (2014), the actual first location of the outbreak was Kansas, USA. Since then, although there have been several epidemics with many deaths around the world (e.g., the Russian typhus epidemic, influenza A/H3N2, or the HIV/AIDS epidemic), their severity has been relatively low for life on planet Earth, and humanity has become accustomed to a relatively safe life with rapidly advancing health care.

Living safely with democratic freedom led to developments in other areas, including management. After the first Industrial revolution, businesses began to grow, and it was no longer so easy for an owner to run a business. Another reason was the complexity of work, which required specialization not only at the level of the worker, but also at the level of the foreman or higher manager in the factory. During the great influenza epidemic (1918-1920), we already had many insights into the management of organizations, but the real breakthrough came later with the translation of Henri Fayol's work into English. The impact of the "Spanish flu" on business has been described, for example, by Bodenhorn (2020).

Henri Fayol divided the vast field of management into several successive and overlapping functions. More than a hundred years after the publication of his book "Administration industrielle et générale" (1916), these functions can still incorporate the latest knowledge. In doing so, he laid a strong foundation for the study and teaching of management. However, the original functions have changed slightly over time.

Fayol's original functions of planning, organizing, commanding, coordinating, and controlling (Jonas, 2021) have become four to five management functions depending on the continent. While in European theory we have five functions (planning, organizing, staffing, leading, and controlling), in American theory staffing is mostly integrated into the organizing function. Where the workforce has gone in the last hundred plus years can be seen in the evolution of the commanding function. This has been expressed in terms like directing or influencing, now called leading, and includes important tools like motivation, communication, or leadership style.

The combination of the Covid-19 disease pandemic and the management function of organizing presented a major challenge for many managers. Ordinary face-to-face management abruptly became remote in early 2020. Organizing the work of individuals as well as groups and teams was suddenly challenged and required adaptation to entirely new conditions. The next period was not much better, as periods of lockdown were often interspersed with periods of looser arrangements, but often with many employees on sick leave. The purpose of our paper is to zoom in on the changes that managers have had to make in their organizing function and to determine, based on empirical data, which changes are likely to persist.

1. Theoretical background

In the theoretical background section, we will briefly describe the basic theoretical insights into the management function of organizing and present findings that can be found in scientific publications in the context of the Covid-19 pandemic.

As noted above, the organizing function has been a core function of management since the inception of such a division, and is therefore time-tested, unlike staffing, coordinating, or leading. But that doesn't mean it can't evolve. As Bunderson, Cantimur, and Rink (2016) note, few topics in management have seen as much change recently as organizing and organizational structure. Managers are reexamining traditional approaches and seeking new designs that support and facilitate employees in doing their work efficiently and flexibly. Organizing is important not only for the management of organizations, but also for employees themselves, because, according to the great management theorist Henry Mintzberg, people need to understand how their organizations work in order to work well within them (Mintzberg & Van der Heyden, 1999).

Among the many definitions of organizing, we can mention, for example, that "organizing is the process by which managers establish the structure of working relationships among employees to allow them to achieve an organization's goals efficiently and effectively" (Jones & George, 2022, p. 276). How strategy is implemented is largely a matter of how managers organize the firm (Hill, Hitt & Hoskisson, 1992); on the other hand, in some cases, the structure of a particular organization may influence the actual strategy to be chosen (Galan & Sanchez-Bueno, 2009).

A key concept in organizing is, of course, organizations, which have been defined in a variety of ways by psychologists, sociologists, management theorists, and practitioners (Chandan, 2019). Organizations are social entities in which a number of people perform a variety of tasks to achieve common goals that individuals could not achieve on their own (Rao & Pande, 2009). A very interesting analogy is offered by Ramasamy (2010), namely with the human body. While the limbs or organs work independently, one part cannot be substituted for another. However, an organization is only a means to an end, as it takes certain inputs from the environment and transforms them into certain outputs desired by society (Rao & Pande, 2009).

As part of the management process, once the strategy is determined and plans are set, organizing begins the implementation and achievement of clarifying job roles and working relationships (Schermerhorn & Bachrach, 2020). In the context of organizing, Kinicki & Soignet (2022) state that organizational performance depends on the extent to which organizational culture, organizational structure, and human resource management practices work together to enable the organization's strategy. Jones & George (2021) go one step further by using the term organizational architecture. It represents the combination of organizational structure, culture, control systems, and human resource management systems that determine how effectively and efficiently organizational resources are used.

The aforementioned relationship between organizing and staffing illustrates Bauer, Erdogan & Short's (2019) view that organizing involves creating an organizational structure and allocating human resources to secure organizational goals. They distinguish between organizing at the organizational level (departmentalization) and organizing at the level of specific jobs (individual job design).

The creation or modification of the organizational structure can be referred to as organizational design. This process includes the following key elements: work specialization, departmentalization, chain of command, span of control, centralization/decentralization, and formalization (Robbins & Coulter, 2020). The main challenge of organizational design is to balance and integrate people and roles (Malhotra & Morris, 2009). Organizational design recognizes two basic organizational forms, the mechanistic organization and the organic organization, the specific choice of which depends on a number of

contingent factors, but they rarely appear in their pure form (Morand, 1995). Mixed forms are more common.

Designing the perfect organizational structure has been the source of much debate over the past 200 years, with early theorists such as Frederick W. Taylor, Henri Fayol, and Max Weber having their individual approaches to introducing structural change in different industries (Neck, Lattimer & Houghton, 2013). According to Rao & Pande (2009), organizational structures support or hinder performance. They observed that public sector organizations in the 1950s to 1980s attracted talent with higher salaries and better benefits than were common in the private sector. However, because of their bureaucratic principles, they were unable to make full use of the talents and skills of their employees, and private companies performed better during this period despite having fewer talented people.

The COVID-19 pandemic hit the world very quickly and unexpectedly, and organizations had to adapt their operations to the sudden changes without any prior preparation or transition period. The situation of the COVID-19 pandemic meant the need for the coordination of different directions and forces in society (Ambrozy, 2022). The main cause was the need to maintain social distance, which resulted in the physical closure of many organizations in the acute phase of the crisis and often a virtual ban on all activities. Due to the need for stricter hygiene measures and also a change in the organization of work, organizations tried to exploit the potential of the online environment and move the implementation of employees' activities to their homes. By taking advantage of digitalization, companies were able to respond quickly and in a timely manner to the needs of customers and employees (Jankelová et al., 2021). The economic, political and social spheres have been engaged in the process of digital transformation for a long time, and the global crisis has provided an opportunity for organizations to accelerate this process. Organizational structures had to be optimized to mitigate the impact of the pandemic, and the changes in question were mainly related to digital transformation, i.e. companies had to switch to remote working. The inevitability of digital transformation led to changes in the practices, processes and values of organizations (Almaz, 2022).

In addition to the fact that the COVID-19 pandemic has greatly accelerated digitalization in many companies and forced the improvement of technical skills of employees, it has caused a forced and massive expansion of virtual structures (teams) (BRANDlab, 2021). During the COVID-19 pandemic, some organizations adopted latent organizing, which is not new (common use in rescue or armed forces) but is still relatively poorly described in the literature. Latent organizing is closely associated with crisis and emergency situations, where certain organizations temporarily begin to undertake activities beyond their standard business activities in the interest of the public good. Although latent departments are not visible in the organizational structure of an organization, they do exist (if the organization prepares extensively for emergencies) (van Fenema & Romme, 2020).

Digital transformation is the fusion of technologies and the integration of physical and digital systems in an organization. However, several studies show that companies that have already embarked on digital transformation are not fully equipped to meet the challenges. Digitalization requires restructuring processes, making companies more agile, investing in organizational structures, and increasing standardization and automation. However, the COVID-19 pandemic has accelerated this digital transformation (Almeida, Duarte Santos & Augusto Monteiro, 2020).

Eurofound (2020) conducted an online survey on working from home between April and May 2020, involving 62,000 respondents from European Union countries. In Slovakia, before the pandemic, only 11.8% of Slovaks used this form of work, but due to the impact of the pandemic, this number increased significantly to 31.3% (Kordošová, 2021). Initially, working from home had a very positive effect on employees, making them more productive and efficient. This led to a discussion about a permanent expansion of this form of work. However, this has raised a number of questions about the adequacy of space for employees to work, the quality of work, safety, contributions to the creation and maintenance of adequate space, compliance with health and safety standards, the availability of appropriate equipment (communication, printing, photocopying, etc.), and the way in which employees plan their working day. The extent to which remote working becomes the norm will be determined primarily by the organization, but also by the attitudes of employees. Surveys show that most employees, after experiencing remote work, are leaning towards a hybrid form of work, where they work in a combined way, either in the organization's office or in a home environment (Jones Lang LaSalle/JLL, 2020).

Barrero, Bloom & Davish (2022) estimate that all working people in the US will be divided into three groups in the foreseeable future:

- Approx. 50% will be workers who cannot work from home and must commute to an office or other
 workplace (especially lower-paid jobs that continue to work on-site during a pandemic, such as
 shop workers, health care workers) or for whom on-site work is essential (manufacturing workers).
 These organizations should operate within the classic organizational structures as before the pandemic and should not be changed.
- 2. Approx. one-tenth will be employees who work from home on a permanent basis (especially employees who have been more productive working remotely; not managers of large teams and employees in various services).
- 3. Approx. 40% should be made up of employees who will work in hybrid organizational structures, partly in a virtual space from home and partly on site (mainly university educated workers; managers or team members who need face-to-face contact to be productive; employees who love the freedom, benefits of working from home and less commuting).

Whether remote work remains common or becomes another brief blip in a long history of starts and stops since the 1970s, it is very likely that the digital footprints created during COVID-19 will serve as the basis for many organizational practices, policies, and ideologies in the future (Leonardi, 2021).

The virus posed a threat primarily in an indoor office environment. The use of the open office model, hot-desking, and sharing of computers or keyboards put employees at risk. As a result, organizations were forced to redesign their offices. They also had to radically change the way they worked in the office. Changes included seating arrangements, employees working in split shifts, staggered working hours, constant monitoring of employees, and the use of disinfectants that allowed employees to be more physically distant from others. Regular office cleaning (cleaning door handles, elevator buttons, handrails, desks, and disinfecting areas) also became an important routine. However, these changes increased the organizations' operating costs. In addition, some organizations were not prepared for the digital transformation and were forced to provide employees with workstations so that they could fully perform their work activities from their home environment (Parker, 2020).

Although remote working is a popular way of working, it is not liked or enjoyed by all employees and therefore needs to be well managed by organizations. An increasing number of homeworkers report a lack of interaction with colleagues and feeling disconnected from the work situation, while on the other hand, some find this form of working convenient (Mullins, 2016).

As can be seen in the preceding paragraphs, the Covid-19 pandemic has caused significant changes in some areas, to which managers of different companies have had to respond through their organizing function. Some of these changes have the potential to be permanent and to serve not only as an emergency solution, but also as a suitable alternative for employees, or as a tool to reduce costs or increase employee motivation.

2. Methods and methodology

For the description of the theory of organizing, we have used textbook literature written in English, mainly from the United States, Great Britain, but also, for example, from India. The advantage of this literature is that it is based on well-established facts and at the same time largely free of new knowledge that is not sufficiently implemented. The textbook literature is supplemented by scholarly sources, primarily articles from scholarly journals indexed in Current Contents Social & Behavioral Sciences or the Social Sciences Citation Index.

We used Clarivate's Web of Science database to search for current scientific knowledge on changes in organizing function due to the Covid-19 pandemic. We included "management function" or "managerial function" as keywords due to the use of both terms in publications, "organizing" or "organising" due to the different spelling of the term in American and British English, and "Covid-19". The time period of the results was limited to 2020 to 2023, and the keyword "coronavirus" was deliberately omitted to avoid including the first publications at a time when the pandemic had not yet been declared. As the pandemic was primarily a health issue, another limitation was the Web of Science category, which was set to "Management". The given results were further processed based on the abstracts. The publications were classified into three groups. Those that are very closely related to the issues inherent in the

management function of the organization, those that are partially related to the function, and those that are only slightly related to the function. A deeper analysis of the collected papers revealed trending themes that emerged during the pandemic, namely sports event organizing, feminism, supply chain organizing, consumer behavior, issues related to teaching and learning, or trade union issues. Due to the limited size of the paper, only selected sources from the first group were used and others will be used in our other publications.

The empirical results in this paper come from two questionnaire surveys conducted approximately one year apart. The respondents were not the same managers, and although there was some overlap, the sample of firms is not identical anyway. However, given the size of the two survey samples, we consider this limitation to be surmountable. In both cases, the survey was not representative, although we tried to be as representative as possible.

The first questionnaire survey was conducted via Google Forms from April 25, 2022 to May 15, 2022 to find out what individual changes had occurred as a result of the Covid-19 pandemic in business management, specifically in the different management functions (planning, organizing, staffing, leading, and controlling), as well as whether the crisis was perceived by the organizations as a learning opportunity and whether the organizational culture had changed. In addition to qualitative responses about what specific changes had taken place, we also asked about the likelihood that managers expected the change to be sustained. Identifying data included the organization's name, legal form, location, and a description of the manager (age, gender, education, management level, etc.). In total, we received 533 questionnaires, some of which were duplicates within the organization (several managers completed the questionnaire) and some of which were discarded from further processing due to incomplete data or an inappropriate respondent (delegation of the questionnaire to a subordinate). The processed research sample amounted to 425 questionnaires from various business entities from all over Slovakia. Due to the fact that private companies are usually the first to introduce new trends, only business entities were contacted, and the response rate was 27.62%.

The second survey collected data in the same way via Google Forms (April 6 to May 12, 2023) and aimed to find out which of the changes most frequently mentioned by managers in the previous survey had been maintained in practice so far and thus tended to remain sustainable. In this case, public administrations or NGOs were also contacted, as we consider management in the tradition of Henri Fayol to be universal. Despite the increase in the number of respondents, the willingness to answer the questions decreased (response rate 20.17%) and we received a total of 425 completed questionnaires. After selecting respondents with insufficient competencies (rank-and-file employees) and merging the questionnaires completed by managers of the same organizations, 349 questionnaires remained to be processed. While the first questionnaire was based on the qualitative responses of the managers, the second questionnaire used a four-point Likert scale (no change, little change, major change, significant change). The responses of managers from the same organization were averaged.

Due to the huge amount of data collected, the paper focuses on only one part – questions related to the organizing function, and basic scientific methods were used to process and interpret the results of the questionnaire surveys.

3. Results

As mentioned above, the first questionnaire survey was conducted in the spring months of 2022. This period marked the end of the third wave of the pandemic in the Slovak Republic, which, like the second wave, was "catastrophic" and in stark contrast to the first wave, which was well managed from a medical point of view. The problems of this wave were mainly the politicization of the vaccination issue and the late introduction of the lockdown due to the lack of clear political leadership (Pažitný et al., 2022). From our perspective, the advantage of this period was that the actions to be taken by managers were still relatively fresh in their minds. The initial actions in the early 2020s may have been chaotic in many cases, but in the later period they settled down and managers already knew how to proceed, what worked and what did not.

Of the 425 companies surveyed, 14 managers (3,29%) reported that their organizational function had undergone significant changes. Justifications often included strict adherence to rules, a complete lockdown of the company, the need to change procedures, or, for example, centralizing decision making without the opportunity for discussion. Major changes were reported by 68 managers (16%), with

justifications such as online meetings, employee testing, increased delegation, or complete digitalization. A total of 176 managers (41,41%) said they had made small changes in their organizing function, such as more online activities, reduced working hours, ensuring substitutability, new procedures due to constraints, etc. In our first survey, 167 managers (39,29%) reported that the pandemic had not caused them to make any changes in their organizational function. Some of these managers were willing to justify why there had been no change, such as that the organizational structure did not need to be changed, the company was implementing a contingency plan, or that procedures remained the same.

The qualitative answers or justifications mentioned in the previous paragraph or given as examples in Table 1 were further elaborated and narrowed down to the following six categories on the basis of their content: online meetings/minimization of face-to-face contacts, organization of representativeness; representation/competence directives; transition to remote working (teleworking, working from home); adaptation of the organizational structure; changes in working practices; greater formalization (standards, directives, instructions). These categories were then used to determine the sustainability of the changes in the second questionnaire.

Table 1. Selected changes in the management function of organizing

Company description	Manager descrip-	Type and specification of change in or-
	tion	ganizing
A medium-sized transportation company	Managing director,	Small changes. Limit face-to-face meetings,
headquartered in Bratislava, during the pan-		more meetings in the online space. (We'll defi-
demic, economic results showed growth.	bachelor's degree.	nitely keep.)
Importer and retailer of soft drinks, head- quartered in Bratislava, during the first year of the pandemic, profits dropped signifi- cantly, sales were relatively stable, with a slight decline in the first year.	Consumer Collecting Manager, male, less than 30 years, mas- ter's degree.	agement area. And this has been carried over into the current more relaxed period. Simply the Home Office option will be here forever. (We'll probably keep.)
Small fruit and vegetable processor, based in		
Trnava HTU1, during the pandemic, profits	tion and Sales, fe-	were running at half capacity. This organiza-
fluctuated, revenues were relatively stable,	•	tion of production is disadvantageous for our
with significant growth in 2022	secondary education.	
Large food retailer, headquartered in Bratislava, during the pandemic, economic results have shown steady growth.	Team coordinator, female, up to 30 years, master's de- gree.	Significant changes. During the pandemic period, we switched to MS Teams and MS Outlook, which we use to communicate with colleagues on a regular basis, delegate tasks, and mark deadlines and tasks on a shared calendar. (We'll definitely keep.)
Temporary employment agency (microenter- prise), headquartered in Trnava HTU, sales decreased in the first year of the pandemic, then grew and stabilized, profit was on a de- clining trend throughout the period.	Managing Director, male, 31 to 45 years, master's degree.	Major changes. New organizational structure with emphasis on quality. Allocation of competencies with emphasis on specialization. (We'll definitely keep.)
Performing arts support activities company, unknown size, headquartered in Bratislava, profit increased significantly in the first year of the pandemic, followed by losses, sales increased significantly in the first year, were stable in the second year, and increased again in the third year.	Chief Operating Officer, male, up to 30 years, bachelor's degree.	Significant changes. In our company we are not too keen on standards and procedures, but entering a new service market has brought the introduction of exact standards and procedures due to the nature of the new service. (We'll probably keep.)
Small property management company, head- quartered in Presov HTU, profits and sales fell significantly in the first year, then stabi- lized.	Operations Manager, female, 31 to 45 years, secondary ed- ucation.	Significant changes. Introduction of new rules and standards for working in the tourism industry. (We probably won't keep.)

Microenterprise in the field of machining, headquartered in Banská Bystrica HUT, profits grew during the pandemic, sales declined in the first year and then grew and stabilized.

Managing director, Small changes. Due to the mandatory quarantered in the field of machining, headquartered in Banská Bystrica HUT, profitemale, up to 30 tine, we had to slightly change the production process depending on who could work, but only sometimes. (We certainly won't keep.)

For the management function of organizing, there was another interesting question in the first questionnaire, namely, "How likely are you to keep these changes in organizing even after the pandemic has fully receded?". Out of a total sample of 425 companies, 127 respondents (29,88%) will definitely not keep the changes, 72 (16,94%) will probably not keep the changes, 110 (25,88%) will probably keep the changes, and 116 managers (27,29%) will definitely keep the changes in organizing.

As noted above, in the second questionnaire we asked, to a lesser extent, about specific changes that managers have had to make in their organizational function, but we did ask about specific changes that were most frequently mentioned in the first questionnaire. In what follows, therefore, we take a closer look at the results for each question. All respondents' responses were measured on a scale from no change, to little change, to major change, to significant change, and then coded 1-4. The middle of the scale was intentionally omitted to ensure that respondents chose at least one side of the answers.

The first change in the organizational function involved online meetings and minimizing face-to-face contact. The mean reached 2.57, indicating that the respondents tended to answer "major changes", the median reached 3, and so did the value of the mode. In the discussion section, we will zoom in on the results according to the characteristics of the research sample.

The second question asked respondents to what extent they had to deal with organizing representation or developing guidelines for representation/competence. The mean response was a near-perfect "little change" (2.02), with both the median and mode of the responses being 2.

The third question focused on the perceived change in the pandemic, especially for office workers, which of course includes managers. It asked about the degree of change in the transition to remote working (teleworking, working from home). Despite the given expectations, the results show an average response of 2.44, i.e., rather "little changes", which is also the median (2). However, the value of the mode that appears relatively most often in the set of answers was already at the value of "major changes" (3).

The fourth question went right to the heart of the organizing function. It asked about the adjustment of the organizational structure due to the impact of the pandemic. However, according to the responses, there was the least change in the Organizing category, as the mean and median were 1.71 and 2, respectively, but the mode was 1 (no change).

The penultimate question asked managers whether they needed to change the way they and their subordinates worked. Again, respondents tended to report more little changes, with the mean of the responses at 2.13 and both the median and mode at 2.

The very last question, which specifically addressed the management function of organizing, asked whether there was an emphasis on greater formalization as a result of the pandemic, i.e., specific standards, policies, or instructions. Interestingly, despite the very strict rules that were necessary at the beginning of the pandemic, managers reported that they left small changes in place. The mean of the responses was 1.86 and both the median and mode were 2.

4. Discussion and conclusion

In management theory, organizing is the second function in the management sequence, after planning and before the other functions of staffing, leading, and controlling. Although many aspects of organizing overlap with other functions, it is inherently irreplaceable. This is evidenced not only by the fact that the function has managed to survive more than a century since its introduction, but also by the fact that it has more or less absorbed the other function originally proposed, that of coordination.

Changes in management theory were most often the result of changes in society, and so among the major events that influenced organizing we can certainly include the Industrial Revolution, and of course not only the first, but all the others that followed. The world wars have also had a great influence, and their lessons have been applied to the life of organizations. World economic crises have shaken the established practices of organizations, and the advent of the computer, or even globalization,

¹ higher territorial unit

internationalization, and interdependence at the end of the second millennium have also contributed to their influence. While the Internet seemed to be a major trend at the beginning of the third millennium, it was the global pandemic of Covid-19 that was to greatly accelerate the various processes of change and may have had a more significant impact on society, the management of organizations and, within it, the functions of organizations.

As our 2022 research shows, 82 managers have made major or significant changes in their organizing function. The question, then, should be whether this is a high or low number for a sample of 425 companies. The logical answer is low, but the limitations of the research question (managers' feelings rather than hard facts) may suggest a different answer. Another possibility is the temporary nature of the actions that managers may have perceived. While organization was very important in the acute phase of the Covid-19 crisis, the changes made to it may have been reversed or mitigated by subsequent phases of the crisis. It is interesting to note that the highest proportion of major and significant changes was reported by medium-sized companies (27.69% of the sample of medium-sized companies). Regarding the retention of changes resulting from the Covid-19 pandemic, even 62.16% of the small enterprises surveyed will probably and definitely retain the changes, and only 29.23% of the medium enterprises.

From an overall perspective, the interesting results are the extent to which managers have made changes in their organizing function for the six most frequently cited changes from 2022 when responding to the questionnaire in 2023. In fact, the answer to this question can give us a closer look at the sustainability of these changes. As mentioned in the results section, online meetings and minimizing face-to-face contact scored higher on the four-point scale of "major changes," meaning the change is more likely to be sustainable. The larger the organization, the higher the response rate, which was as high as 73.26% for large organizations. Therefore, we expect that online meetings are here to stay and will become a normal part of work for many organizations, but especially larger ones.

Organizing for representativeness, the representation/competency policy, was more likely to show up as unpromising in the results, with the mean, median, and mode all at the "small change" level of the scale. While there is nothing wrong with having different people who can do the same job, such a decision can ultimately be very inefficient. In addition, it is not the norm for employees to be absent from their workstations, as they were during lockdowns or sick leave. Therefore, we expect that although organizations will learn from the pandemic situation and even have contingency plans in place for such situations, organizing substitutes and creating such policies will not become the norm. Major and significant changes were observed in 91 respondents. Again, we observed an increasing frequency of such responses according to the size of the organization, except that medium-sized organizations had a slightly higher proportion of responses than large organizations (32.91%/31.40%).

The shift to remote work (telecommuting, working from home) had the second largest change in tilt after the first question, with a mean response of 2.44, median of 2, and mode of 3. Again, it seems logical that organizations have discovered the benefits of remote work. While managers have been largely skeptical in past decades, forced remote work has shown more than a few the possibility of trusting their subordinates, so we expect that many organizations are and will continue to move toward hybrid work models. "Major or significant change" was selected by 192 respondents. This question also confirms the rule that the larger the company, the more likely the change is to be sustainable, although the proportion of responses indicating major and significant change was little different for small and medium-sized organizations (50.00% and 51.90%, respectively).

The adjustment of the organizational structure represents a significant change in the functioning of the company, as it is usually long-term. The results of the second questionnaire survey show an average value of 1.71, which with a median of 2 tends towards small changes, but the mode was 1, i.e., no change. Although the onset of the pandemic was a major change for organizations, it was not enough to have a major impact on organizational structures. Only 61 of the 349 companies surveyed had experienced major or significant changes in this area. As the size of the organization increased, the proportion of responses in favor of change also increased, reaching 22.09% for all large organizations.

Major or significant changes in work practices due to the pandemic were reported by 109 respondents. The mean score of 2.13 was in favor of the changes, with both the mode and median scores of 2. Changes that managers had to make in the work organization of themselves or their subordinates could prove to be appropriate, leading to a good experience and consequently to the maintenance of the

change. The highest response rate was obtained in small companies (37.78%), while medium and large organizations had similar proportions (32.91%/32.56%) to their total population (79/86 organizations).

Greater formalization in the form of the introduction and modification of standards, guidelines or instructions was seen in only 17 companies. Although it was crucial at the beginning of the pandemic, it gradually disappeared as society relaxed its rules. Similarly, organizations understood that they could achieve worse results through formalization. With a mean of 1.86 and a median and mode of 2, the survey results tend to show little change and less potential for persistence and sustainability as a change. It is interesting to note that even with this question, organizations other than large organizations proved to be more susceptible to change. With a 29.11% share, the largest or most significant changes were mostly in mid-sized organizations, while large organizations had a 22.09% share.

Overall, we can conclude that organizing as a management function has undergone certain changes due to the impact of the Covid-19 pandemic. Immediately after the outbreak of the pandemic, companies had to quickly adapt to the new conditions if they wanted to survive or continue their operations. Therefore, they looked for and gradually found ways to organize a business or work under difficult conditions. The answers to the first questionnaire show that up to 167 managers from the sample of 425 did not make any changes, but on the other hand 258 managers noticed the changes. Among the specific responses, six categories emerged as the most common, which were then used in the second questionnaire to verify whether the changes were permanent. The results show that changes such as online meetings and the reduction of face-to-face contact, as well as the transition to a hybrid form of work in which employees can work from home for a certain amount of time, are more likely to be permanent. To a lesser extent, possible changes in organizational structures, greater formalization in "peaceful" times, or changes in work procedures will persist. Overall, we can expect to see further major shifts in any management function after the next major crisis, and the sustainability of these changes as they are verified over time.

Funding: This research was funded by Scientific Grant Agency VEGA of the Ministry of Education, Science, Research and Sport of the Slovak Republic, grant number 1/0328/21 and Cultural and Educational Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic, grant number 1/0623/22.

References

- 1. Almaz, F. (2022). A new way of doing business during the COVID-19 pandemic. *Management-Journal of Contemporary Management Issues*, 27(1), 337–359. https://doi.org/10.30924/mjcmi.27.1.19
- 2. Almeida, F., Duarte Santos, J., & Augusto Monteiro, J. (2020). The challenges and opportunities in the digitalization of companies in a post-covid-19 world. *IEEE Engineering Management Review*, 48(3), 97–103. https://doi.org/10.1109/emr.2020.3013206
- 3. Ambrozy, M. (2022). Some economic and ethical aspects of the COVID-19 pandemic. *Acta Academiae Beregsasiensis*. *Economics*, 1(1), 93–100. https://doi.org/10.58423/2786-6742/2022-1-93-100
- 4. Barrero, J. M., Bloom, N., & Davish, S. J. (2023, July). *The evolution of working from home wfhresearch.com*. WFH Research. https://wfhresearch.com/wp-content/uploads/2023/07/SIEPR1.pdf
- 5. Bateman, T., & Konopaske, R. (2022). M: Management (7th ed.). New York, McGraw Hill.
- 6. Bauer, T., Erdogan, B., & Short, J. (2019). Principles of Management (Version 4.0). Boston, FlatWorld.
- 7. Bodenhorn, H. (2020). *Business in a time of Spanish influenza* (No. w27495). National Bureau of Economic Research. https://doi.org/10.3386/w27495
- 8. BRANDlab. (2021, March 4). Pandémia Covid-19 urýchľuje digitalizáciu firiem [The Covid-19 pandemic accelerates the digitalisation of companies]. Forbes. https://www.forbes.sk/pandemia-covid-19-urychluje-digitalizaciu-firiem/
- 9. Bunderson, J. S., van der Vegt, G. S., Cantimur, Y., & Rink, F. (2016). Different views of hierarchy and why they matter: Hierarchy as inequality or as cascading influence. *Academy of Management Journal*, 59(4), 1265–1289. https://doi.org/10.5465/amj.2014.0601
- 10. Chandan, J. S. (2019). Principles of Management (WBUT) (2nd ed.). Vikas Publishing.
- 11. Duncan, R. (1979). What is the right organization structure? decision tree analysis provides the answer. *Organizational Dynamics*, 7(3), 59–80. https://doi.org/10.1016/0090-2616(79)90027-5
- 12. Eurofound. (2020, June 24). *Covid-19: Policy responses across Europe*. https://www.eurofound.europa.eu/publications/report/2020/covid-19-policy-responses-across-europe
- 13. Fayol, H. (1917). Administration industrielle et générale. Dunod et Pinat.
- 14. Galan, J. I., & Sanchez-Bueno, M. J. (2009). The continuing validity of the strategy-structure nexus: New findings, 1993-2003. *Strategic Management Journal*, 30(11), 1234–1243. https://doi.org/10.1002/smj.782

- 15. Hill, C. W., Hitt, M. A., & Hoskisson, R. E. (1992). Cooperative versus competitive structures in related and unrelated diversified firms. *Organization Science*, *3*(4), 501–521. https://doi.org/10.1287/orsc.3.4.501
- 16. Jankelová, N., Joniaková, Z., Blštáková, J., Procházková, K., Skorková, Z., & Abuladze, L. (2021). How companies overcome crisis through the sharing of information and teamwork performance during the COVID-19 pandemic. *Entrepreneurship and Sustainability Issues*, 8(4), 757–772. https://doi.org/10.9770/jesi.2021.8.4(47)
- 17. Jonas, A. (2021, April 7). *The five functions of Fayol's management*. Business Value-Oriented Principles. https://bvop.org/journal/five-functions-fayol-management/
- 18. Jones Lang LaSalle/JLL. (2020, April 20). *Tenant needs in a post-pandemic world:* 2020 *Forecast Series*. Tenant needs in a post-pandemic world | 2020 Forecast Series. https://www.us.jll.com/en/trends-and-insights/research/2020-first-look-navigating-post-COVID-19
- 19. Jones, G. R., & George, J. M. (2022). Contemporary Management (12th ed.). New York, McGraw-Hill.
- 20. Kinicki, A., & Soignet, D. B. (2022). Management: A practical introduction (10th ed.). New York, McGraw-Hill.
- 21. Kordošová, M. (2021). Domácka práca, telepráca a "home office": výzvy a možnosti. [Homeworking, teleworking and "home office": challenges and opportunities.]. https://ivpr.gov.sk/wp-content/up-loads/2021/12/bulletin_ivpr_11_2021.pdf
- 22. Leonardi, P. M. (2020). Covid-19 and the new technologies of organizing: Digital Exhaust, digital footprints, and artificial intelligence in the wake of remote work. *Journal of Management Studies*, 58(1), 249–253. https://doi.org/10.1111/joms.12648
- 23. Malhotra, N., & Morris, T. (2009). Heterogeneity in professional service firms. *Journal of Management Studies*, 46(6), 895–922. https://doi.org/10.1111/j.1467-6486.2009.00826.x
- 24. Mintzberg, H., & Van der Heyden, L. (1999). Organigraphs: Drawing how companies really work. *Harvard business review*, 77(5), 87-95.
- 25. Morand, D. A. (1995). The role of behavioral formality and informality in the enactment of bureaucratic versus Organic Organizations. *Academy of Management Review*, 20(4), 831–872. https://doi.org/10.5465/amr.1995.9512280023
- 26. Mullins, L. J. (2016). Management & Organisational Behaviour (11th ed.). Harlow, Pearson Education Limited.
- 27. Neck, C. P., Lattimer, C. L., & Houghton, J. D. (2013). Management. Hoboken, John Wiley & Sons.
- 28. Nieuwenhuizen, C., Rossouw, D., & Badenhorst, J. A. (2012). *Business management: A contemporary approach*. Cape Town, Juta Academic.
- 29. Parker, L. D. (2020). The COVID-19 office in transition: Cost, efficiency and the Social Responsibility Business Case. *Accounting, Auditing & Samp; Accountability Journal*, 33(8), 1943–1967. https://doi.org/10.1108/aaaj-06-2020-4609
- 30. Pažitný, P., Kandilaki, D., Loeffler, Ľ., & Zajac, R. (2022, December 12). *Nadúmrtnosť na COVID-19 v kontexte rozhodnutí zdravotnej politiky (roky 2020 2022) [COVID-19 excess mortality in the context of health policy decisions* (2020-2022)]. Pažitný & Kandilaki Healthcareconsulting.sk. https://healthcareconsulting.sk/sites/default/files/2022 12 15 ppt nadumrtnost 1.pdf
- 31. Ramasamy, T. (2010). Principles of Management (2nd ed.). Mumbai, Global Media.
- 32. Rao, P. S., & Pande, H. S. (2009). Principles and practice of Management. Mumbai, Himalaya Pub. House.
- 33. Robbins, S., Coulter, M., & Randel, A. (2021). Management: Global edition (15th ed.). Harlow, Pearson.
- 34. Schermerhorn, J. R., & Bachrach, D. G. (2020). Management (14th ed.). Hoboken, John Wiley & Sons.
- 35. Sine, W. D., Mitsuhashi, H., & Kirsch, D. A. (2006). Revisiting burns and stalker: Formal structure and new venture performance in emerging economic sectors. *Academy of Management Journal*, 49(1), 121–132. https://doi.org/10.5465/amj.2006.20785590
- 36. van Fenema, P. C., & Romme, A. G. (2020). Latent organizing for responding to emergencies: Foundations for Research. *Journal of Organization Design*, *9*(1), 1–16. https://doi.org/10.1186/s41469-020-00074-z
- 37. Wade, L. (2020, May 14). From black death to fatal flu, past pandemics show why people on the margins suffer most. Science. https://www.science.org/content/article/black-death-fatal-flu-past-pandemics-show-why-people-margins-suffer-most. https://doi.org/10.1126/science.abc7832
- 38. Worobey, M., Han, G.-Z., & Rambaut, A. (2014). Genesis and pathogenesis of the 1918 pandemic H1N1 influenza A virus. *Proceedings of the National Academy of Sciences*, 111(22), 8107–8112. https://doi.org/10.1073/pnas.1324197111

Sustainability of innovative enterprises in Slovakia

Ivana Mišúnová Hudáková 1, Jozef Kovács 2,*

- doc. Ing. Ivana Mišúnová Hudáková, PhD. (Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovak Republic); ivana.misunova@euba.sk
- ² Ing. Jozef Kovács (Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovak Republic); jozef.kovacs@euba.sk
- * Correspondence: ivana.misunova@euba.sk;

Abstract: Innovation in a complex and changing business environment is increasingly gaining importance and is becoming an important factor determining the success of business activities. Innovative enterprises are striving to create new markets for innovative products and services. The implementation of effective business strategies influences their sustainability in an era of turbulence and complexity. Innovation and sustainability are key aspects that create synergies and influence the development and success of businesses in today's world. Particularly in the current dynamic era, their need to innovate is becoming more and more urgent, as the current pan-demand has highlighted. Businesses have been forced to react quickly and flexibly to the changing environment to which they have been exposed. The aforementioned need to introduce innovation in Slovak enterprises is inevitable. The aim of this paper is to highlight the sustainability of innovative enterprises and their sustainability in the long term. In order for enterprises to sell, the need to introduce innovations in Slovak enterprises from the perspective of adaptation is just necessary. Enterprises in a complex business environment, which is characterized by a high degree of openness, are directly forced to innovate, not only from the perspective of competitiveness, but also for their existence.

Keywords: innovation; sustainability; business strategy

Introduction

"Innovation in the era of globalisation and digitalization is becoming an increasingly important factor in determining the success of business activities. They provide businesses with higher growth, increase efficiency, competitiveness and enable businesses to create new markets. The Europe 2020 strategy sees innovation as a driver of our future growth. Particularly in the current dynamic period, the need for innovation is even greater, as highlighted by the current pandemic, during which businesses have been forced to react quickly and flexibly to changes in the market. The need to innovate is inevitable for Slovak SMEs in terms of adaptation. According to the European Commission's assessment, skills and innovation are one of the areas where Slovak SMEs lag furthest behind" (SBA, 2020). Their economic prosperity is a dynamic process and requires a dynamic solution.

1. Theoretical background

As a strategic issue, innovation in the firm represents an important source of competitiveness and its essence is based on the creation, adoption and implementation of new ideas, processes, products or services (Baregheh, Rowley & Sambrook, 2009). They contribute to the efficiency of overall work, reduce costs in the enterprise or save money and provide enterprises with higher growth, increase efficiency, increase competitiveness and enable enterprises to create new markets. Despite these unquestionable aspects, Slovakia has long been among the below-average EU countries in terms of innovation adoption (Adamcová, 2020).

To be sustainable in the long term and to ensure success in the marketplace in the face of complexity and turbulence, innovative businesses need to evolve continuously. They need to clearly define their uniqueness and sustainable competitive advantage, which becomes the core of business strategy. Improving business performance requires successful innovation and invention, which represents an idea, an invention, a new technical solution, a tangible output of scientific research, but only some inventions become innovations (Csank, Jovanovič & Vozáb, 2016).

The innovation process is underpinned by recent trends such as "the role of global value chains, the emergence of new information technologies and their impact on new business models, the growing importance of knowledge capital, and advances in understanding innovation processes and their impact on the economy" (OECD, 2018).

Examples include successful start-ups, scaleups, SMEs that are constantly innovating, and new technologies-based firms (NTBFs). NTBFs are highly innovative and technology-dominated businesses. Innovative enterprises take on an important macro-economic role, are agents of socio-economic progress, contribute to sustainable economic growth, are creators of skilled jobs, and develop the market by establishing new industries. Even enterprises with a regular stream of small innovations are value creators of the national economy.

Innovative companies in the past period of the Oslo Manual used four types of innovation – product, process, organization and marketing innovation. In the current period, the Oslo Manual distinguishes two types of innovation – product innovation and business process innovation. It defines innovation as "a new or improved product or process (or combination thereof) that is significantly different from previous products or processes and has been made available to potential users (product innovation) or has been put into use by an entity (process innovation). A unit is defined as anything that develops innovations – sub-enterprises, households or associations" (OECD, 2018).

In addition to product and process innovation, marketing and organizational innovation is defined as "the implementation of a new marketing method involving significant changes in product design or packaging, product positioning, product promotion or product pricing." (OECD/Eurostat, 2005). Organizational innovation is "the implementation of a new way of organizing a firm's business practices, workplace organization or external relations. It aims at changes in the workplace to increase productivity but also to increase job satisfaction, reduce administrative or transaction costs" (OECD/Eurostat, 2005). Organizational innovation in an enterprise includes "new business practices (new ways of supply chain management, quality management), new methods of organizing human resources (training, centralization, decentralization), and new methods of organizing external relations with sub-enterprises and other institutions" (ČSÚ, 2016).

Design is also coming to the fore, playing a key role in the development and implementation of innovations. Although a definition of design has not yet been established, according to the 'Frascati Manual', design can be described as "a post-intentional, multifaceted innovation activity focused on planning and design processes, technical specifications, and other user and functional characteristics for new products and processes" (OECD Publishing, 2015).

In Eurostat, eco-innovation is also defined. It is "any form of innovation aimed at significant and demonstrable progress towards the Sustainable Development Goal. This can be achieved either by reducing environmental impact or by achieving a more efficient and responsible use of resources" (European Commission, 2022).

In recent years, according to the SBA, according to various surveys, there has been "a downward trend in the share of innovating SMEs in the total number of SMEs, indicating that the interest in innovation among Slovak SMEs is not growing, but despite this, more than 94% of entrepreneurs consider it necessary to innovate, while at the same time more than half of innovating enterprises (53.8%) reported that they innovate regularly" (OECD Publishing, 2015). "However, innovation processes in enterprises do not need to be managed in isolation, as external partnerships also play an important role and can be beneficial" (Dahlander & Gann, 2010; Love, Roper & Vahter, 2013; Bouncken, Fredrich & Gudergan, 2022; Hutter, Gfrerer & Lindner, 2020).

Innovative enterprises should be guided by a "sustainable business strategy", which is the overarching, overarching strategy of the enterprise. This strategy is based on the principles of the concept of sustainable development. The corporate social responsibility strategy should be seen as an integral part of the company's strategy, i.e. the sustainable development strategy. The sustainable development strategy is followed by sustainable business unit strategies and then sustainable functional strategies" (Hrdinová, Drieniková, Naňo, Sakál, 2011).

"A key characteristic of strategy is the provision of surplus value over normal behavior" (Zimmermann & Arndt, 2011) and dealing with the problem of how a business will compete in its business or in one of its market segments. The purpose of business strategy is to gain a competitive advantage over rivals (Slávik, 2013).

However, sustainability requires a drastic rethinking and renewal of existing activities, competencies, corporate culture and stakeholder relationships (Bertassini, Ometto, Severengiz & Gerolamo, 2021; Gandolfo, & Lupi, 2021; Hofmann & Jaeger-Erben, 2020; Kaipainen, Aarikka-Stenroos & Ranta, 2020).

Becoming sustainable involves a continuous process of organizational innovation and cross-cutting development (Fowler & Hope, 2007) that is aligned with the economic, environmental and social needs of current and future generations. The prerequisites for business sustainability and the journey from idea through overcoming vulnerabilities to success is dependent on a well-chosen business strategy. The concept of strategy often emphasizes "how an entrepreneur seeks to achieve a goal and therefore uses a process approach to strategy (Austin and Vancouver, 1996; Dess, Lumpkin and Covin, 1997; Hart, 1992; Olson and Bokor, 1995; Rajagopolan et al., 1993)" (Von Gelderen, Frese & Thurik, 2000).

The fact is that strategic development for sustainability is a complex process and fundamentally changes the way established businesses do business. (Adamcová, 2020; Hrdinová, Drieniková, Naňo, & Sakál, 2011; Zimmermann & Arndt, 2011). This is a strategic development called "strategic renewal" (Agarwal & Helfat, 2009).

Sustainability and circularity change the business logic of established enterprises and require these enterprises to reshape existing business models (Frishammar & Parida, 2019; Gandolfo & Lupi, 2021; Ranta, Keränen & Aarikka-Stenroos, 2020; Rovanto & Bask, 2020).

The trend is towards innovative enterprises that can reach the elite at record speed and build a strong competitive advantage, but also "a temporarily created organization, a cluster, used to find a repeatable and scalable business model" (Bryan, 2015) is a prerequisite for a viable and sustainable innovative enterprise. Some authors state that "from the perspective of innovations, the collaboration of large enterprises with start-ups makes them more productive" (Bryan, 2015).

It is clear from many research studies that the development of a sustainability strategy is a key practice in successfully updating established business models (Santa-Maria, Vermeulen & Baumgartner, 2021). Business model innovation can include new ways for a company to create value and new fixed offerings (e.g., product or service innovation), new ways for customers to view the firm's offerings (position innovation), changes in how the firm evaluates its activities (paradigm innovation), and operations (process innovation). Thus, "an innovated business model is a new integrated logic of value creation and capture that may involve a new combination of new and old products or services, market position, processes, and other types of changes" (Frankenberger, Weiblen, Csik & Gassmann, 2013).

Much research has not considered how incumbents should renew (innovate) their business strategies to promote sustainability. It is about renewing business strategies to support sustainability in line with their changing business models.

"Businesses often seek to innovate their processes, products and services in order to achieve revenue growth or to maintain or improve profit margins. Innovation of business processes, products and services is mostly expensive and time consuming. They require significant initial investment in research and development, the purchase of specialized resources, the construction of new plants and equipment or the creation of new business units. However, the return on such investments is uncertain. For this reason, more and more enterprises are looking at innovation of their business model as a lower cost, lower risk alternative or as a complement to process, product and service innovation. The ability to frequently and successfully innovate the business model can help a firm to increase its resilience to changes in the external environment and represents a sustainable competitive advantage" (Mitchell & Coles, 2003). An innovative and sustainable business model refers to how an enterprise creates, delivers, and captures value because "enterprises are human-made institutions designed to create a new product or service under extremely uncertain conditions," (Ries, 2015) which must also respond to a global environment now marked by either pandemic or invasion. Given these facts, "innovation is the key to solving or resolving social and environmental problems, firms are increasingly following the development of sustainable innovations to create shared social and business value" (Du, Bstieler & Yalcinkaya, 2022).

Innovation achieves "long-term growth and success of a business in a changing business pro-center" (Day & Schoemaker, 2016). Therefore, innovative "businesses will need to develop new conceptions of strategy" (Hart, 1995) and ensure their sustainability (ADngelo & Magnusson, 2021; Denicolai, Zucchella & Magnani, 2021). Strategic sustainability has gained importance and has become a key issue in business strategies (Engert, Rauter & Baumgartner, 2016; Martin & Rice, 2010).

Therefore, it is important to examine the strategic renewal process of incumbent businesses aimed at achieving strategic sustainability. Emerging innovative enterprises can achieve strategic sustainability through "key success factors" (Saura, Palos-Sanchez & Grilo, 2019; Ceauşu, Marquardt, Irmer & Gotesman, 2017), which are prerequisites for a sustainable enterprise (Ghezzi, 2020; Shepherd & Gruber, 2020; Bortolini, Nogueira Cortimiglia, Danilevicz & Ghezzi, 2018; Schwaninger & Scheef, 2016), "are viable and sustainable in the long term" (Etim, 2020).

Some scholars explain that "the impact of innovation moves the firm forward, and in this logic, they openly talk about the positive impacts of innovation strategies that pose specific challenges for the firm" (Dahlander, O'Mahony & Gann, 2014).

To be successful and strategically sustainable, businesses need to have a good business model, a well-chosen business strategy and to continuously innovate processes. "The process of integrating sustainability into business strategy varies from company to company, it is particularly challenging in established companies that are trying to renew their business models in order to achieve sustainability and circularity" (Frishammar & Parida, 2019; Rovanto & Bask, 2020; Kaipainen, Aarik-ka-Stenroos & Ranta, 2020).

Renewal for sustainability has been found to require incumbents to redesign their business model and value creation (Hofmann & Jaeger-Erben, 2020; Ranta, Keränen, & Aarik-ka-Stenroos, 2020), business and core activities (Albino, Balice & Dangelico, 2009; Shrivastava, & Scott, 1992) as well as stakeholder relationships, networks, and entrepreneurial ecosystems (Aarik-ka-Stenroos, Ritala, & Thomas, 2021; Kaipainen, Aarikka-Stenroos, & Ranta, 2020).

However, due to the difficulty and gradual implementation of strategic renewal, incumbents are often criticized for acting slowly or for deliberately hindering the diffusion of sustainable innovations in order to maintain their strategic position (Smink, Hekkert & Negro, 2015).

We note that innovative enterprises are creators of new ideas, concepts and more effective ways of bringing success, whether in finding an innovative product/service or in a cluster of smaller innovations that create value for the enterprise. Enterprises in a complex business environment, characterized by a high degree of openness, are forced to innovate, not only from a competitive perspective but also for their very existence.

2. Methods and methodology

In the present paper we have used a qualitative approach. The paper was developed on the basis of theoretical knowledge through gathering information on innovative enterprises. It aims at an indepth understanding of the complex and contextual aspects of the topic focusing on innovative enterprises and their sustainability. This approach is often used to explore issues that are difficult to measure with quantitative methods and emphasizes qualitative characteristics such as beliefs, attitudes, values, opinions and perceptions of renowned authors on the research topic.

By studying the available literature on the subject, we have gained new knowledge and insight in the area under study. By using literature analysis (literature search), which consists mainly of the study of the literature of experts in the field of research, we discuss and draw conclusions that should be beneficial for innovative enterprises in Slovakia.

This involves the use of cutting-edge book publications from a variety of authors who are dedicated to innovation in enterprises and publish their findings in journals in indexed databases such as Web of Science, Scopus and Ebsco. We also draw on surveys and various studies that have inspired our research in this area to explore knowledge about innovative enterprises, innovative business strategies and innovative business models. The research results and discussion are the output of the VEGA project 1/0006/22 "Accelerating the Growth of Innovative Enterprises – Scaling Scale-ups and New Technology Based Businesses (NTBFs)".

3. Results

As innovative businesses play an important role in creating new opportunities and sustained economic growth, their ability to innovate and respond to new challenges puts them at the heart of the modern business world.

Such innovative enterprises, not only on the domestic market but also on the foreign market, which are an important part of the economy, are able to adapt to rapidly changing conditions in the business environment. They often bring new solutions, technologies and products to the market. Innovation is the driving force behind success. Innovative companies in Slovakia and abroad realize that continuous innovation is the key to success. They invest in research and development to create new products or improve existing ones.

From the researched findings, we conclude that innovative enterprises operate in various sectors in which innovation is visible in many aspects (new technologies and technological processes, innovations in healthcare, innovations in the energy sector, etc.). To innovate does not only mean to develop innovations, but also the support of the state and various institutions that support the emergence and development of innovative enterprises is needed, as this requires financial support.

At the same time, cooperation with research centers or universities should be highlighted so that they can combine their know-how and resources with scientific knowledge and their expertise. This synergy contributes to the creation of new innovative solutions that can have a positive impact on businesses and the economy as a whole. It is universities or research centers that create the innovation space in which new ideas are often born, where quality scientific research takes place in qualitative and quantitative terms through talent.

It is a priority for innovative companies to have access to such knowledge, enabling them to develop new technologies and solutions. Cooperation in finding talented people in universities or researchers is a priority for their scientific expertise, growth and competitiveness. Mutual cooperation can accelerate the process of commercialization of various scientific innovative knowledge and technologies, also leading to the creation of an innovation environment.

The trend for innovative businesses is to emphasize their sustainability, and they are becoming more agile with the advent of digital transformation. They are able to respond quickly to the changing business environment in an era of complexity and turbulence. In particular, they are quick to react to technological change and seize new opportunities in the business environment. Many innovative enterprises place a high value on sustainability. Innovative green products and eco-friendly solutions are coming to the fore. With the rise of digital automation, many enterprises are introducing technological innovations that can respond quickly to technological changes in the business environment and exploit technological solutions and innovations. They are also seizing new opportunities in a complex business environment and are able to react quickly to change and seize new opportunities.

The European Commission's Science, Research and Innovation Performance (SRIP) Report 2022, which analyses the EU's innovation performance in a global context, also shows "that research and innovation are the source of 8% of productivity growth across the EU. In the global environment, Europe remains a strong player in terms of scientific and technological output. Although it represents only 6% of the world's population, it accounts for around 18% of global R&D investment and 21% of the world's most cited scientific publications. In terms of technological output, the EU is the world leader in the climate field with 23% of all patent applications. On the positive side, almost 13% of raw materials used in the EU came from re-cycled waste material. The EU is also making significant contributions in other areas such as bio-ecosustainability (23%) and health (17%). However, this position is weakening as the EU's main trading partners have improved their innovation performance more rapidly in recent years.

R&D investment in the EU fell during the crisis, with significant differences between sectors. The EU's largest R&D investors in healthcare and information technology services increased their R&D investment between 2019 and 2020 (10.3% and 7.2% respectively), but the EU's largest R&D investors in other sectors decreased their R&D investment during the crisis, for example in the information technology provision (-3.6%), chemicals (-3.7%), automotive (-7.2%) and aerospace (-22.6%) sectors.

European funding accounted for only 4.4% of total public spending on science and research in the Slovak Republic, putting us in one of the last positions in the EU.

Declining business dynamics in the EU will have an impact on innovation and economic growth. The report argues that improving the EU's business environment and innovation capacity requires a renewed vigor to tackle long-standing problems such as gaps in access to finance, regulatory frameworks that resist innovation, persistent gaps between high performing and lagging businesses, and difficulties in attracting and retaining talent."

In innovative companies, managers are placed under high demands and are forced to think together with other employees about how to innovate processes to make them sustainable on a regional to local level, to create an innovation system to increase the skills of start-up entrepreneurs in the areas of no-new technologies, innovative products, services, processes or social innovation. Innovation is a priority for every business, affecting their future, whether from the perspective of owners or employees. Every enterprise has a certain potential of innovation capacity, which can be achieved by a coherent package of strategies, creative employees and many innovation projects, innovative ways of inspiration, trainings, but also by supporting start-ups in their region.

Exploring the reasons for the low proportion of innovating businesses according to the SBA in May-June 2020, it emerged that entrepreneurs considered lack of finance (71.5%), lack of adequate government/EU support (38.2%) and lack of skilled labor (25.7%) as the biggest barriers to innovation uptake. In the context of the COVID-19 pandemic, up to 50.0% of respondents stated that they had to cancel or postpone planned innovation activities (Adamcová, 2020).

Current studies identify sustainable competitive advantage as a major option for business growth and viability. Sustainable competitive advantage is an important concept in the field of management and business. It means the ability of a business to achieve long-term success in the market and outperform its competitors.

Based on the information gathered in the research on innovative enterprises, we can conclude that five factors from the business environment are important in their emergence and sustainability through competitive advantage. We emphasize the most important factors:

- Innovation these are the ones that are able to innovate; they are the key factor for creating a
 sustainable competitive advantage; enterprises exposed to a turbulent business environment are
 able to continuously develop new products, processes or services and thus tend to be more successful in the market.
- 2. Investment not only in terms of process streamlining and improvement, but also in terms of modernization, technology and human resource development, which becomes a strong manifestation of the competitive advantages of innovative enterprises; it improves the efficiency and quality of production; innovative enterprises offer lower prices for their products and services compared to their competitors.
- 3. Human resources only highly qualified and motivated employees are an invaluable source of competitive advantage; enterprises that take care of their employees and invest in their development tend to achieve better results; the human resources factor influences the prosperity of the enterprise.
- 4. Natural resources in some industries, natural resources have a major impact on competitive advantage; their efficient use can help businesses achieve a sustainable competitive advantage.
- 5. Financial resources financial stability and the availability of financial resources contribute to the creation of a firm's competitive advantage; firms with easier access to finance often have greater flexibility to invest and grow, which is also evident in their growth strategies.

The factors influencing the creation and emergence of competitive advantages of innovative enterprises are not a static state, but must be maintained and should continue to evolve over time.

Slovak enterprises often innovate on their own and are aware of the importance of innovation, with external influences being their main stimulus. However, innovation is very risky and very costly, and its outcome is uncertain. For this reason, the sustainable development of innovative enterprises requires a steady flow and overproduction of creative ideas (invention and innovation).

Favorable results are conditioned by quality ideas/inventions, quality implementation of invention-innovation, quality commercialization of innovation, quality repetition of the whole process at an ever-higher level, where the process ascends in a spiral. In spite of these facts, the whole process or its result, in spite of all possible efforts and the highest quality, is never absolutely perfect or world original and therefore it has to be constantly examined.

In order for companies to move forward, this issue with its emphasis on the strategic sustainability of innovative companies is, in our opinion, a research gap that needs to be explored further and we would like to address this topical issue in more detail in the next period focused on the creation, development and maintenance of innovative companies.

4. Discussion

In today's business environment, which is complex and changing, innovative businesses have an irreplaceable place, perspective and future. Innovation is one of the main driving forces that help businesses not only to survive and grow, but also to sustain themselves in the market in the long term. There are many reasons why innovation is a priority for any business, and these reasons overlap different aspects of business.

The first reason is to ensure competitiveness, where markets are constantly changing and increasing competition means that innovative businesses need to move forward. Innovation enables them to create and market new products, services or technologies that can provide a sustainable competitive advantage in the long term.

The second reason is that innovative enterprises, coming up with innovative business models and innovative business strategies, exploit new opportunities from the external business environment and develop markets. Innovation helps enterprises to develop long-term sustainable strategies that are combined with innovative business models. New ways in which innovative businesses can grow and evolve must constantly be sought to create a stable market place in the business environment. Innovation enables businesses to enter new markets not only in Slovakia but also abroad. Innovative businesses can discover entirely new market segments or expand into new areas, thereby increasing their revenues and growing.

A third, important reason is that customers constantly expect new products and new services. It is innovation that provides the reason to stay loyal to a brand. To make sure that customers do not prefer competing products or use competing services. Only innovation can help businesses to react quickly to changes in trends, regulations and customer preferences, it can diffuse risk in the business. Innovative businesses can better cope with unexpected events such as economic crises or market fluctuations.

The competitive advantage of innovative enterprises, not only in Slovakia but also abroad, is to attract talented people who are willing to work on the continuous development of new ideas and projects. Innovative enterprises also contribute to the sustainability of the business environment.

All these reasons show that innovation is not just a luxury, but a necessity for every enterprise. Without innovation, businesses would be at risk of stagnation and a gradual loss of market position. It is therefore important to have an innovation strategy, to invest in research and development and to foster a culture of openness to new ideas within businesses, because innovation is the key to their continued success and survival in the market in today's competitive and dynamically changing economy.

5. Conclusions

The innovation environment is created by innovative enterprises, which play an important role in today's business world, both domestically and internationally. Their ability to innovate and flexibly react to new challenges is a key factor in today's business. To be sustainable, innovative businesses need to come up with new solutions, technologies and products that contribute to sustainable economic growth, because innovation is the driving force behind their success.

It is obvious that they should invest primarily in research and development, focusing not only on new products, but also on improving existing products and services. Collaboration with research institutions and universities is an indisputable part of this, making it possible to combine know-how and resources with scientific knowledge.

The digital transformation brings a wealth of new opportunities and new modern trends for innovative businesses. Therefore, innovative enterprises must also be able to react quickly to technological change in order to be strategically sustainable.

To conclude, we note that the European Commission's report also confirms that innovation contributes to productivity growth at European level. Nevertheless, the EU's competitive position is threatened by the rapid growth in innovation performance of other global players.

Financial investment in R&D is important, but it also depends on factors such as access to finance, regulation and the availability of skilled labor.

Given these facts, we conclude that innovative companies need to maintain their innovation capacity and sustainable competitive advantage. However, investment in research and development, care for human resources, efficient use of natural resources and financial stability are essential.

From the in-depth qualitative analysis carried out on the basis of the theoretical knowledge, we clearly argue that innovative enterprises are the driving force for sustainable economic growth and competitiveness. The ability to innovate and adapt to changing business conditions is crucial for future entrepreneurship in an innovative environment.

Funding: This research was funded by VEGA 1/0006/22 "Accelerating the Growth of Innovative Enterprises – Scaling Scale-ups and New Technology Based Businesses (NTBFs)".

References

- OECD. (2018, October 22). Oslo Manual 2018 OECD. Oslo Manual Aarikka-Stenroos, L., Ritala, P., & Thomas, L. (2021). Circular economy eco-systems: A typology, definitions and implications. In S. Teerikangas(Ed.), Edgar Elgar handbook of sustainability agency. Edgar Elgar publishing. https://doi.org/10.4337/9781789906035.00024
- 2. Adamcová, E. (2020, August 19). *Slovenskí podnikatelia nestačia na európskych inovačných lídrov*. Monitoring MSP. https://monitoringmsp.sk/2020/08/19/slovenski-podnikatelia-nestacia-na-europskych-inovacnych-lidrov/
- 3. Agarwal, R., & Helfat, C. E. (2009). Strategic renewal of organizations. *Organization Science*, 20(2), 281–293. https://doi.org/10.1287/orsc.1090.0423
- 4. Albino, V., Balice, A., & Dangelico, R. M. (2009). Environmental strategies and green product development: An overview on sustainability-driven companies. *Business Strategy and the Environment*, 18(2), 83–96. https://doi.org/10.1002/bse.638
- 5. Baregheh, A., Rowley, J. & Sambrook, S. (2009). Towards a multidisciplinary definition of innovation. *Management Decision*, 47(8), 1323-1339. https://doi.org/10.1108/00251740910984578
- 6. Bertassini, A. C., Ometto, A. R., Severengiz, S., & Gerolamo, M. C. (2021). Circular economy and sustainability: The role of organizational behaviour in the transition journey. *Business Strategy and the Environment*, 30(7), 1–34. https://doi.org/10.1002/bse.2796
- 7. Bortolini, R. F., Nogueira Cortimiglia, M., Danilevicz, A. de, & Ghezzi, A. (2018). Lean startup: A comprehensive historical review. *Management Decision*, 59(8), 1765–1783. https://doi.org/10.1108/md-07-2017-0663
- 8. Bouncken, R. B., Fredrich, V., & Gudergan, S. (2022). Alliance Management and innovation under uncertainty. *Journal of Management & Samp; Organization*, 28(3), 540–563. https://doi.org/10.1017/jmo.2022.34
- 9. Bryan, G.H. (2015). What is the proper definition of a startup? [online]. Quora, 2015. [cit. 2016.11.13]. Dostupné na internete: https://www.quora.com/What-is-the-proper-definition-of-a-startup
- 10. Ceauşu, I., Marquardt, K., Irmer, S. J., & Gotesman, E. (2017, July). Factors influencing performance within startup assistance organizations. In *Proceedings of the International Conference on Business Excellence* (Vol. 11, No. 1, pp. 264-275). Sciendo.
- 11. Český statistický úřad. (2016, June 3). *Inovační aktivity Podniků v ČR Český statistický úřad.* https://www.czso.cz/documents/10180/46388845/21300316.pdf/770e47ed-5125-45b3-9bec-7d78f1629c8a?version=1.1
- 12. Csank, P., Jovanovič, P., & Vozáb, J. (2016). Inovační Kapacita ČR: Hlavní závěry ověřovacích analýz. https://inka.tacr.cz/media/publications/2016/02/23/INKA Inova%C4%8Dn%C3%AD kapacita %C4%8CR hlavn%C3%AD z%C3%A1v%C4%9Bry ov%C4%9B%C5%99ovac%C3%ADch anal%C3%BDz.pdf
- 13. Dahlander, L., & Gann, D. M. (2010). How open is innovation? *Research Policy*, 39(6), 699–709. https://doi.org/10.1016/j.respol.2010.01.013
- 14. Dahlander, L., O'Mahony, S., & Gann, D. M. (2014). One foot in, one foot out: How does individuals' external search breadth affect innovation outcomes? *Strategic Management Journal*, 37(2), 280–302. https://doi.org/10.1002/smj.2342
- 15. DAngelo, V., & Magnusson, M. (2021). A bibliometric map of intellectual communities in frugal innovation literature. *IEEE Transactions on Engineering Management*, 68(3), 653–666. https://doi.org/10.1109/tem.2020.2994043
- 16. Day, G.S. & Schoemaker, P.J.H. (2016). Adapting to fast-changing markets and technologies, *California Management Review*, 58(4), 59-77. https://doi.org/10.1525/cmr.2016.58.4.59
- 17. Denicolai, S., Zucchella, A., & Magnani, G. (2021). Internationalization, digitalization, and sustainability: Are smes ready? A survey on synergies and substituting effects among growth paths. *Technological Forecasting and Social Change*, 166, 120650. https://doi.org/10.1016/j.techfore.2021.120650
- 18. Du, S., Bstieler, L., & Yalcinkaya, G. (2022). Sustainability-focused innovation in the business-to-business context: Antecedents and managerial implications. *Journal of Business Research*, 138, 117–129. https://doi.org/10.1016/j.jbusres.2021.09.006

- 19. Engert, S., Rauter, R., & Baumgartner, R. J. (2016). Exploring the integration of corporate sustainability into strategic management: A literature review. *Journal of Cleaner Production*, 112, 2833–2850. https://doi.org/10.1016/j.jclepro.2015.08.031
- 20. Etim, E. S. (2020). The Utilization of Social Media Platforms for viability of Femaleowned Small and Medium-scale Enterprises in South Eastern Nigeria. *Acta Universitatis Danubius. Œconomica*, 16(1), 96-111.
- 21. European Commission. (2022). *Eco-Innovation*. Green Business. https://ec.europa.eu/environment/eco-innovation/faq/index_en.htm#eco-innovation-background-information
- 22. Fowler, S. J., & Hope, C. (2007). Incorporating sustainable business practices into company strategy. *Business Strategy and the Environment*, 16(1), 26–38. https://doi.org/10.1002/bse.462
- 23. Frankenberger, K., Weiblen, T., Csik, M., & Gassmann, O. (2013). The 4I-framework of business model innovation: a structured view on process phases and challenges. *International Journal of Product Development*, 18(3/4), 249. https://doi.org/10.1504/ijpd.2013.055012
- 24. Frishammar, J., & Parida, V. (2019). Circular business model transformation: A roadmap for incumbent firms. *California Management Review*, 61(2), 5–29. https://doi.org/10.1177/0008125618811926
- 25. Gandolfo, A., & Lupi, L. (2021). Circular economy, the transition of an incumbent focal firm: How to successfully reconcile environmental and economic sustainability? *Business Strategy and the Environment*, 30(7), 1–12. https://doi.org/10.1002/bse.2803
- 26. Ghezzi, A. (2020). How entrepreneurs make sense of lean startup approaches: Business models as cognitive lenses to generate fast and frugal heuristics. *Technological Forecasting and Social Change*, 161, 120324. https://doi.org/10.1016/j.techfore.2020.120324
- 27. Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of Management Review*, 20(4), 986–1014. https://doi.org/10.5465/amr. 1995.9512280033
- 28. Hofmann, F., & Jaeger-Erben, M. (2020). Organizational transition management of circular business model innovations. *Business Strategy and the Environment*, 29(6), 2770–2788. https://doi.org/10.1002/bse.2542
- 29. Hrdinová, G., Drieniková, K., Naňo, T., Sakál, P. (2011). Udržateľné SZP Integrálna súčasť stratégie udržateľného rozvoja priemyselného podniku. [online]. International Scientific Conference "In Look Days 2011", Dostupné na internete: http://www.scss.sk/cd_apvv_lpp.../Hrdinová%20a%20kol.pdf.
- 30. Hutter, K., Gfrerer, A., & Lindner, B. (2020). From popular to profitable: Incumbents' experiences and challenges with external corporate accelerators. *International Journal of Innovation Management*, 25(03), 2150035. https://doi.org/10.1142/s1363919621500353
- 31. Inovačný potenciál MSP na Slovensku. Slovak Business Agency. (2020). http://www.sbagency.sk/sites/default/files/inovacny-potencial-msp-na-slovensku.pdf; Európska komisia. (2009). Európa 2020. Stratégia na zabezpečenie inteligentného, udržateľného a inkluzívneho rastu. https://ec.europa.eu/archives/growthandjobs-2009/pdf/complet_sk.pdf
- 32. Kaipainen, J., Aarikka-Stenroos, L., & Ranta, V. (2020). Strategic renewal process towards environmental sustainability A longitudinal case. XXXI ISPIM Conference Proceedings, June 2020.
- 33. Keijzers, G. (2002). The transition to the sustainable enterprise. *Journal of Cleaner Production*, 10(4), 349–359. https://doi.org/10.1016/S0959-6526(01)00051-8
- 34. Love, J. H., Roper, S., & Vahter, P. (2013). Learning from openness: The dynamics of breadth in external innovation linkages. *Strategic Management Journal*, 35(11), 1703–1716. https://doi.org/10.1002/smj.2170
- 35. Martin, N., & Rice, J. (2010). Analysing emission intensive firms as regulatory stakeholders: A role for adaptable business strategy. *Business Strategy and the Environment*, 19(1), 64–75. https://doi.org/10.1002/bse.661
- 36. Mitchell, D., & Coles, C. (2003). The ultimate competitive advantage of continuing business model innovation. *Journal of Business Strategy*, 24(5), 15–21. https://doi.org/10.1108/02756660310504924
- 37. Národná kancelária Horizontu. (2022, July 7). *Správa o výkonnosti vedy, výskumu a inovácií* 2022. ERA Portál Slovensko. https://eraportal.sk/aktuality/bola-zverejnena-sprava-o-vykonnosti-vedy-vyskumu-a-inovacii-2022/
- 38. OECD Publishing. (2015, October 8). Frascati Manual 2015: Guidelines for collecting and reporting Data on Research and Experimental Development. https://www.oecd.org/innovation/frascati-manual-2015-9789264239012-en.htm
- 39. 2018 Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition. https://www.oecd.org/science/oslo-manual-2018-9789264304604-en.htm
- 40. OECD. (2018, October 22). *Oslo Manual 2018 OECD*. Oslo Manual 2018 Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition. https://www.oecd.org/science/oslo-manual-2018-9789264304604-en.htm
- 41. OECD/Eurostat. (2005, November 10). Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd Edition. OECD iLibrary. https://www.oecd-ilibrary.org/science-and-technology/oslo-manual 9789264013100-en
- 42. Park, I., Lee, J., Nam, J., Jo, Y., & Lee, D. (2022). Which networking strategy improves ICT start-up companies' technical efficiency? Managerial and Decision Economics. https://doi.org/10.1002/mde.3536

- 43. Ranta, V., Keränen, J., & Aarikka-Stenroos, L. (2020). How B2B suppliers articulate customer value propositions in the circular economy: Four innovation-driven value creation logics. *Industrial Marketing Management*, 87, 291–305. https://doi.org/10.1016/j.indmarman.2019.10.007
- 44. Ries, E. (2015). *LEAN STARTUP-Jak budovat úspešný byznys na základě neustálé inovace*. Bratislava: BIZBOOKS, 2015. 280 s.
- 45. Rovanto, I. K., & Bask, A. (2020). Systemic circular business model application at the company, supply chain and society levels—A view into circular economy native and adopter companies. *Business Strategy & the Environment*, 30(2), 1153–1173. https://doi.org/10.1002/bse.2677
- 46. Santa-Maria, T., Vermeulen, W. J. V., & Baumgartner, R. J. (2021). How do incumbent firms innovate their business models for the circular economy? Identifying micro-foundations of dynamic capabilities. *Business Strategy and the Environment*. https://doi.org/10.1002/bse.2956
- 47. Saura, J. R., Palos-Sanchez, P., & Grilo, A. (2019). Detecting indicators for startup business success: Sentiment analysis using text data mining. *Sustainability*, 11(3), 917. https://doi.org/10.3390/su11030917
- 48. Schwaninger, M., & Scheef, C. (2016). A test of the Viable System Model: Theoretical claim vs. empirical evidence. *Cybernetics and Systems*, 47(7), 544–569. https://doi.org/10.1080/01969722.2016.1209375
- 49. Shepherd, D. A., & Gruber, M. (2020). The Lean Startup Framework: Closing the academic–practitioner divide. *Entrepreneurship Theory and Practice*, 45(5), 967–998. https://doi.org/10.1177/1042258719899415
- 50. Shrivastava, P., & Scott, H. I. (1992). Corporate self-greenewal: Strategic responses to environmentalism. *Business Strategy and the Environment*, 1(3), 9–21. https://doi.org/10.1002/bse.3280010303
- 51. Slávik, Š. (2013). Strategický manažment. Bratislava: SPRINT 2. ISBN 987-80-89393-96-1. s. 213.
- 52. Smink, M. M., Hekkert, M. P., & Negro, S. O. (2015). Keeping sustainable innovation on a leash? Exploring incumbents' institutional strategies. *Business Strategy and the Environment*, 24(2), 86–101. https://doi.org/10.1002/bse.1808
- 53. Von Gelderen, M., Frese, M. & Thurik, R. (2000). Strategies, uncertainty and performance of small business startups. *Small Business Economics*, 15(3), 165-181.
- 54. Zimmermann, R., & Arndt, O. (2011). Das Strategiebuch 72 grundfiguren strategischen handelns für Wirtschaft, Politik, kommunikation, design, Architektur und Alltag. Campus-Verlag. p.6. ISBN 9783593393506.

IT service management as the support for digital transformation in the financial sector

Jana Filanova 1,* and Matej Cerny 2

- Department of Information Management, Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovak Republic, jana.filanova@euba.sk
- ² Department of Information Management, Faculty of Business Management, University of Economics in Bratislava, Bratislava, Slovak Republic, matej.cerny@euba.sk
- * jana.filanova@euba.sk

Abstract: Digital transformation in the financial sector is a continuous process that affects both the external and internal environment by redesigning internal processes and existing methods. The aim of this paper is to evaluate the state of IT service management (ITSM) as a support for digital transformation with an emphasis on business-IT alignment and the use of conceptual frameworks in IT operations management. The paper focuses on banks and insurance companies because they have been allocating significant resources to managing their digital transformation The research results are based on the analysis of data from a questionnaire survey among companies in Slovakia. The results of our research, in line with comparative studies, confirmed that most financial companies have assured operation of IT services. Companies that reported having an IT strategy in place also reported that their IT strategy is aligned with their business strategy. The most used standard is ISO/IEC 27001, which has seen an increasing trend due to massive digitization.

Keywords: IT Management, Digital Transformation, Financial Sector

Introduction

Industrial revolutions have brought upon the world, economic development, growth of world wealth, increase of leisure funds as well as longer life span of people. Each new revolution brings many changes that represent a potential chance for the success of those who know how to manage them, but also a threat to those who do not possess the necessary skills. From a conceptual point of view, Industry 4.0 consists of four basic principles that IT management must ensure therefore the possibilities of current technology are used in the company and the competitiveness of the company is maintained (Marr, 2016):

- interoperability integration of industrial machines, tools, and vehicles into the IoT computer framework,
- transparency of information the ability of computer systems equipped with sensors to create virtual copies of machines and objects in the real world,
- technical assistance computer machinery equipped with artificial intelligence to assist human workers in decision-making and physical work,
- decentralized decisions the ability of automated systems to act and perform tasks independently.

Industry 5.0 recognizes the power of industry to achieve societal goals beyond jobs and growth, to become a resilient provider of prosperity by making production respect the boundaries of our planet and placing the well-being of the industry worker at the center of the production process. Industry 5.0 complements the existing Industry 4.0 paradigm by having research and innovation drive the transition to a sustainable, human-centric, and resilient European industry. It is apparent that Industry 5.0 results from the European Commission's consensus on the need better to integrate social and environmental European priorities into technological innovation and shift the focus from individual technologies to a systematic approach (Xu et al., 2021).

Banks and financial companies in Slovakia have introduced and are currently introducing many technological innovations in recent years. These include mobile banking, the concept of open banking,

the use of artificial intelligence, increasing digitization of processes, new ways of authenticating clients, and new ways of communicating with clients. Ultimately, the result is not only an improvement in client experience, but also a streamlining of processes.

Digital transformation in the banking sector is a continuous process that affects both the external and internal environment by redesigning internal processes and existing methods. There are many reasons that digital transformation takes place, such as servicing remote areas without physical branches, differentiation from competitors, or reduction of operating costs (Kitsios et al., 2021).

The article presents the results of research in the field of digital technologies and IT service management (ITSM) in the financial sector in Slovakia. The scientific paper consists of several parts. Theoretical background includes analysis and comparison of literature sources, which were drawn primarily from citation and reference databases Web of Science, Scopus, EBSCO, and others. The Methods and Methodology section presents the research model, which consists of four phases. Within the methodology, three research questions were formulated. In the next part of the scientific paper, the research results are presented, and conclusions are formulated.

1. Theoretical background

For successful digital transformation, it is necessary to maximize active and systematic use of advanced online and digital technologies that form the basis of business and create an open, horizontal organizational culture and communication system to equally share and distribute advanced technologies and competencies throughout the entire organization (Kim et al. 2022).

Applying new technologies is topical for companies, especially those in the financial sector. New technologies related to the digitalization of business processes, automatization, and the use of Artificial intelligence require different competencies from managers and specialists, such as computer science, big data analysis, predictive analytics, cybersecurity, co-creation, working with virtual assistants among others (Mavlutova & Volkova, 2019). To succeed with digital transformation, companies must adapt their governance with respect to their digital maturity. They must be agile and flexible to launch the project; they should not use the big bang approach, but rather agile and test and learn approaches (Lacombe & Jarboui, 2023).

The level of organizations' dependence on information technology has increased significantly in recent decades. Digital business transformation brings business and IT alignment. It is considered the third stage of the introduction of digital technologies: (1) digital competencies, (2) digital literacy, and (3) digital transformation. All of these technologies give companies the ability to radically change business models and create new products and services. Therefore, the administration and management of enterprise IS/IT (ITSM) is very important. Enterprises realize that without the digital transformation of businesses, the degree of efficiency and optimization of operating costs would be unattainable (Töröková, 2019).

IT costs represent a growing share of the overall cost of the banking and financial sector, accounting for between 1% and 6.7% and amounting to a 3.7% average of turnover or net banking income (NBI) across all sectors. In this way, IT costs represented more than 6.3% of the banking and financial sector's NBI in 2014 (Gartner, 2014) and even 7.16% between 2016 and 2017 (Deloitte, 2017). Cichowlas (2015, p. 40) used the term "invisible infostructure" for IT teams to refer to the technologies that companies rely on to launch their digital transformation and develop infrastructure that enables reliable and secure access to data and application services by erasing technological complexity and bringing together old and new technologies (Lacombe & Jarboui, 2023).

In the banking industry, almost all banking activities and products are now dependent on technology and IT. Some frameworks have been developed to govern IT, such as COBIT 2019 to prioritize actions, but there is still a gap between management's expectations of the current level of capability and providing recommendations on what is needed to improve performance in order to meet expectations (Widharto et al., 2022).

When implementing digital transformation, effective IS/IT management is a key determinant of success. Without effective management, the digital transformation process can be riskier and more expensive due to waste and missed opportunities. Managing authorities must decide on the company's visions and strategies, set corporate goals, set transformation tasks, ensure compliance with the company's strategy, policies and standards, and monitor performance. ITSM helps organizations implement

and accelerate digital transformation. Through enterprise service management strategies, optimized ITSM capabilities can help other business functions replace their potentially obsolete, manually demanding activities/processes with technology workflows and other productivity-enhancing capabilities found in modern ITSM tools (Akter et al., 2020).

ITSM is a method of managing information and communication technologies, their operation and development using the principles of service-based management from the perspective of customers and IS/IT service providers (Sukmandhani et al., 2017). Service management is a set of capabilities and methodologies that an organization uses to plan, build, deliver, and ensure the quality of the services they provide to customers (internal or external) - in IT, from applications to networks to connectivity. ITSM is a source of practical guidelines to be used as a quality standard in creating process improvements in society (Uddin, 2014). Effective ITSM application is achieved by integrating three main elements, namely people, processes, and technologies, into a well-designed system based on industry best practices (Magdalena, 2017). The development of IS/IT services, their implementation and support throughout the life cycle of IS/IT services are part of ITSM (Cots et al., 2016).

The definition and use of standardized IT Management techniques and processes provide the basis for IT Service Management and IT Governance. With the establishment of de facto standard "Best Practice" reference and process models such as the IT Infrastructure Library (ITIL) or Control Objectives for IT and related Technologies (CobiT), an integrated management architecture for the provision of services built upon standards-based processes and tools becomes feasible. ITIL provides a structured and widely adopted approach to IT Service Management and its processes. ITIL can further be aligned with related standards such as ISO 20000 to manifest IT Service Management practice or CobiT to support IT Governance. However, IT Management processes must be developed to align with the existing IT infrastructure and operation and must be modeled around frameworks such as ITIL (Knahl, 2009).

While the findings of several studies confirm the existence of a relatively wide range of standardized approaches, they also confirm that these frameworks overlap and use inconsistent terminology. The simple applicability of these frameworks in business practice that these standards declare is in fact not quite so simple. For many enterprises, they are frameworks that force them to apply prescribed procedures and entail an increase in various bureaucratic tasks, etc. On the other hand, we must add, that a lot of research confirms various benefits that the implementation and use of standardized approaches bring to enterprises, not only for IT departments, but also for other business units and, ultimately, for the enterprise as a whole. Effective adoption of mechanisms (structural, procedural, and relational mechanisms) can help companies reduce costs, improve product and service quality, and increase competitive advantage and operational efficiency (Lunardi et al. 2017).

2. Methods and methodology

A systematic literature review, a structured and rigorous method of gathering, categorizing, and analyzing extant literature, was used for this research. The aim of our research was to evaluate the current state of IT service management (ITSM) as a support for digital transformation in the financial sector in Slovakia. The data were drawn from a questionnaire survey conducted in 2022 among companies in the Slovak Republic. The questionnaire focused on basic information in relation to the IT service management. The focus of the survey consisted of questions to obtain basic information regarding the conceptual frameworks used by companies in IT management. We were interested in the manner and extent of their implementation, the company's motivations for implementing them, the barriers to implementing conceptual frameworks, and their benefits. Of the total research sample, 7.41% were companies classified in the financial and insurance services industry. In our research presented in this paper, we focused exclusively on these companies.

We have divided the workflow, which is illustrated in Figure 1 in the form of a research model, into four basic phases. In the first phase, we were concerned with the study and analysis of literature sources. The second phase consisted of setting the research questions. In the third phase of the research, we conducted statistical processing of the questionnaire survey data. The fourth phase was aimed at evaluating the research results and formulating conclusions.

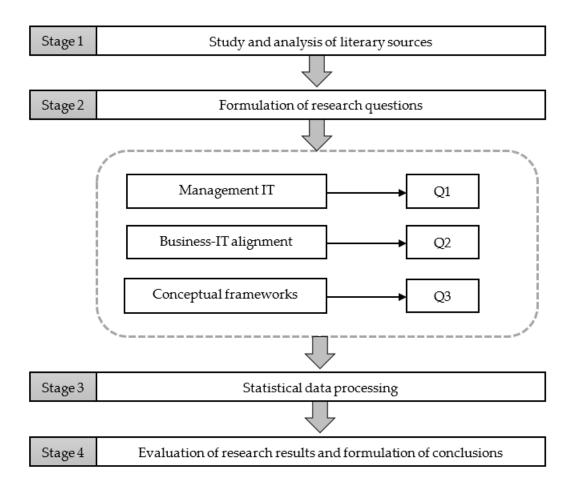


Figure 1. Research model.

Source: Author's own

Based on the analysis of extensive scientific studies and other literature sources, we formulated the following research questions:

- 1. (Q1) How is IT management in the financial sector assured and what are its responsibilities with respect to IT investments?
- 2. (Q2) Do companies in the financial sector have a developed IS/IT strategy and is this strategy aligned with the corporate strategy?
- 3. (Q3) Do financial companies use conceptual frameworks, standards, methodologies, and best practices to manage IT services?

In addition to the standard methods of scientific work, such as analysis, comparison, and synthesis, specific methods were also used to process the paper. These are mainly statistical methods for the analysis of the questionnaire survey data as well as for the evaluation and statistical verification of the results. Descriptive statistics methods and contingency tables were used to evaluate the results.

3. Results

In this section of the paper, the results of the research are presented. As already mentioned, within the questionnaire survey were selected companies classified in the financial and insurance services sector in the total number of 14, which includes the 6 largest banks in Slovakia. In terms of legal form, the research sample consists of joint stock companies (71.43%) and limited liability companies (28.57%). The companies are mostly based in the Bratislava region (85.71%). Within the scope of the organization in terms of geography, the research sample is made up of companies operating only in the Slovak Republic (35.71%), globally (28.57%), Europe (28.57%), Slovakia and the Czech Republic (7.14%). Regarding the structure of owners of the organization operating in the Slovak Republic, the dominant foreign owner

(50.00%), the exclusive domestic owner (21.43%), and the exclusive foreign owner (21.43%) make up the largest share. To categorize companies by size, we used the European Commission's (2012) definition of small and medium-sized enterprises (SMEs). In terms of the category of companies by size, the distribution is as follows: micro - 7.14%, small - 28.57%, medium - 14.29% and large - 50.00%.

3.1. IT management and its responsibilities with regard to IT investments

As part of the research, we were interested in how IT management is provided in the financial sector, and what its responsibilities are regarding IT investments. 10 of the companies surveyed have a separate IT department or IT manager. Of these, in two companies, managers have no authority regarding IT investments. In half (50.00%) of the companies, IT management has decisive authority over IT investments of more than 20,000%. From the questionnaire survey, we found that in two financial companies, there is no full-time IT professional, and IT operations are outsourced to them.

Further, we investigated which areas of IT operations management are most covered by companies in the financial sector. Respondents answered this question by providing a value on a scale of 0 to 100 that corresponded to the level of coverage of the management area.

Table 1. IT management areas covered

IT Operations Management Areas	Mean	Median	SD
Portfolio Management	66.36	69.50	23.60
Financial Management of Services	69.64	80.00	32.96
Capacity And Performance Management	62.14	72.00	28.17
Service Catalogue Management	65.93	72.50	26.61
Service Level Management	63.79	70.00	26.70
Availability Management	74.21	80.00	21.42
Service Continuity Management	67.71	80.00	29.90
Information Security Management	83.36	90.00	25.86
Supplier Management	65.29	80.00	34.17
Change Enablement and Control	65.64	75.00	28.35
IT Asset Management	62.50	70.00	30.18
Service Configuration Management	68.86	77.50	26.18
Deployment Management	67.64	70.00	25.18
Knowledge Management	69.21	80.00	26.10
Monitoring and Event Management	75.86	80.00	18.80
Incident Management	79.57	82.50	12.10
Service Desk	69.71	80.00	31.67
Service Request Management	75.21	84.50	26.32
Problem Management	75.71	80.00	26.25
Continuous Improvement	69.36	77.50	29.18

Source: Author's own

As shown by the results presented in Table 1, financial companies clearly have the most coverage of the information security management area (M = 83.36, Me = 90.00, SD = 25.86) within the IT operation management. Closely related to information security management are other areas that received an average rating higher than 75, namely Incident Management, Problem Management, Monitoring and Event Management, and Service Request Management.

3.2. Business-IT alignment

Alignment of business and IT is key for organizations in terms of strategic and competitive use of information and digital technologies (Jonathan, 2021). Therefore, as part of the second research question, we were interested in whether companies in the financial sector have an IS/IT strategy and to what extent this strategy is aligned with the corporate strategy. We focused on exploring the strategic

importance of IT and strategic alignment of IT with business through selected variables, based primarily on assumptions such as elaboration of business strategy, IT strategy, and others that can characterize the level of maturity in this area.

The results of the research confirmed that 12 surveyed financial companies (85.71%) have developed information strategy. Companies that reported having an IT strategy in place also reported that their IT strategy is aligned with their business strategy. The importance and significance of IT for enterprises is different and depends on the extent to which the company's main objectives are supported through IT.

Table 2. Investigating the strategic importance of IT and the business-IT alignment through selected variables.

Variables	Mean	Median	SD
IT strategy is aligned with business strategy	82.86	85.00	13.26
Business processes are defined and described	80.71	80.00	13.71
IT is seen more as a service aimed at supporting the business	68.57	70.00	18.34
Process ownership is clearly defined and described	77.14	80.00	17.62
There is a defined link between IT and business processes	83.86	87.00	16.40

Source: Author's own

Table 2 shows mean scores on a scale of 0-100, reflecting a level of agreement with each statement. The highest level of agreement in the sample of enterprises surveyed was recorded for the statement that there is a defined link between IT and business processes (M = 83.86, Me = 87.00, SD = 16.40).

The alignment of business activities with IT based on selected factors is presented in Table 3. Respondents indicated their response as a level of alignment ranging from 0 - no alignment to 100 - the highest level of alignment. In the investigated sample of companies, the highest level of alignment was recorded for corporate activities (M = 81.43, Me = 80.00, SD = 14.06). The lowest level of alignment was recorded for IT user expectations (M = 72.43, Me = 80.00, SD = 22.25).

Table 3. Business-IT alignment based on selected factors.

Factors of Business-IT Alignment	Mean	Median	SD
Corporate Activities	81.43	80.00	14.60
Expectations of IT Users	72.43	80.00	22.25
IT User Needs	75.00	80.00	19.12
IT User Requirements	72.86	80.00	21.99
Corporate Priorities	77.86	85.00	14.24
Corporate Objectives	77.86	85.00	14.24

Source: Author's own

3.3. Conceptual frameworks for IT management

This part discusses conceptual frameworks and standards used in information technology management and operations. The questionnaire survey revealed that 71.43% of companies in the financial sector use at least 1 or more conceptual frameworks in IT operations. We found that most companies (28.57%) use the ISO/EIC 27001 standard. This standard assists organizations in developing and maintaining an information security management system (ISMS) on the organizational level (Disterer, 2013). The use of the ISO/IEC 27001 standard has seen an increasing trend due to massive digitization. Since firms increasingly store their information based on ICT and governments and suppliers more and more require firms to ensure information security (Mirtsch et al., 2021). To a lesser extent, companies in the financial sector also use the ITIL framework and the international standard ISO/IEC 20000, which focus on IT service management.

We further found from the survey results that some financial companies (28.57% of the research sample) do not use any frameworks or standards in IT operations. Therefore, we were interested to know what would motivate companies to use conceptual frameworks in IT operations management.

Table 4. Motivation factors for implementing ITSM conceptual frameworks

Motivation Factors	Mean	Median	SD
Increasing employee motivation	52.79	55.00	27.75
Retaining knowledge in the company	72.14	80.00	21.10
Reduction of costs	85.71	90.00	9.38
Increase profit	90.71	90.00	8.29
Increase productivity	84.29	82.50	18.38
Systems recovery options and procedures	73.64	72.50	11.98
Reducing incidents and errors	81.43	85.00	11.84
IS/IT planning and monitoring	66.43	70.00	17.81
Quality culture	65.71	67.50	19.00
Standardization of processes and services	75.71	80.00	18.38
Client or regulatory requirements	75.71	87.50	26.15
Marketing tool. Reliability and/or reputation	73.57	82.50	23.65
Continuous improvement	80.36	90.00	19.60
Competitive advantage	83.21	87.50	16.83
User satisfaction	80.00	80.00	15.19

Source: Author's own

Table 4 shows the mean score on a scale from 0 to 100, which reflects the level of motivation with regard to individual motivational factors. We identified the following top 5 motivators for implementing ITSM conceptual frameworks in the surveyed sample of companies: increasing profits, reduction of costs, increasing productivity, competitive advantage, and reducing incidents and errors.

4. Discussion

Digital transformation has become one of the key concepts for companies that care about continuous development and remaining competitive. Companies in the financial and insurance services sector in Slovakia are gradually undergoing a process of digital transformation. Such a process cannot be done without the support of IT management, a strategic approach to information technology, effective management of IT operations, and business-IT alignment. The aim of the scientific paper was to evaluate the current state in the field of ITSM as a support for digital transformation in the financial sector in Slovakia with an emphasis on business-IT alignment and the use of conceptual frameworks in the field of IT operations management.

The focus of the paper was to find answers to three research questions. The first research question concerned IT management in the financial sector and its competencies with respect to IT investments. We found that there are still financial companies in Slovakia that do not have sufficient IT management in place. The companies that do have IT management in place focus mainly on covering the area of information security management.

According to Heilig et al. (2017) and Vial (2019), finding the right fit between new digital technologies and organizational adaptations gets complex as organizations climb to the next generation of digital transformation. According to Nkoyock and Spiker (2018), the success of an organization's digital transformation endeavor is contingent upon how well the business and IT strategies are aligned. We therefore examined the extent to which the IS/IT strategy of financial companies is aligned with corporate strategy. The highest level of agreement in the sample of enterprises surveyed was recorded for the statement that there is a defined link between IT and business processes.

Conceptual IT frameworks help companies manage their IT better and more securely. Therefore, it is important that as many companies as possible implement these conceptual frameworks (Romanova & Cerny, 2022). As part of the third research question, we found that the most widely used conceptual framework in the financial sector is ISO/EIC 27001. ISO/IEC 27001 addresses the area of IT security and

is also quite widely adopted by companies, indicating the perception of IT security as an important area for companies (Romanova & Cerny, 2022).

We are aware that it is the sample of companies from a given region and industry only that represents the limitations of this research. We consider another limitation to be simply assessing the level of maturity of the ITSM areas and processes covered. In the future, we plan to assess the whole topic more comprehensively. As part of further research in the area of IT operations management, we intend to focus on evaluating the level of maturity of ITSM processes in terms of the enterprise size category. We will focus on creating a conceptual framework for small and medium-sized enterprises that is simple and easy to implement so that companies do not have to spend a lot of effort and resources on its implementation and operation. In the area of digital transformation, in the future, we will explore the implementation of Industry 5.0 technology concepts that should support the three core elements of Industry 5.0, namely: human-centricity, resilience, and sustainability.

5. Conclusions

The area of IT governance is one of the most debated areas. This has been initiated by changes in the evolution of IT, its importance, and the way it is viewed. IT has long been seen as not just a view of the technology itself, but also of its importance in business activities and IT management in a business context.

The sectors of banks and insurances are undergoing a major digital transformation. Banks have been carrying out ambitious digital transformation projects recently, with the sector now using different digital and mobile technologies to diversify its distribution channels and improve customer satisfaction (Schuchmann & Seufert, 2015). The aim of the new digital banking system is to make the customer the main driver of its operations. The development of new applications capable of improving the user's experience is the key tool they use to gain the trust of these new digital customers. The insurance sector is undergoing a digital transformation, with big data allowing for more accurate pricing, better adjustment of guarantees, and the development of insurance based on the uses, as well as a more exhaustive and formalized analysis of risks (Boyer, 2015). In addition, policyholders are now using physical channels less and increasingly adopting modern communication technologies and social media.

For successful digital transformation, it is necessary to maximize active and systematic use of advanced online and digital technologies that form the basis of business today and create an open, horizontal organizational culture and communication system to equally share and distribute advanced technologies and competencies throughout the entire organization.

One of the principal challenges for digital transformation was, and still is, whether the change affects a whole organization or just the IT department. Successful digital transformation is not merely about an IT revolution or introducing automation. It's a holistic business change covering entire organizations and working together with the overall business strategy. It requires mixing people, machines, and business processes, with all the challenges this entails. It also requires governance, continuous monitoring, and intervention from the top to ensure that both digital leaders and non-digital leaders are making good decisions about their transformation efforts. It's why organizations should use conceptual frameworks and IT service management (ITSM) tools for digital transformation.

Funding: This research was funded by grants from the Slovak Ministry of Education Science, Research and Sport, VEGA No. 1/0662/23 Digital transformation of companies and their readiness to integrate the elements of Industry 5.0 (proportion 50 %) and VEGA No. 1/0767/21 Modelling the decision-making of investors assessing business proposals (proportion 50 %).

References

- 1. Akter, S., Michael, K., Uddin, M. R., McCarthy, G., & Rahman, M. (2022). Transforming business using digital innovations: The application of AI, blockchain, cloud and data analytics. *Annals of Operations Research*, 1-33. https://doi.org/10.1007/s10479-020-03620-w.
- 2. Boyer, J. M. (2015). La tarification et le big data: quelles opportunités?. *Revue d'économie financière*, (4), 81-92. https://doi.org/10.3917/ecofi.120.0081.

- 3. Cichowlas, A. (2015). Technologie et transformation des services bancaires: l'exemple de technovision de Capgemini. *Revue d'économie financière*, (4), 35-56. https://doi.org/10.3917/ecofi.120.0035.
- 4. Cots, S., Casadesús, M., & Marimon, F. (2016). Benefits of ISO 20000 IT service management certification. *Information Systems and e-Business Management*, 14, 1-18. https://doi.org/10.1007/s10257-014-0271-2.
- 5. Deloitte (2017). Deloitte 2016-2017 global CIO survey. Available at: www2.deloitte.com/us/en/insights/ focus/cio-insider-business-insights/technology-investments-value-creation.html#::text=Embed %20Figure%20.
- Disterer, G. (2013). ISO/IEC 27000, 27001 and 27002 for information security management. *Journal of Information Security*, 4(2). https://doi.org/10.4236/jis.2013.42011.
- 7. Gartner (2014). IT metrics: technology research. Gartner, Inc (IT Key Metrics Data 2014, Gart. Benchmark Anal). Available at: www.gartner.com/en/documents/2635815 (accessed 4 August 2022).
- 8. Heilig, L., Lalla-Ruiz, E., & Voß, S. (2017). Digital transformation in maritime ports: analysis and a game theoretic framework. *Netnomics: Economic research and electronic networking*, 18(2-3), 227-254. https://doi.org/10.1007/s11066-017-9122-x.
- 9. Jonathan, G. M., Rusu, L., & Van Grembergen, W. (2021). Business-IT alignment and digital transformation: Setting a research agenda. In 29th International Conference on Information Systems Development (ISD2021), València, Spain, September 8-10, 2021. Association for Information Systems. urn:nbn:se:su:diva-200367.
- 10. Kim, E., Kim, M., & Kyung, Y. (2022). A Case Study of Digital Transformation: Focusing on the Financial Sector in South Korea and Overseas. *Asia Pacific Journal of Information Systems*, 32(3), 537-563. https://doi.org/10.14329/apjis.2022.32.3.537.
- 11. Kitsios, F., Giatsidis, I., & Kamariotou, M. (2021). Digital transformation and strategy in the banking sector: Evaluating the acceptance rate of e-services. *Journal of Open Innovation: Technology, Market, and Complexity*, 7(3), 204. https://doi.org/10.3390/joitmc7030204.
- 12. Knahl, M. H. (2009). A Conceptual Framework for the Integration of IT Infrastructure Management, IT Service Management and IT Governance. *World Academy of Science, Engineering and Technology*, 52, 438-443. https://api.semanticscholar.org/CorpusID:166345368.
- 13. Lacombe, I., & Jarboui, A. (2023). Governance and management of digital transformation projects: an exploratory approach in the financial sector. *International Journal of Innovation Science*, 15(4), 611-635. https://doi.org/10.1108/IJIS-02-2022-0034.
- 14. Lunardi, G. L., Maçada, A. C. G., Becker, J. L., & Van Grembergen, W. (2017). Antecedents of IT governance effectiveness: An empirical examination in Brazilian firms. *Journal of Information Systems*, 31(1), 41-57. https://doi.org/10.2308/isys-51626.
- 15. Magdalena, L. (2017). Analisis Problem Management pada IT Helpdesk dengan implementasi ITSM dan SLA (Studi Kasus: Citigroup Indonesia). *Jurnal Digit: Digital of Information Technology*, 1(2). https://doi.org/10.51920/jd.v1i2.2.
- 16. Marr, B. (2016). What everyone must know about industry 4.0. Forbes, June, 20, 2016.
- 17. Mavlutova, I., & Volkova, T. (2019). Digital transformation of financial sector and challengies for competencies development. In 2019 7th International Conference on Modeling, Development and Strategic Management of Economic System (MDSMES 2019) (pp. 161-166). Atlantis Press. https://doi.org/10.2991/mdsmes-19.2019.31.
- 18. Mirtsch, M., Kinne, J., & Blind, K. (2020). Exploring the adoption of the international information security management system standard ISO/IEC 27001: a web mining-based analysis. *IEEE Transactions on Engineering Management*, 68(1), 87-100. https://doi.org/10.1109/TEM.2020.2977815.
- 19. Nkoyock, A., & Spiker, B. K. (2018). Business-IT Strategic Alignment: A Prerequisite for Digital Transformation. Lulu. com.
- 20. Romanova, A., & Cerny, M. (2022). Factors Influencing the Use of Conceptual Frameworks in The Field of IT Management. *Journal of Software & Systems Development*, 1-17. https://doi.org/10.5171/2022.779754.
- 21. Schuchmann, D., & Seufert, S. (2015). Corporate learning in times of digital transformation: A conceptual framework and service portfolio for the learning function in banking organisations. *International Journal of Advanced Corporate Learning*, 8(1). https://doi.org/10.3991/ijac.v8i1.4440.
- 22. Sukmandhani, A. A., Wijanarko, B. D., Gunawan, E., Pratama, D., Gaol, F. L., & Sutedja, I. (2017). Measurement effectiveness and efficiency to improve the IT services using ITSM. In 2017 International Conference on Information Management and Technology, 334-339. https://doi.org/10.1109/ICIMTech.2017.8273561.
- 23. Töröková, A. (2019). IT Governance ako súčasť digitálnej transformácie. In *Ekonomika, financie a manažment podniku* 2019 : zborník vedeckých prác, 573-585.
- Uddin, B. (2019). Evaluasi Penerapan Manajemen Layanan Ti Menggunakan Kerangka Kerja It Infrastructure Library (Itil) Sub Domain Service Desk, Incident Management, Dan Problem Management. *Jurnal TEDC*, 8(2), 171-177.
- 25. Vial, G. (2021). Understanding digital transformation: A review and a research agenda. *Managing Digital Transformation*, 13-66.

- 26. Widharto, P., Suhatman, Z., & Aji, R. F. (2022). Measurement of information technology governance capability level: a case study of PT Bank BBS. *TELKOMNIKA* (*Telecommunication Computing Electronics and Control*), 20(2), 296-306. https://doi.org/10.12928/telkomnika.v20i2.21668.
- 27. Xu, X., Lu, Y., Vogel-Heuser, B., & Wang, L. (2021). Industry 4.0 and Industry 5.0—Inception, conception and perception. *Journal of Manufacturing Systems*, 61, 530-535. https://doi.org/10.1016/j.jmsy.2021.10.006.