



CER Comparative European Research 2022

Proceedings | Research Track

of the 17th Biannual
CER Comparative European Research
Conference

International Scientific Conference for Ph.D. students of EU countries

April 25-27, 2022 | London



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Introduction

The conference Proceedings you are holding is a collection of selected peer-reviewed texts presented at the international scientific conference Comparative European Research - CER 2022 (April 25-27, 2022).

The biannual international scientific conference is organized under the auspices of the SCIEEMCEE scientific platform every March and October and follows up on activities aimed at providing greater support for the scientific activities of Ph.D. students and beginning researchers. The various biannual CER conferences represent a space for the international assessment of the qualitative standard of scientists and the results achieved by the various academic institutes. The CER conference is an ideal place for comparing the standard of scientific work, particularly on a European scale.

The Proceedings from the CER 2022 conference contains several dozen academic texts whose main purpose is the presentation and sharing of knowledge always in one of nine conference sections. The conference Proceedings prioritize only those articles which are good enough to offer readers new insights into the issues analyzed, or which extend the known boundaries of science. The guarantor of the CER 2022 conference is a signatory of the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities, and therefore all papers are made available to professionals and the general public via OpenAccess.

The conference committee, comprising experts from several university departments, believes that the CER international scientific conference will attract an ever wider base of participants to join in the discussions and will stimulate further scientific work and interdisciplinary development.

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APPLYING INDUSTRY 4.0 AND ITS IMPACT IN PRINTING INDUSTRY

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Abstract: *Industry 4.0 poses revolutionary challenges for enterprises in technological, organisational and management perspective. The aim of this paper was to identify the digital transformation within the ongoing industrial revolution led by Industry 4.0 and to define its application and impact in the printing industry in Slovakia. The article used a literature review of foreign and domestic authors from international databases to form the conceptual framework of the article. Subsequently, in the next part of the article, the results of a questionnaire survey concerning the application of Industry 4.0 in 50 enterprises operating in the printing industry in Slovakia were interpreted. Based on the results of the conducted survey, we conclude that the awareness of Industry 4.0 in the printing industry is at the moderate level. The majority of respondents believe that Industry 4.0 can significantly transform manufacturing. The biggest benefit in the application of Industry 4.0 in enterprises of the printing industry is the reduction of manufacturing costs. The most preferred Industry 4.0 technology among the respondents was additive manufacturing. The biggest barrier to the implementation of Industry 4.0 in the printing industry is the lack of financial resources for its implementation.*

Keywords: *digitalisation, digital transformation, Fourth Industrial Revolution, Industry 4.0, printing industry*

1. Introduction

Industry 4.0 is also known as the Fourth Industrial Revolution, which has become a central concept in recent times as it represents a new phase in the manufacturing industry, with new and innovative technologies being introduced to provide more cost-effective, reliable, economical solutions. An exception is not the printing industry, which is also undergoing a transformation with the support of revolutionary Industry 4.0 technologies that are significantly changing business processes.

The main objective of the article was to identify the digital transformation in the ongoing industrial revolution led by Industry 4.0 and to define its application and impact in the printing industry in Slovakia. In addition to the conceptual framework, the article also aimed to create a real state of the field through a survey of enterprises in the printing industry located in different regions in Slovakia.

2. Conceptual Framework

In recent years, we have experienced a new industrial revolution, which is transforming the way enterprises operate in the marketplace and leading to various changes. This is the fourth wave of socio-economic evolution, which is called Industry 4.0. The evolution towards Industry 4.0 has a significant impact on the manufacturing industry. It represents the latest trends in automation and digital technologies that are gaining popularity in the manufacturing industry [1,2].

The Fourth Industrial Revolution refers to the social, industrial and technological changes caused by the digital transformation of industry, which are identified with the concept of Industry 4.0 [3,4]. The Fourth Industrial Revolution, also known as Industry 4.0, stems from the rapid advancement of digital technologies such as the

Internet of Things and Cyber-Physical Production Systems. It has the potential to weave positive changes to enterprise [5].

Industry 4.0 came about in the 21st century and focused on all types of industries with intelligent systems. The achievements of this revolution include fully automated systems, artificial intelligent systems that work in uncertain situations, with machine learning having a positive influence on the Fourth Industrial Revolution [6]. Industry 4.0 is the digital transformation of manufacturing and related industries and value creation processes. Industry 4.0 is widely seen as the forthcoming Fourth Industrial Revolution driven by the digitalisation and automation of production and value chain processes [7]. Industry 4.0 is based on the integration of new technical solutions. Particularly important in this case is the integration process of intelligent machines and systems and the changes in manufacturing processes. The idea of Industry 4.0 is to connect individual technological components with people, machines, equipment and products that interact with each other [8]. The implementation of the Industry 4.0 concept aims to connect machines and equipment via the internet and to digitalise all manufacturing processes [9-13]. Industry 4.0 is essentially a trend towards automation and data sharing in manufacturing technologies and processes, including cyber-physical systems, the Internet of Things, cloud computing, cognitive computing and artificial intelligence [14].

The key focus of Industry 4.0 is on new technologies that will have a major impact on business processes. The new technologies of Industry 4.0 include virtual reality, 3D printing, simulation, big data analytics, cloud computing, radio frequency identification, Internet of Things,

cybersecurity, machine-to-machine communication, robots, drones, nanotechnology, and business intelligence [15-17].

3. Research Methodology

The survey involved 50 enterprises from the printing industry operating in Slovakia. Data collection from the enterprises was conducted by electronic questionnaire. For a better understanding of the results, it is important to become informed about the basic characteristics of the respondents in view of the size of the enterprise, legal form and geographical location.

In the construction of the conceptual framework, the analysis, synthesis, and comparison of the terminological apparatus from foreign scientific sources from recent years, which are in international databases, were used. Interpretation of the studied issue from the practical side was conducted on the basis of the evaluation of the questionnaire survey, where descriptive analysis was used. The results of the data were illustrated from the graphical aspect by using pie charts.

Respondents who answered the questions were mainly represented by medium-sized enterprises (48%) with 50-249 employees. Only a two percent lower proportion (46%) in the research sample was represented by small enterprises employing 10-49 employees. Large enterprises from the printing industry in Slovakia were the least represented in the survey on Industry 4.0. Their share was at the level of 6%.

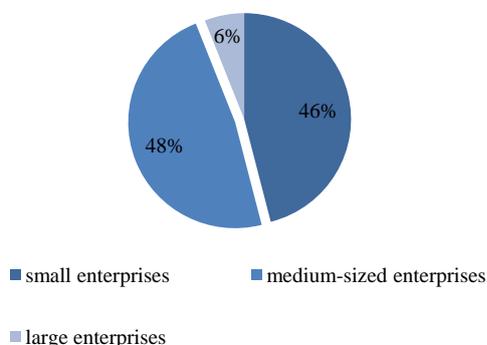


Figure 1: Respondents by size of enterprise

Enterprises in the printing industry in Slovakia were dominated by limited liability companies. They constituted more than 4/5 of the survey participants. The legal form of business in the form of a joint stock company was represented with a share of 12%.

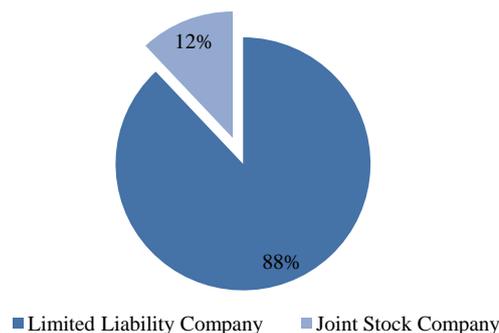


Figure 2: Respondents by legal form of business

Figure 3 illustrates the percentages of enterprises in the printing industry in Slovakia by geographical location. Enterprises from Bratislava Region obtained a significant position, as they accounted for more than 2/5 of the survey participants. Trnava Region, Nitra Region, Žilina Region and Banská Bystrica Region achieved an identical representation in the survey (10%). The smallest number of enterprises from the printing industry from Prešov Region (6%) and Trenčín Region (4%) participated in the survey.

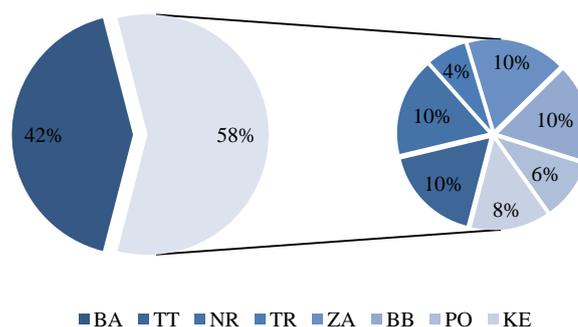


Figure 3: Respondents by geographical location

4. Data Analysis and Discussion

Successful digital transformation and a seamless transition to Industry 4.0 requires acceptance of the ongoing industrial revolution and a perfect digitalisation awareness. We examined this fact among enterprises in the printing industry in Slovakia. Based on the summarised responses, Figure 4 illustrates the percentage values of the respondents' answers on the level of awareness of Industry 4.0.

The results show that 14% of respondents presented an excellent level of awareness of Industry 4.0. 27% of enterprises from the printing industry in Slovakia have a good knowledge of the Industry 4.0 concept. The highest awareness (35%) about Industry 4.0 is at the moderate level. At the same time, the results indicate that 15% of enterprises from the printing industry have the very poor level and 9% of respondents have the extremely poor level regarding digitalisation.

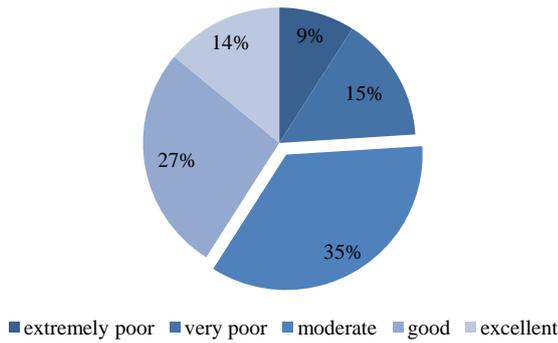


Figure 4: Level of awareness of Industry 4.0

Industry 4.0 can transform enterprises in printing industry in a variety of areas. Participants were asked to identify the business areas in the enterprise that impact the most from Industry 4.0. As shown in Figure 5, the majority of respondents (29%) consider that Industry 4.0 can significantly transform manufacturing. 24% of enterprises in printing industry report that Industry 4.0 is impacting logistics significantly. 19% of respondents consider that IT is an enterprise area that can impact from Industry 4.0 concept. Based on the survey results, 12% of respondents indicate that the Industry 4.0 concept improve research and development. Purchasing (10%) and human resources (6%) ranked in the last two places.

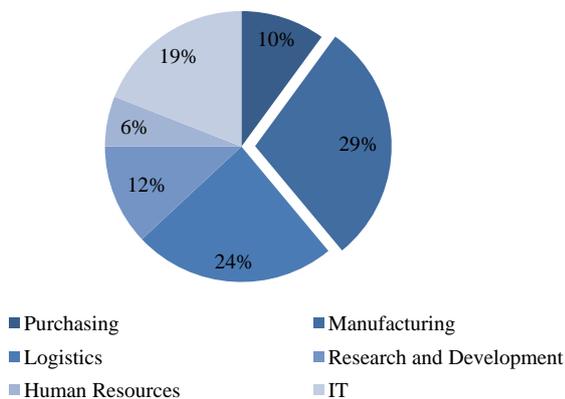


Figure 5: Impact of Industry 4.0 in business areas

Figure 6 summarises benefits of Industry 4.0 in printing industry in Slovakia. With the largest percentage share (31%) for respondents, the application of Industry 4.0 represents a reduction in manufacturing costs. Early detection of manufacturing problems also ranked high in percentage share (24%) for enterprises in printing industry. Implementing Industry 4.0 reduces downtime in the enterprise. This possibility was indicated by 17% of the respondents. The benefit of Industry 4.0 for 13% of participants is increased agility of operations. Enterprises from printing industry considered digital data exchange (8%) and efficient use of employees (7%) to be the least important.

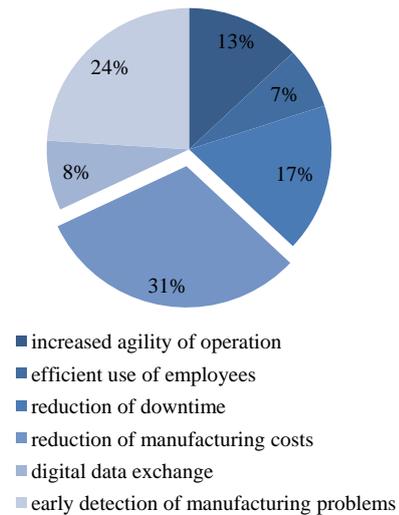


Figure 6: Benefits of Industry 4.0 in the printing industry

The implementation of Industry 4.0 in the printing industry in Slovakia also provides the use of several Industry 4.0 technologies that are an integral part of this concept. Based on the aggregated data, a pie chart was created, which is illustrated in Figure 7. The most preferred Industry 4.0 technology among the respondents was additive manufacturing. This technology reached 21%. The high percentage (18%) was also recorded about virtual technologies. Advanced robots are used by enterprises operating in the printing industry at 15% and cloud computing at 13%. Respondents indicated that simulation is important to them as an Industry 4.0 technology with a share of 11%. The least responded use machine to machine (9%), internet of things (8%) and data analytics (5%) within the enterprise.

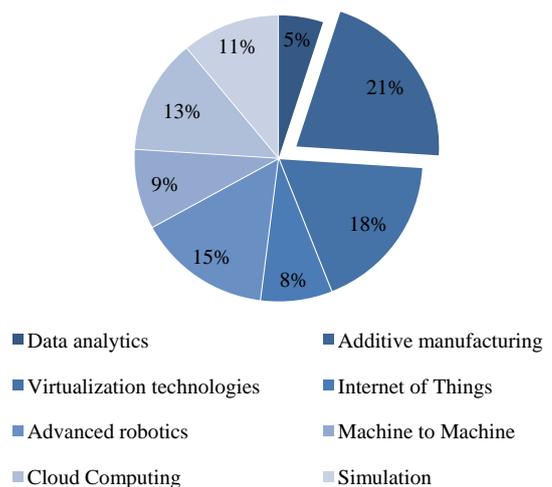


Figure 7: Using Industry 4.0 technologies in the printing industry

Enterprises always confront many difficulties when implementing new technology due to a large number of barriers. New modern technologies, which are comprehensively covered by Industry 4.0, are no

exception. Figure 8 looks at the identification of Industry 4.0 barriers in the printing industry in Slovakia. The biggest barrier (25%) for the application of Industry 4.0 for the respondents was the lack of financial resources for its implementation. The second biggest barrier (18%) for enterprises in the printing industry in the application of Industry 4.0 is the uncertainty of required results that the respondents expect from this concept. Respondents with almost similar percentage values rated other barriers. These include lack of necessary infrastructure (16%), lack of experience with new technologies (15%) and lack of professional skills of staff (14%). The smallest barriers for enterprises in applying Industry 4.0 were the loss of jobs (7%) and lack of interest on the part of business management (5%).

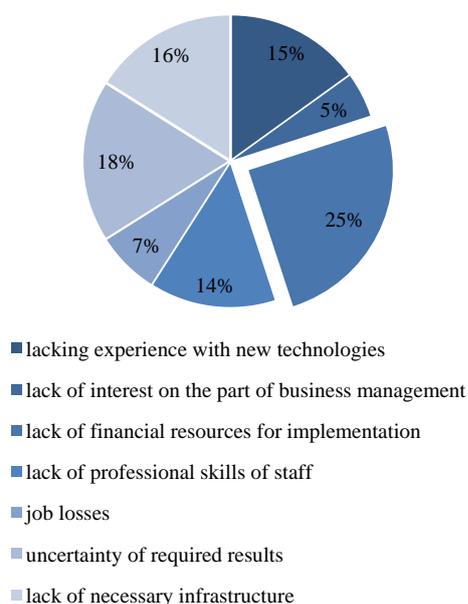


Figure 8: Industry 4.0 barriers in the printing industry

5. Conclusions

Industry 4.0 presents many technological, organisational and management challenges to enterprises. The application of Industry 4.0 is occurring through new technologies, transforming business processes, revolutionising all areas of the enterprise and requiring new competencies for employees. Business processes are made more transparent, decentralised and less hierarchical by the application of Industry 4.0. In recent years there have been major advances in the printing industry. Great progress have been made in the introduction of digital printing technologies, making manufacturing leaps and bounds towards becoming part of the smart factory. Within the conceptual framework, the authors' views were identified, where we concluded that Industry 4.0 is the Fourth Industrial Revolution, driven by digitalisation and automation through individual disruptive technologies. From the results of the questionnaire survey we conclude that Industry 4.0 in the printing industry in Slovakia has its justification and growing tendency, thus its role is constantly gaining strength. This is confirmed by the dominance of additive manufacturing, which uses

augmentative technologies in the form of cloud connectivity, data analytics, automation and software integration, enabling manufacturers to use technology in new and innovative ways in the printing industry.

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References

- [1] Rodriguez Salvador, M., & Mancilla De La Cruz, J. (2018). Presence of Industry 4.0 on Additive Manufacturing: Technological Trends Analysis. *DYNA*, 93(1), 597–601. <https://doi.org/10.6036/8815>
- [2] Thames, L., & Schaefer, D. (2016). Software-defined Cloud Manufacturing for Industry 4.0. *Procedia CIRP*, 52, 12–17. <https://doi.org/10.1016/j.procir.2016.07.041>
- [3] Strozzi, F., Colicchia, C., Creazza, A., & Noè, C. (2017). Literature review on the “Smart Factory” concept using bibliometric tools. *International Journal of Production Research*, 55(22), 6572–6591. <https://doi.org/10.1080/00207543.2017.1326643>
- [4] Lu, Y. (2017). Industry 4.0: A survey on technologies, applications and open research issues. *Journal of Industrial Information Integration*, 6, 1–10. <https://doi.org/10.1016/j.jii.2017.04.005>
- [5] Suleiman, Z., Shaikholla, S., Dikhanbayeva, D., Shehab, E., & Turkyilmaz, A. (2022). Industry 4.0: Clustering of concepts and characteristics. *Cogent Engineering*, 9(1). <https://doi.org/10.1080/23311916.2022.2034264>
- [6] Vinitha, K., Ambrose Prabhu, R., Bhaskar, R., & Hariharan, R. (2020). Review on industrial mathematics and materials at Industry 1.0 to Industry 4.0. *Materials Today: Proceedings*, 33, 3956–3960. <https://doi.org/10.1016/j.matpr.2020.06.331>
- [7] Bauer, W., Schlund, S., Hornung, T., & Schuler, S. (2018). Digitalization of Industrial Value Chains—A Review and Evaluation of Existing Use Cases of Industry 4.0 in Germany. *Logforum*, 14(3), 331–340. <https://doi.org/10.17270/j.log.2018.288>
- [8] Porubčínová, M., & Fidlerová, H. (2020). Determinants of Industry 4.0 Technology Adaption and Human - Robot Collaboration. *Research Papers Faculty of Materials Science and Technology Slovak University of Technology*, 28(46), 10–21. <https://doi.org/10.2478/rput-2020-0002>
- [9] Zhong, R. Y., Xu, X., Klotz, E., & Newman, S. T. (2017). Intelligent Manufacturing in the Context of Industry 4.0: A Review. *Engineering*, 3(5), 616–630. <https://doi.org/10.1016/j.eng.2017.05.015>
- [10] Pilloni, V. (2018). How Data Will Transform Industrial Processes: Crowdsensing, Crowdsourcing and Big Data as Pillars of Industry 4.0. *Future Internet*, 10(3), 24. <https://doi.org/10.3390/fi10030024>
- [11] Zunino, C., Valenzano, A., Obermaisser, R., & Petersen, S. (2020). Factory Communications at the Dawn of the Fourth Industrial Revolution. *Computer Standards &*

- Interfaces, 71, 103433. <https://doi.org/10.1016/j.csi.2020.103433>
- [12] Vuksanović Herceg, I., Kuč, V., Mijušković, V. M., & Herceg, T. (2020). Challenges and Driving Forces for Industry 4.0 Implementation. *Sustainability*, 12(10), 4208. <https://doi.org/10.3390/su12104208>
- [13] Lee, J., Kao, H.-A., & Yang, S. (2014). Service Innovation and Smart Analytics for Industry 4.0 and Big Data Environment. *Procedia CIRP*, 16, 3–8. <https://doi.org/10.1016/j.procir.2014.02.001>
- [14] Wang, S., Wan, J., Li, D., & Zhang, C. (2016). Implementing Smart Factory of Industrie 4.0: An Outlook. *International Journal of Distributed Sensor Networks*, 12(1), 3159805. <https://doi.org/10.1155/2016/3159805>
- [15] Kosacka-Olejnik, M., & Pitakaso, R. (2019). Industry 4.0: state of the art and research implications. *Logforum*, 15(4), 478–485. <https://doi.org/10.17270/j.log.2019.363>
- [16] Ammar, M., Haleem, A., Javaid, M., Walia, R., & Bahl, S. (2021). Improving material quality management and manufacturing organizations system through Industry 4.0 technologies. *Materials Today: Proceedings*. <https://doi.org/10.1016/j.matpr.2021.01.585>
- [17] Sahal, R., Alsamhi, S. H., Breslin, J. G., Brown, K. N., & Ali, M. I. (2021). Digital Twins Collaboration for Automatic Erratic Operational Data Detection in Industry 4.0. *Applied Sciences*, 11(7), 3186. <https://doi.org/10.3390/app11073186>

BEST PRACTICE MANAGEMENT AND PROTECTION OF LIMITED NATURAL RESOURCES IN ARAB SMART CITIES

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Abstract: *The aim of the article is to identify common and different elements of Smart Cities best practice in managing limited resources in a sustainable way. The thematic focus of the article is very actual, as today's cities have to deal with climate change, population growth and the limits of natural ecosystems. Methods of secondary analysis, comparison and summarization of the acquired knowledge were mainly used to fulfill the goal. The importance of the issue is also recognized by mineral oil-producing cities, which are among the best practices of Arab cities, namely Abu Dhabi (Masdar City), Dubai and Riyadh. Their Smart City strategies for sustainable development, protection and management of limited resources are based on central planning, centrist-oriented visions and plans focused on citizens, projects, knowledge management and technology development. However, we must not forget the specific elements of cultural aspects, monarchy and central planning that work in Arabia, but they may not be as effective in Europe or America.*

Keywords: *management, sustainability, Smart City, limited resources, comparison*

1. Introduction

The economy of the eastern countries of the world has been largely focused on limited natural resources (mineral oil) since 1950. Cities that want to gain a competitive advantage are therefore starting to invest in Smart Environmental Protection. Saudi Arabia has set itself the primary goal of improving urban ecology by 2050 by promoting sustainable development. In 2016, five initiatives were set up to support resource management in the area.

The 2020 urban plan for Dubai includes the creation of buildings from the so-called green concrete, which reduces toxic substances in the air by up to 45 %. Etihad Esco - ADEWA (Abu Dhabi Electricity and Water Authority) plan ensures resource efficiency for pharmacies, airports and the city center since 2013 [4].

Strategic management in Saudi Arabia was already aware of the scarcity of natural resources in the 20th century. Sheikh Rashid bin Saeed Al Maktoum, vice president of the Sustainable Cities Project in the Middle East, in 1990 predicted the need to introduce a so-called "Greenprint". The planning process was to be set up to reduce water, energy, food and waste consumption [3].

The importance of protecting and managing limited resources is reflected in Smart City's innovative strategies in Saudi Arabia as well, in order to promote sustainability and conserve resources for future generations. The aim of the article is to identify common and different elements of Smart Cities best practice in managing limited resources in a sustainable way.

2. Methodology

Within the article, the method of secondary analysis of case studies, articles and strategies of selected cities was

used. In addition, the method of summarization, comparison, induction and deduction was used.

Smart City's best practice in the territory of Saudi Arabia in the field of limited selection was selected on the basis of the Smart City Index 2021. The first three Arab cities in the ranking were Abu Dhabi (28th place), Dubai (29th place) and Riyadh (30th place) (Table 1).

Table 1 Top Arab Smart Cities in Smart City Index 2021

	<i>City</i>	<i>Ranking</i>
<i>Smart City Index 2021</i>	Abu Dhabi	28.
	Dubai	29.
	Riyadh	30.

Source: own processing according to [2]

The structure of the order of the results of the article reflects the location of the selection cities in Smart City Index 2021 in Table 1.

3. Results

3.1. Abu Dhabi's Masdar City

Since 2006, the government has been investing in the construction of a "city" of the future with solar panels, in which transport will take place on solar-powered aircraft and autonomous cars [4]. The name Masdar in Arabic means spring or source. The cooperation is realized through the support of the city of Abu Dhabi [3]. Cultural aspects, monarchy and central planning are common elements in the management of Arab cities. When creating the concept of a sustainable city, the necessary innovation center and the trust of citizens are a necessary aspect. The decision-making process is very dynamic, flexible and fast. The funds are obtained mainly through the sale of mineral oil [6].

Masdar's vision is to implement effective resource management, sustainability and alternative solutions to prevent the use of fossil fuels by 2025 [8]. The most important asset is citizens, especially educated professionals who can support the diversity of resources [5].

Opportunities to support the development of Smart City approaches create [5]:

- HDP high GDP,
- wealth gained from the sale of mineral oil resources,
- a flexible and strong government representing the views of the population,
- the possibility to innovate and invest in both "greenfield" and "brownfield".

Masdar makes it possible to see Abu Dhabi as a leader in technological development, a promoter of innovation, economic diversification, sustainable development and the expansion of the city [5].

As early as 1990, Sheikh foresaw that "his grandfather and father drove a camel, he drove a Mercedes, his son owned a Land Rover, his grandson inherited a Land Rover and his great-grandson will drive a camel again due to lack of resources and environmental pollution," [3].

The primary goal of the Masdar project is to create a so-called An "eco-copy" that will not produce any carbon. The partial goals for achieving the main goal are [3]:

- secure renewable energy sources,
- look for alternatives for the consumption of limited resources,
- implement technologies for the creation of Smart City,
- use solar and wind propulsion and energy,
- desalinate and purify water resources for their further consumption,
- reduce the share of waste per capita.

The strategic goal is to reduce energy consumption by 50 % and emissions by up to 70 % by 2050. For a sustainable future, the city management focuses on diversifying the resource economy. The set goals can be achieved through the so-called "knowledge" management and innovation support [9].

Masdar projects are the best practice for the world's cities to manage their limited resources, for example by creating solar or wind farms (London Array, Dudgeon Farm, Gemasolar in Spain or Tafila in Jordan). According to Dr. Al Zeyoudi says that "limited resource management projects can save the lives of up to seven million people a year, not just the planet but especially its people, the best thing the world can do is invest in global urban development," [9].

3.2. Dubai

Smart City Dubai's strategic plan focuses on sustainability through a vision of limited resource protection. The city's

management strives to improve air quality, preserve limited water resources for future generations, increase efficient energy consumption and increase the amount of greenery [1].

As part of air protection, it is planned to reduce its pollution by up to 90 % from 2021. Data are collected through the National Air Quality Platform (AQI). The project is implemented in cooperation with the General Secretariat of the Executive Council of Dubai [1].

The long-term sustainability of water resources is a key aspect of the quality of life in the Smart City concept. The strategic goals and plans are implemented in cooperation with the Dubai Electricity & Water Authority, which sets regulations, standards and policies. The basic ambition is to create a city that will implement integrated water management efficiently and at low cost [1].

Dubai wants to increase energy efficiency in the next two stages. The goal is to reduce energy consumption and emissions by 25 % by 2030, by up to 75 % by 2050 by building green buildings and increasing the amount of greenery. At the same time, these activities will have a positive impact on the sustainable management of water resources and the air [1].

Dubai builds its Smart City strategy on innovative technologies, projects, knowledge management, data collection and citizen feedback [1].

3.3. Riyadh

Smart City Riyadh's Sustainability Strategy addresses five areas, such as water management, air protection, biodiversity conservation, air quality and waste reduction [7, 10].

The strategy aims to convert 94 % of waste into energy, increase water recycling from the current 11 % to 100 %, increase public transport use from 5 % to 20 %, plant 15 million green spaces in the city and reduce air pollution by 50 %. All goals, plans and sustainability strategies of Smart City Riyadh are set by 2030 [7, 10].

Specific projects for the management and protection of limited resources are focused on the use of solar and wind energy or the preservation of marine diversity [7, 10].

Diversity protection is ensured by cooperation between the city, The Red Sea Development Company and universities. The green space is implemented in an innovative way NEOM'S THE LINE, where the project is provided mainly by the participating communities based on renewable energy and regenerative development Riyadh [7, 10].

Sustainability support is held and presented not only by citizens, but also by the strategic management of the city. Through new technologies, stakeholder participation and

cooperation, a new vision for the city of Riyadh is being built [7, 10].

4. Discussion

On the performed analysis of secondary data, it was possible to summarize common and different elements of limited resource management approaches in Arab Smart Cities (Table 2).

Table 2 Common and differently identified elements of limited resource management in the analyzed cities

Element/Smart City	Abu Dhabi (Masdar)	Dubai	Riyadh
City support	Yes	Yes	Yes
Citizens' trust and support	Yes	Yes	Yes
Technology	Yes	Yes	Yes
Economic diversification	Yes	No	No
Innovation	Yes	Yes	Yes
Knowledge management	Yes	yes	Yes
Project management	Yes	Yes	Yes
Energy	Yes	Yes	Yes
Water management	Yes	Yes	Yes
Air purity	Yes	Yes	Yes
Less waste	Yes	No	Yes
Planting greenery	No	Yes	Yes
Financing from the sale of mineral oil	Yes	Yes	Yes
Cultural aspects	Yes	Yes	Yes
Monarchy	Yes	Yes	Yes
Central planning	Yes	Yes	Yes
Cooperation	Yes	Yes	Yes
Biodiversity	No	No	Yes

Source: own processing according to Results (section 3)

All analyzed cities achieve a high level of support of strategic (city, government), tactical (private companies) and operational levels of management (technology suppliers). Their strategies are centrist-oriented to trust and support citizens. The great motivation is the support of the city and the state in the field of building the sustainability of cities.

New approaches are implemented on the basis of innovations and modern technologies, especially on platforms used for data collection from the field. Through the collected data, it is possible to perform analysis and conversion of data into information. This process is important for the managerial function of planning, decision making and also knowledge management.

Resource protection and management are influenced by project management principles, as plans and strategies are implemented by various projects, which are mainly financed by the sale of mineral oil.

Within the issue of limited resources, cities focus on energy, water, greenery and air. Dubai, as the only city analyzed, does not give priority to reducing waste. Abu Dhabi is specific in the element of focus on economic diversification, Riyadh is specific in promoting marine biodiversity.

Cooperation between the primary and public sectors in the implementation of projects, plans and strategies is an essential element for all analyzed cities.

Cultural aspects, monarchy and central planning are evident in the established strategies in meeting the set goals, thus confirming the aspects typical of urban management in Saudi Arabia.

With their approach and identified elements, Arab cities are also a best practice for other global Smart Cities to manage, protect and access limited resources efficiently, sustainably and responsibly in times of climate change.

5. Conclusion

Managing and protecting scarce resources is an essential aspect of building, managing and developing global smart cities. Countries characterized by mineral oil extraction are also interested in resource protection. In Saudi Arabia, the best practices of Smart Cities of 2021 include three cities, Abu Dhabi (Masdar City), Dubai and Riyadh. Common elements are the protection of water, air resources and energy. The approach to economic diversification, biodiversity, etc. is different. These cities are best practices not only for Saudi Arabia. However, we must not forget the specific elements of cultural aspects, monarchy and central planning that work in Arabia, but may not be as effective in Europe or America.

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References

- [1] AL-DABBAGH, R. (2021). Dubai, the sustainable, smart city. *Renewable Energy and Environmental Sustainability* 7:3. DOI:10.1051/rees/2021049
- [2] Argaam. (2021). *Riyadh jumps 23 spots in Smart City Index 2021 to rank 30th globally*. [online]. [2022-01-19]. Available on: <https://www.argaam.com/en/article/articledetail/id/1507230>
- [3] FRENCH, K. (2018). *Developing a Smart and Sustainable City: Is Masdar City the Answer?* [online]. [2022-01-19]. Available on: https://www.uwp.edu/learn/colleges/socialsciencesprofessionalstudies/upload/MasdarCity2018_KF.pdf
- [4] GABR, A. (2016). *5 initiatives making the UAE perfect for eco-friendly startups*. [online]. [2022-01-19]. Available on: <https://www.wamda.com/memakersge/2016/01/5-initiatives-making-the-uae-the-perfect-place-for-eco-friendly-startups>
- [5] MOAVENZADEH, F. – KHAN, Z. (2017). *Masdar Institute. Ten Years in the Making*. [online]. [2022-01-19]. Available on: <https://www.slideshare.net/ZarinaKhan3/masdar-institute-10-years-in-the-making-by-dr-fred-moavenzadeh-with-assistance-from-zarina-khan>
- [6] NOORI, N. – HOPPE, T. – DE JONG, M. (2020). *Classifying Pathways for Smart City Development*:

Comparing Desing, Governance and Implementation in Amsterdam, Barcelona, Dubai and Abu Dhabi. *Sustainability* 2020, Volume: 12, Issue: 10, 4030.

[7] Royal Commission for Riyadh City. (2022). *HRH the Crown Prince and Chairman of the RCRC Launched Riyadh Sustainability Strategy*. [online]. [2022-01-19]. Available on: <https://www.rcrc.gov.sa/en/news/riyadh-sustainability-strategy>

[8] TOK, E. – MOHAMMAD, F. A. – MEREKHI, M. A. (2014). Crafting Smart Cities in the Gulf Region: A Comparison of Masdar and Lusail. *European Scientific Journal* 2014, ESJ 10, p. 448-460.

[9] UAE 2020. *Building a Prosperous Tomorrow*. Published by GT Media ME, Wenlock Road, London, United Kingdom. [online]. [2022-01-19]. Available on: https://issuu.com/atmyearbook2015/docs/digital_edition

[10] Vision2030 Saudi. (2022). *A Sustainable Saudi Vision*. [online]. [2022-01-19]. Available on: <https://www.vision2030.gov.sa/v2030/a-sustainable-saudi-vision/>

IMPACT OF PILLARS OF INDUSTRY 4.0 ON HUMAN CAPITAL MANAGEMENT IN COMPANIES

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Abstract: *The Fourth Industrial Revolution (Industry 4.0) represents a new concept of business operation. It has several elements (trends, technologies) that companies can use to their advantage. Thanks to modern technologies, companies can increase their performance, efficiency, or competitiveness in the market in which they operate. The pillars of Industry 4.0 generally include digitalization, automation, robotics, the Internet of Things, cloud computing, cyber-physical systems, and 3D and 4D printing. All these elements have an impact on various processes in the company (supply, production, logistics, marketing, finance, etc.), apart from personnel, e.g., human capital management. The paper aims to explain the basic concepts related to the problem of the impact of elements of Industry 4.0 on human capital management and to point out the specific impact of individual elements on human capital and whole process of human capital management.*

Keywords: *Industry 4.0, pillars of Industry 4.0, human capital, human capital management*

1. Introduction

Thanks to the fourth industrial revolution (Industry 4.0) companies can use new technologies in various areas. These technologies can help them better respond to customer requirements but also to the challenges of competition or the entire market in which they operate. Of course, they can bring them many positives, such as speeding up processes, simplifying work, reducing the workload of employees, increasing work productivity, or reducing administration. On the other hand, technologies can bring disadvantages for companies, especially in the form of higher financial costs, in the need for redundancies, or the necessary training and courses for employees.

Such modern technologies are also associated with the need to acquire highly qualified personnel who will operate the individual machines and equipment. It looks forward that there will be a shortage of staff with the necessary training, and therefore companies will have to try to improve the qualifications of their current employees through various courses and training. It can be argued that the implementation of pillars of Industry 4.0 can increase the quality of the entire human capital management process. In addition, there will be an increase in the overall performance of companies and their competitiveness in the market.

The article aim is to explain the basic concepts related to the issue of the impact of elements of Industry 4.0 on human capital management and to point out the specific impact of individual elements of Industry 4.0 on human capital and human capital management in companies.

2. The essence and pillars of the 4th industrial revolution

Industry 4.0 is an initiative of Germany and dates back to 2011. It is based on digitalization and has stimulated the emergence of smart factories in which individual machines

and devices use the Internet of Things, cyber-physical systems, and cloud computing. Smart factories provide a completely new, hitherto unknown approach to production [4, 20]. Industry 4.0 is also considered a form of digitalization and integration of information and communication technologies into individual business processes [17].

The revolution can be characterized by three factors, namely the rapid exponential pace of development, the emergence of unprecedented paradigms in the economy, business, society and finally, the overall internal transformation of all systems [22].

Industry 4.0 is expected to make a big difference in how people live, work and communicate e. g. there is a gradual relocation of individual areas of people's lives from the current (physical) to the digital environment. It is important to note, man no longer has full power and control over this environment because he governs by various algorithmic rules [17, 25].

Remarkably, previous industrial revolutions (Industry 1.0 to Industry 3.0) have been associated with the emergence of new inventions and forms of energy (energy from water, fossil fuels, steam, electricity, assembly lines, mass production, ICT) [16, 23].

Industry 4.0 is built on several pillars, including Big Data and its analysis, autonomous robots, simulations, horizontal and vertical system integrations, the Internet of Things, additive manufacturing (3D printing), cloud systems, augmented reality, cyber data protection, digitalization, and virtual reality, or 3D printing [5, 6, 19]. Another author added sensors and related technologies and cybernetics with artificial intelligence into elements [26].

Industry 4.0 is often associated with Company 5.0 because they have the same foundation (human) and use the same

elements, such as Big Data, Artificial Intelligence, The Internet of Things, and Cloud Computing [21]. Therefore, pillars of Industry 4.0 include digitalization, automation, robotics, artificial intelligence, the Internet of Things, Business Intelligence, and additive manufacturing [23].

Industry 4.0 has an impact on work productivity. Elements such as automation, digitalization, robots, and co-bots can make work easier and faster for employees. They will perform work that is endangering to health and life-threatening, thus reducing the incidence of accidents at work and reducing the costs of eliminating the factors that caused the accident (e. g. improving ergonomics in the workplace, better deployment of equipment, machinery and come.). Co-bots can also perform work that loses human creativity and creativity (routine job). In this case, employees can be assigned to jobs where creativity and originality are important. In these positions, employees can continue to grow professionally and personally. Other benefits of Industry 4.0 for companies include faster production, less downtime and failure, higher product quality, cost savings, optimization of the value chain, or increased competitiveness [10, 15].

On the contrary, the problem (disadvantage) is the change in the labor market and the related growth of unemployment. Unemployment may increase when it is not possible to retrain workers, either because of the lack of financial resources of the company or the reluctance of further training by workers. Another disadvantage is the reduction in creativity at work, which occurs by substituting human capital with machinery and equipment. This substitution will also lead to the mentioned retraining of staff [23].

3. Human capital and human capital management

Every author looks at the term "human capital" differently. In general, it can be argued that it is not just a physical asset (e. g. the physical strength of a person). It is likely a collection of innate and acquired knowledge, knowledge, skills, abilities, but also talent, creativity that a person has. The same opinion is shared by the author Goldin (2016), who defined the term human capital (HR) as an asset that includes skills, knowledge, health, education, but also the expertise of the person, which can be used at work [8].

The diversity of human capital is determined by the environment in which one lives, works, studies, but also by continuous education, whether in schools or through self-education or by the influence of other people one encounters [20].

Human capital is currently one of the factors of production. However, it is a relatively new factor of production, which joined the existing three - labor, land, capital - only a few years ago and is mainly associated with the factor of production labor [12].

Human capital management is a set of activities for managing the organization's human capital. It involves the

current knowledge, abilities, skills, and talent of man but also their importance and use for the organization or systematic development and strengthening [12, 3].

According to team of authors, human capital management is an approach in which the intangible asset of a company (people) is managed through management functions [11].

According to Kucharčíková (2019), the process of human capital management consists of seven phases [13]:

1. Identification of major skills and knowledge for achieving KPIs.
2. Quantification of the value of human capital.
3. Measuring the efficiency of human capital.
4. Analysis, evaluation, and quantification of performance impacts.
5. Identification of deficiencies.
6. Take corrective action to increase the efficiency of human capital.
7. Reporting.

Due to the elements of Industry 4.0, a new type of human capital management was created - namely digital human capital management. It represents automated, online management of all personnel processes. Individual information about employees is thus quickly available to HR managers also the employees themselves. The digital form of these personnel processes can be achieved through the implementation of highly automated and digitized information systems (HRIS) and supporting technologies (electronic signatures, cloud services) [7].

4. Materials and Methods

Various scientific methods are used in this article. In particular, it is a comprehensive content analysis of professional literature and research studies, which were selected based on two criteria:

- published in 2015 at the latest,
- keywords based on which resources were sought - human capital, human resources, human potential human capital management, Industry 4.0, elements of Industry 4.0.

In addition to content analysis, it was also used the method of synthesis and comparison.

5. Results and discussion

The onset of the fourth industrial revolution has resulted in changes in the labor market. The advent of new technologies will cause some jobs to disappear and others to transform, making it necessary to retrain employees. As a rule, the more predictable and repetitive the work, the more likely it is that employees will be replaced by technology at their site.

As many as 33 % of companies expect that they will not need as many employees as before when they introduce modern technologies [2, 18].

The above was also confirmed by the situation in the Chinese company located in Dongguan City. In this company, up to 90 % of workers were exchanged for machinery and equipment. This step has increased productivity by up to 250 % and reduced errors and failures by 80 %. Automation is, in this case, rather negative for the labor market. As from the original 650 employees, their number has been reduced and, in the company, work only 60 of them. It is important to note that the company initially considered reducing the number of employees to only 20 [9].

Industry 4.0 requires highly qualified staff with the necessary IS/ICT and digital knowledge and skills. Only, in this way, it will represent added value for the company, but also for the country's economy itself [21]. The nature of the work will also change. Normal routine activities will be performed by machines and equipment (modern IS/ICT); therefore, employees will have to supplement their education or retrain [1]. It will be necessary for them to increase the value of their human capital.

The most important finding is that the implementation of the elements of the Fourth Industrial Revolution does not result in the substitution of human capital for machinery and equipment, but their interaction [20].

The irreplaceability and great importance of human capital have also been confirmed in the context of digital progress, which is joined to the introduction of digital technologies in businesses, and human capital plays a significant role. People are the ones who become a central part of the business, not only because of their work but also because of their knowledge, skills, and competencies in digital technologies. Therefore, companies should focus on human capital and potential and not on financial and real capital. In the age of digital technologies, the emphasis is on various knowledge and skills as labor components of HC, e. g. on the digital skills and competencies, ICT literacy, e-skills, the ability to adapt to new environments and, finally, digital literacy, which will enable people to work in a digital environment intuitively. Due to this, people's skills are divided into two large groups, namely hard skills, which represent the primary competencies - technical skills, abstract thinking, the ability to create and work with written text, count and work with computers. The second group consists of the so-called soft skills, e.g., flexible competencies - the ability of teamwork, decision-making, communication, and application of a situational approach to work. In addition, the quality of human capital at the time of digitalization also includes characteristics such as knowledge of foreign languages, mobility, high level of education, ability to use computer programs, independence, or creativity. The impact of digitalization on human capital is arduous to determine because mathematical and statistical methods for evaluation are not sufficiently developed [24].

One study shows that the number of children attending school facilities (secondary schools) increased by up to

55% at that time. As a result, they have increased their education, expanded their knowledge, skills, and abilities, thus contributing to the faster development of the manufacturing industry. The authors recommend a similar pressure in investment in education at present. It would provide personnel with the required knowledge ready for Industry 4.0 [14].

It can be argued that the elements of Industry 4.0 are important for the company. On the one hand, thanks to them, the company can gain a competitive advantage in the market in which it operates, on the other hand, these elements bring many changes, especially in the field of human capital and labor market.

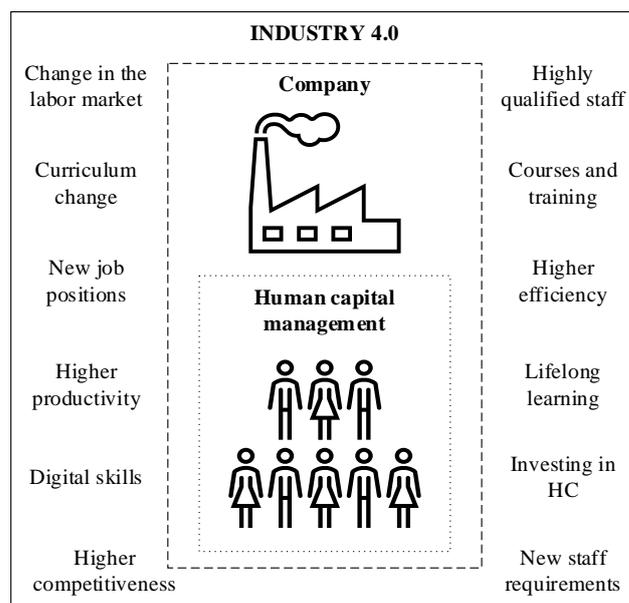


Figure 1: Influence of Industry 4.0 on human capital
Source: own processing

The article shows that in providing activities in the field of human capital management, the implementation of elements and technologies of Industry 4.0 will increase the demands on companies to invest in human capital through education and ensuring the required structure of its components.

6. Conclusion

Industry 4.0 is a big challenge for businesses. Its elements will affect all business areas. The financial and personnel aspects are important in the implementation of Industry 4.0 elements. The authors almost unequivocally agreed that Industry 4.0 would bring enormous changes to the labor market. The reason will be new technologies, for the operation of which it is necessary to have digital knowledge and skills as element components of human capital. Is it possible to speak that Industry 4.0 will significantly change the labor market? Yes, it is. It is based on the studied literature. Several authors have agreed that there will be a change in jobs, especially in the aspect of their nature. As a rule, the more routine and repetitive the work, the more likely it is that a machine - a modern

technology and not a human - will work in each workplace.

In the case of Industry 4.0, companies cannot focus only on the technology they want to use and implement. Emphasis should also be placed on employees who are the bearers of human capital because it represents the intangible wealth of every business, and they are the ones who will work with the new digital technologies. About employees, the question is: "What are the key skills, abilities and knowledge of people for Industry 4.0?". Knowledge of foreign languages, IT and digital literacy, critical and analytical thinking and lifelong learning were identified as a necessity. Education, one of the options for investing in human capital, is related to modern technologies. As technologies evolve and modernize rapidly, it is necessary to adapt the knowledge and skills of employees.

Therefore, it can be argued that on the one hand, technology will help companies to eliminate accidents at work (substitution of human capital by technology for dangerous jobs), but on the other hand, routine and stereotypical work performed by lower-skilled workers will disappear. If such workers want to continue working, they will have to retrain to acquire the necessary knowledge and skills so they can be transferred to a different position than before. Given this, there must be procedures, standards, or methodologies for how companies should implement elements of Industry 4.0. This implementation will lead to increased demands on financial resources. At the same time, it will be increased pressure to evaluate the effectiveness of investment in education and the efficiency of exploitation of human capital as part of the human capital management process.

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References

- [1] Agolla, J. E. *Human Capital in the Smart Manufacturing and Industry 4.0 Revolution*. In: Petrillo, A., R. Cioffi, F. De Felice, Digital Transformation in Smart Manufacturing. DOI: 10.5772/intechopen.73575, s. 44, 2018
- [2] Berkovič, V., Krajčo, K. *Štruktúra pracovných miest v budúcnosti z pohľadu zamestnávateľov*. Conference: The impact of Industry 4.0 on job creation. Pp. 69-74, ISBN: 978-80-8075-939-1, 2021
- [3] Cahyaningsih, E., Sensuse, D. I., Noprison, H. *Multi Methods for Knowledge Management Strategy Roadmap of Government Human Capital Management*. In: Procedia Computer Science. Vol. 124, pp. 496-503, 2017
- [4] Crnjac, M., Veža, I., Banduka, M. *From concept to the introduction of industry 4.0*. In: International Journal of Industrial Engineering and Management, vol. 8, issue. 1, pp. 21-30, 2017
- [5] Demir, K. A., Doven, G., Sezen, B. *Industry 5.0 and Human-Robot Co-working*. Procedia Computer Science. Volume 158, pp. 688-695, 2019
- [6] Erboz, G. *How to Define Industry 4.0: The Main Pillars of Industry 4.0*. At: Conference: Managerial trends in the development of enterprises in globalization era. Pp. 761-767, 2017
- [7] <https://images.forbes.com/forbesinsights/StudyPDFs/Adobe-HumanCapitalManagement-REPORT.pdf>
- [8] Goldin, C. *Human capital*. Pp. 55-86, DOI: 10.1007/978-3-642-40406-1, 2016
- [9] <https://www.weforum.org/agenda/2017/02/after-replacing-90-of-employees-with-robots-this-companys-productivity-soared>
- [10] Kicová, M. *Enterprise's process innovations in the context of enterprise's financial performance*. Strategic Management. Volume 24, pp. 3-13, 2019
- [11] Kucharčíková, A., Bogačíková, S., Chovanec, P., Štefaníková, Z. *Manažment ľudského kapitálu alebo manažment ľudských zdrojov?*, 2014
- [12] Kucharčíková, A., Tokarčíková, E., Blašková, M. *Human Capital Management – Aspect of Human Capital Efficiency in University Education*. Vol. 177, pp. 48-60, 2015
- [13] Kucharčíková, A. *The Human Capital Management*. In Enterprises in Žilina Region of Slovakia, VI. International Strat. research congress, 2019
- [14] <https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages>
- [15] Miller, A., Miller, M. *Study of the problems of technological integration in the manufacturing industry in Russia*. Strategic Management. Vol. 24, pp. 33-42, 2019
- [16] Nahavandi, S. *Industry 5.0 – A Human-Centring Solution*. DOI: <https://doi.org/10.3390/su11164371>, 2019
- [17] Neumann, W. P., Winkelhaus, S., Grosse, E. H., Glock, Ch. H. *Industry 4.0 and the human factor – A systems framework and analysis methodology for successful development*. International Journal of Production Economics. Vol. 233, 2021
- [18] <https://www.oecd.org/employment/good-jobs-for-all-in-a-changing-world-of-work-9789264308817-en.htm>
- [19] Oztemel, E., Gursev, S. *Literature review of Industry 4.0 and related technologies*. In: Journal of Intelligent Manufacturing. Vol. 31, pp. 127-182, 2020
- [20] Pilichowska, P. *Human capital as a condition for the development of Industry 4.0 in the European Union countries*. Studies of the industrial geography commission of the Polish geographical society. Vol. 35, No 2, pp. 9-26, 2021
- [21] Polat, L., Erkollar, A. *Industry 4.0 vs. Society 5.0*. The International Symposium for Production Research. Pp. 333-345, 2020
- [22] Schwab, K. M. *Die Vierte Industrielle Revolution*. Pantheon, München, p. 12, 2016
- [23] Sima, V., Ghorghhe, G. I., Subić, J., Nancu, D. *Influences of the Industry 4.0 Revolution on the Human Capital Development and Consumer Behaviour: Systematic Review*. Sustainability. Vol. 12, No 10, 2020

- [24] Zaborovskaia, O., Nadezhina, O., Avduevskaya, E. *The Impact of Digitalization on the Formation of Human Capital at the Regional Level*. Journal of Open Innovation: Technology, Market and Complexity. Pp. 1-24, 2020
- [25] Zakharov, N., Kuznetsov, A., Britvina, I. *The dilemma of job creation and loss before of Industry 4.0*. In: *Vplyv Industry 4.0 na tvorbu pracovných miest 2019*. Publishing House Alexander Dubček University in Trenčín, pp. 457-462, 2020
- [26] Záležáková, E. *Nástup Industry 4.0*. In: *Manažment podnikania a vecí verejných: vedecko-odborný časopis*. Roč. 13, č. 7, s. 1-9, 2018

INFOTAINMENT AND ITS CHANGES IN COMMERCIALIZATION OF RADIO NEWS

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Abstract: *The article deals with implementation of infotainment in the broadcasting of private radio broadcasting, especially within the news block. Radio news is an essential part of the broadcast structure, but like other formats, the structure of news is changing. The need to survive in the media marketplace within commercial radio stations is forcing them to adapt the content and simplify the interpretation of news content and even the news itself. Listeners are therefore seeing the work of news presenters change, new elements are being added to broadcasts, they are hearing under-reporting of serious news, lightweight reporting designed to entertain or engage the listener. In the Slovak Republic, there are significant players in the radio market, especially the two most listened private radios, Rádio Expres (Bauer Media Group) and FUN Rádio (Fun Media Group), which set the direction and new trends in the field of infotainment. It leads to the commercialization of media. This study will focus specifically on finding out the different elements of infotainment in the news blocks of the aforementioned radios.*

Keywords: *radio, commercial broadcasting, news service, infotainment, commercialization*

1. Introduction

Radio news is a fixed part of the broadcasting programme structure of this type of media. It is intended to provide prompt information on current events to be interpreted for listeners by experienced radio personnel. The shape of broadcasting is changing due to many factors, and the shape of public service and commercial broadcasting is also different. Commercial radios create their content based on agency ratings' results. Broadcasters consult agencies not only for the music format but also for the overall broadcasting to fit a certain target group. Editorial offices get smaller and individual employees get multiple job functions now, as a result of financial cuts [1]. The changes in commercial radios affected for example the length of news service programs, but also blocks as well as their preparation and usage of various radio broadcasting journalistic genres [2]. This article is mainly devoted to the changes in the field of radio news, and in particular to the various infotainment elements that are part of radio news.

1.1 Radio broadcasting

In general, radio functions are divided into five categories: news and information, education and advertising of goods, services and entertainment and the last one persuasion and actuation [3]. It is the entertainment function that seeps into other parts of the broadcast where we have not seen the infotainment phenomenon in the past. It is news that should report on various events in a serious and consistent manner. A news broadcast is a generally isolated and closed section of a program that is divided from the rest of the program by a verbal or auditory signal (sound, gong, pause, etc.) or composition. The dramaturgy of this part of broadcasting is consistent [4].

However, the news blocks are being adapted to the new times and to engage the listener, their length is being shortened, simple language is being used, as well as the repetition of individual news items, which are gradually being developed in the broadcast. It is true that the news block still focuses on important parts of life from home and the world, but the form of the news is changing. The information is often presented in an entertaining and engaging way, with the presenter's voice accompanied by a musical underscore. Reports contains shocking findings also make their way into the news bulletins, especially in the case of commercial radio. Also, the editorial office of the employees who prepare the material is shrinking. Sports, weather and traffic information (in some cases called traffic service) are also part of the news coverage. The weather and traffic service is also often used by private broadcasters to sell sponsorship messages that are not allowed to appear in the news [5]. Thus, radio broadcasting is clearly keeping up and applying all the ways to stay current and keep listener.

1.2 Infotainment

The term „infotainment“ refers to the blending of entertainment with journalism in many media genres. Infotainment is a language mashup of information and entertainment can be regarded as two parallel developments: news becoming more entertaining, and entertainment taking on political themes. As a result, infotainment should not be considered a separate news genre [6]. This relatively new term has a wide range of connotations and isn't always related with news. It has been used to describe a wide range of content phenomena, including soft news, personalization, and human interest in traditionally hard news TV formats; talk show genres that combine seriousness with levity, factual opinions with private feelings; journalists' popular, lighthearted, or emphatic style; and the introduction of music,

dramatization, and fictional elements in informational journalistic genres.

It blurs the line between information and entertainment. Infotainment is employed as a normative notion - even as a pejorative term. The allegation of detrimental impacts takes many forms: from public „dumbing down,“ which affects our sense of reality and promotes a cynical perspective of politics, to disengagement, and finally, the demise of our civic culture [7]. The emergence of infotainment began in the late 1980s, when government prohibitions in a number of nations were eased, allowing private parties to transmit television for the first time. With the introduction of commercial television channels, audiences were increasingly divided and a result was that, news organizations could no longer just assume that people would watch or listen. The new media environment offers so many options that citizens who are uninterested in politics may easily skip the news. To sustain advertising income, a consumer-centered approach to news production has supposedly taken hold, in which the public is seen as customers who want to be amused rather than citizens who need to be informed [8]. All of this results in the quality of news programmes and their production being heavily oriented towards the aspect of attracting audiences and making the content more attractive as they seek to survive economically. The public interest thus takes a back seat, as does audience education.

Commercialization of private Broadcasting

The critique of commercialization is especially difficult to reconcile with the redemption of the popular, because popularity is almost always a prerequisite for economic success, and disliking one entails disliking the other. While the word „commercialism“ may refer objectively to specific free-market arrangements, it has also come to have implications for the sort of mass-produced and ‘marketed’ media content, as well as the relationships between media producers and consumers [9]. Commercialization and the profit incentive, on the other hand, have their limits. Even publicly traded media firms rely on a degree of journalistic innovation, inventiveness, and a desire to work hard. Readers and viewers have high expectations of the news as a source of information. This has resulted in, and will continue to result in, acute tensions between goals concerned with „maintaining the institution of news journalism“ on the one hand, and the needs of financial market operators on the other [10]. Radio media are therefore struggling with various aspects of work: whether adapting to individual new trends in system of broadcasting, the accumulation of job positions, but also the outflow of listeners. For this reason, they have to do everything to survive from a marketing and economic point of view and still be a fully-fledged part of the media market in the conditions of the Slovak Republic.

2. Infotainment elements in private radio broadcasting Methodology

For the purposes of the paper, we select only a portion of the extensive research that was conducted in late 2021. The research focused on „current trends in news broadcasting by licensed broadcasters (commercial radio stations)“. In this scientifically rigorous quantitative media research, we analysed in detail the news broadcasts of the two most listened to radio stations in Slovakia. Within the scope of the topic on which this scientific article is focused, we have selected only a part of the aforementioned research, which is devoted to infotainment, and has not been published in its entirety in a comprehensive study so far. This is therefore new information that has not been published before. For the data collection in the mentioned research we have chosen a quantitative method of media content analysis.

Indicators related to the characteristics of news content and form of the selected radio in the context of infotainment were monitored

Are the news underplayed, a combination of informing and entertaining, sensationalism, events presented in a brief and simple way, with an emphasis on distraction rather than on the social relevance of the information, editors combine facts with various considerations and speculations.

The research sample consisted of the main news programs of the two most listened commercial radios in Slovakia: INFOEXPRES (Rádio Expres) and SPRÁVY FUN RÁDIA (FUN Rádio) [11]. We listened to the news shows during primetime, in the morning from 06:00 a.m. to 09:00 a.m. and in the afternoon in blocks from 14:00 p.m. to 20:00 p.m. In addition, we included weekend newscasts from the 10:00 a.m. to 3:00 p.m. block on Saturdays and Sundays. The subject of the research was the news coverage in one selected week (7 days) in the date range of November 1st-7th, 2021. A short pre-survey preceded the analysis of the media content to validate the methods used and the selected categories of interest.

Brief characteristics of the selected radios

Rádio EXPRES – this radio has been broadcasting since December 1999. Its Hot AC music format predominantly seeks to appeal to listeners aged 20 to 40 with secondary and higher education. In addition to music, the broadcasts include news, traffic service and other informative and entertaining features [12]. Rádio Expres has been the most listened to radio in Slovakia for several years. INFOEXPRES news is mostly made up of agency news. The news is broadcast throughout the day always at the full hour and during prime-time in the morning (06:00–10:00), in addition to the main news, the so-called INFOEXPRES PLUS is also broadcast always at half past each hour.

FUN Rádio – it is the first Slovak private radio, which has been broadcasting since June 1990 [13]. Initially, the broadcast from the studio in Bratislava covered 4 hours,

for the rest of the day the signal from the French Fun Radio broadcast was taken over. Gradually, the broadcasts from Bratislava expanded – from 4 hours to 12 to the final 24 hours a day. Today its musical profile places it in the CHR (Contemporary Hit Radio) category. In addition to music, it provides listeners with a full information service throughout the day – news, traffic service or weather reports [14]. Fun Radio's news is mostly made up of agency news, sometimes also using information from various news websites. News is broadcast throughout the day. In the morning broadcast (06:00–10:00), in addition to the main newscast on the full hour, a one-minute quick newscast „Slovakia and the world in 60 seconds“ is also broadcast.

3. Results

As part of the qualitative content method, we analysed 167 broadcasted news blocks in our selected radio stations (102 news blocks in Rádio Expres, 65 news blocks in FUN Rádio).

Table 1 Number of news blocks broadcast in the period under the research

<i>Together week (1. – 5. november 2021)</i>		<i>Together weekend (6. – 7. november 2021)</i>	
Rádio Expres	FUN Rádio	Rádio Expres	FUN Rádio
90	65	12	0
TOTAL: 167			

Source: own processing, 2021

Infotainment has long since become a fixed part of commercial broadcasting. Using our research, we have been investigating how this element of commercialisation is emerging in news broadcasting. We can conclude that infotainment appeared in every news block we analyzed for both commercial radios. Of course it appears in different forms. But what we can say unequivocally is that the commercial radio stations are also trying to adapt the news to the masses and make its content more „digestible“. The news bulletins are shorter, all contributions are taken from the agency news, during PRIME time, the news is broadcast every 30 min (main news every full hour, short news every half hour).

The research uncovered the most common elements of infotainment:

- underplaying a news blocks,
- the brevity of news,
- informal speech,
- teasing and linking for other shows (self promotion),
- teasing of the weather forecast,
- sounded headline,
- traffic information moved to the beginning of the news bulletin (FUN Rádio).

Table 2 Selection of the most used infotainment elements in the news

<i>Elements of infotainment</i>	<i>in %</i>
Advertising before the weather or traffic info	90.4
Background music	80.2
Teasing weather and traffic ahead of news	57.5
Brevity	50.9
Weather information at the beginning	46.7
Sounded headline	37.7
Read text only	26.3
Teasing of another own programe	21.0
Slang words	14.4
Added sound effects to some sports news	14.4

Source: own processing, 2021

In general, we can say that the structure of commercial news is based on 3 to 4 news stories, to which 1 or 2 sports stories are added. The news block usually consists of social information and sport but also includes weather information. It is not true that the news starts mostly with headlines. This is always the case with Rádio Expres, but it is not the case of FUN Rádio. In case of FUN Rádio, the news block always starts with the traffic service and then continues with the news itself, followed by the weather. As part of the infotainment, some radios also involve their editors in the broadcast. Talking about Rádio Expres, this is noticeably marked. The editors are queried, they also enter the broadcast apart from the newscast. The listener can thus also perceive them differently as people who interpret facts and deliver breaking news. In contrast, in FUN Rádio, the news editor does not enter the broadcast at all, only when reading the news. The listener thus has no chance to get to know the news anchor better.

4. Conclusion

The analysis clearly showed that there are elements of infotainment in the broadcasts of the two most listened to commercial radios in Slovakia (Rádio Expres and FUN Rádio). Of the selected aspects, advertising before traffic and weather information was the most frequent, and sub-feeds and the use of music in the news block were also very frequent. The news blocks of commercial broadcasters tend to be short and clearly worded reports that highlight the current political situation, social information, but there are always references to weather or sports with traffic information that may be useful to listeners. All types and forms of infotainment have the ambition to become a fixed part of broadcasting so that they can attract listener's attention. The thing to engage the listener is the voiced or better said sounded headline, which authentically complements the message and can draw the listener into the action. News creators may be part of the broadcast, but it must also be constantly reiterated that the presenter is a professional user of the language, and therefore care must be taken to ensure correct grammar and the omission of slang terms, dialect or scientific words.

This is also how broadcasters try to approach the listener, in addition to taking legitimate and correct steps. The use

of infotainment could be divided into several groups, namely audio: sound headlines, sound effects during sports news (e.g. during a football match, etc.), underplaying of news blocks; advertising: advertising before weather and traffic information, teasing of the weather, other programmes; but also formal: use of slang words, reading of text, short and concise information in the news, without explaining the context more extensively. People are increasingly turning away from conventional forms of news coverage in favor of lighter alternatives (e.g., entertainment) or using these new news formats in addition to traditional news consumption. People watch media (including news shows) not just to get information but also to be amused, establish views, and be prepared for future social interactions, according to the uses-and-gratifications hypothesis [15]. Clearly and distinctly worded messages that are intended to carry informational value have merit, but it is important to pay attention to the form, which is also part of the broadcast and speaks volumes about the quality of the individual media outlet. Commercial broadcasters are also fighting for listeners through the elements they put forward to diversify and appeal to listeners, specifically in ways that have not been used to such a significant extent in the past. For this reason, too, the topic of infotainment and change in radio work is timely and needs to be continually explored.

Bibliography

- [1] BRNÍK, A., BÔTOŠOVÁ, E., KAPEC, M.: Current Changes in the News Service of Commercial Radio Stations in Slovakia. In: BRYZGALOVA, E. N., RUSAKOVA, O. F. (eds.): *Diskursologija i mediakritika sredstv massovoj informacii: 3 meždunarodnaja naučno-praktičeskaja konferencija*. Belgorod : Politerra, 2021.
- [2] BRNÍK, A., BÔTOŠOVÁ, E., KAPEC, M.: Changes In Broadcasting To Keep A Listener In Commercial Radios In Slovakia. In: MCGREEVY, M., RITA, R. (eds.): *CER Comparative European Research 2021*. London : Sciemcee Publishing, 2021. [online]. [2022-03-02]. Available at: <https://www.sciemcee.org/library/proceedings/cer/cer2021_proceedings01.pdf>.
- [3] KUYUCU, M.: The Functions of Radio and Their Future in the Evolving Radio Broadcasting. In: *The Journal of Academic Social Science Studies*, 2016, Vol. 13, No. 1, ISSN 2329-9150. [online]. [2022-03-30]. Available at: <https://www.researchgate.net/publication/303901022_The_Functions_of_Radio_and_Their_Future_in_the_Evolving_Radio_Broadcasting>.
- [4] HUDÍKOVÁ, Z., HABIŇÁKOVÁ, E.: *Radio Broadcasting and Radio Production*. Trnava : Faculty of Mass Media Communication, University of Ss. Cyril and Methodius in Trnava, 2018.
- [5] BRNÍK, A., BÔTOŠOVÁ, E., KAPEC, M.: *Rozhlasová tvorba a prax*. Trnava : FMK UCM in Trnava, 2020.
- [6] BOUKES, M.: Infotainment. In: VOS, T. P., HANUSCH, F. (eds.): *International Encyclopedia of Journalism Studies: Forms of Journalism*. Hoboken (NJ) : Wiley-Blackwell. [online]. [2022-01-30]. Available at: <https://www.researchgate.net/publication/332737698_In_fotainment>.
- [7] BRANTS, K.: Infotainment. In: KAID, L., HOLZTBACHA, CH. (eds.): *Encyclopedia of Political Communication*. California : Sage, 2008. [online]. [2022-01-30]. Available at: <https://www.researchgate.net/publication/267448165_Infotainment>.
- [8] BOUKES, M.: Infotainment. In: VOS, T. P., HANUSCH, F. (eds.): *International Encyclopedia of Journalism Studies: Forms of Journalism*. Hoboken (NJ) : Wiley-Blackwell. [online]. [2022-01-30]. Available at: <https://www.researchgate.net/publication/332737698_In_fotainment>.
- [9] MCQUAIL, D.: *McQuail's Mass Communication Theory*. 6th Ed. London : Sage, 2010.
- [10] ALLERN, S.: Journalistic and Commercial News Values News Organizations as Patrons of an Institution and Market Actors. In *Nordicom Review*, 2011, Vol. 23, No. 1, p. 137-152. ISSN 14031108.
- [11] *Kontinuálny multiklientský prieskum spotrebného správania, mediálnej konzumácie a životného štýlu*. [online]. [2022-01-14]. Available at: <<https://www.median.sk/sk/mml-tgi/>>.
- [12] *Rádio Expres*. [online]. [2022-01-14]. Available at: <<https://www.radia.sk/radia/expres>>.
- [13] *Fun Rádio*. [online]. [2022-01-14]. Available at: <<https://www.funradio.sk/clanok/750-o-nas-o-fun-radio/>>.
- [14] *Fun Rádio*. [online]. [2022-01-14]. Dostupné na: <<https://www.radia.sk/radia/fun>>.
- [15] BOUKES, M.: Infotainment. In: VOS, T. P., HANUSCH, F. (eds.): *International Encyclopedia of Journalism Studies: Forms of Journalism*. Hoboken (NJ) : Wiley-Blackwell. [online]. [2022-01-30]. Available at: <https://www.researchgate.net/publication/332737698_In_fotainment>.

PERCEPTION OF SUSTAINABLE DEVELOPMENT BY MANAGERS IN SLOVAK MANUFACTURING ENTREPRISES

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Abstract: Awareness of sustainable development is still insufficient in enterprises. It may be due to the low motivation of managers to acquire new knowledge in these areas. My primary aim was to determine managers' knowledge and understanding of sustainable development and corporate social responsibility in manufacturing enterprises. The practical part of the paper sets out research hypotheses that are statistically verified. The survey was conducted in 2021 and 2022. Three hundred one managers from manufacturing Slovak enterprises attended it. Some of the enterprises were of foreign origin (German, Czech, Danish, Polish and others).

Keywords: sustainable development, corporate social responsibility, manufacturing enterprises, reporting

1. Introduction

The macroeconomic and dynamic environment assumes that enterprises will behave sustainably based on their beliefs [1]. Sustainable development is a persistent phenomenon that requires the development of procedures and policies for the adequate implementation of sustainable development [2]. Some enterprises have made their efforts and started to create workplaces focused on sustainable development to minimise waste and save electricity and natural resources. All this is done to achieve the objectives of AGENDA 2030 proposed by the United Nations [3]. However, when choosing goals, the enterprise must pay attention not only to economic sustainability [4], but also to reducing the negative impact of its activities on the enterprise's surroundings.

The enterprise's sustainable orientation brings many benefits. Better enterprise's image and improve enterprises' long-term performance [5]. Many enterprises are implementing measures to present themselves as an enterprise focused on sustainable development. But these measures are far from sufficient. Enterprises carry out their sustainable activities chaotically, without feedback, control and reporting. Two authors [6] examined the relationship between measures contributing to sustainable development and corporate social responsibility reporting. However, they have failed to find how managers measure and record progress in sustainable activities and corporate social responsibility in enterprises. The authors [7] add in their study that corporate social responsibility reporting is better in the more significant enterprise (i.e. it has more employees and adequately sets up environmental management).

Because of the above shortcomings, it is necessary to perceive the need to create measures aimed at social responsibility and sustainable development. It is required to revise existing metrics to record and report on corporate social responsibility and sustainable development. It is also desirable to create new frameworks for recording corporate

social responsibility and sustainable development, which managers could apply on the strategic level of management. This is especially important due to the high waste of natural limited as well as unlimited resources. [8]

2. Methodology

The paper aims to determine the measure of the size of the enterprise that affects the knowledge and implementation of sustainable development and corporate social responsibility (CSR).

The questionnaire is created on the basis of the following mind map, which was designed on the basis of previous knowledge.

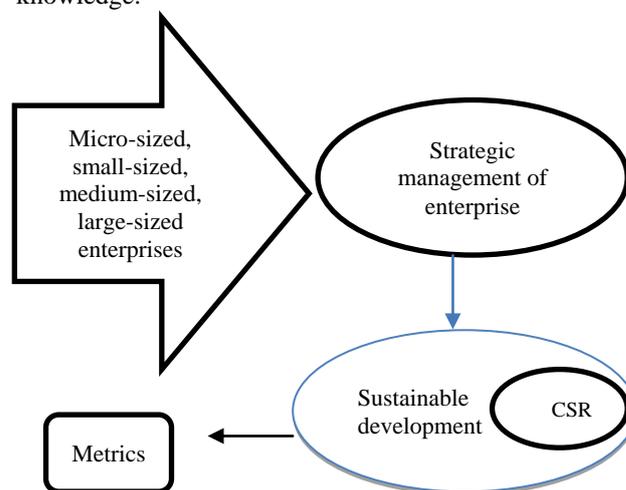


Figure 1: Elements of questioning in the survey

In the research participated 301 Slovak managers of manufacturing enterprises answered questions concerning the relationship of management to sustainable development and corporate social responsibility.

The structure of enterprises within the questionnaire by size and their count is shown in the following table 1:

Table 1 Structure of the sample according to the size of the enterprises in the questionnaire survey

Size of enterprises	Number of Enterprises
Micro-sized enterprises	96
Small-sized enterprises	122
Medium-sized enterprises	47
Large-sized enterprise	36
Total	301

Small-sized enterprises had the highest number based on the size of the enterprise, precisely 40.53%. On the other hand, large-sized enterprises were represented only 11.96%.

The first main question in the questionnaire survey was to find out the knowledge about CSR, and thus whether the term is a CSR for the management of a manufacturing enterprise known.

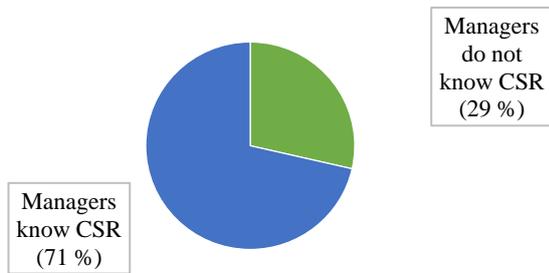


Figure 2: Percentage of responses to management knowledge about CSR

The following question focused on the use of CSR measurement systems. An important finding is that up to 56.9% of companies do not use CSR recording systems. Instead, the use of ISO standard 26000 has emerged as the most widely used tool. A relatively even distribution I found for EFQM (5.41%), CRI (4.59%), GRI (4.59%) and other internal systems (6.22%).

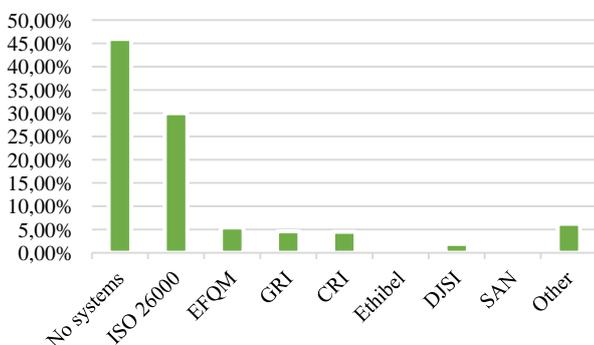


Figure 3: Percentage of responses to the survey of the use of CSR measurement systems

In another question, the questionnaire focused on raising awareness of the concept of sustainable development. The results show that up to 56.2% of production managers do not have knowledge of sustainable development and its nature. The remaining 43.8 respondents encountered this concept, most often at work (46.2%), via the Internet and TV (30.1%), in private (13.3%) and from acquaintances (9.1%).

The last question asked about managers' interest in expanding knowledge about sustainable development. The answer received the highest number in which managers are interested in expanding knowledge about sustainable development, but only if the knowledge and its application will have a significant benefit for the company. Out of the total number of 301 respondents, up to 18% of respondents are not interested in further expanding their knowledge about sustainable development, even if the management did not know this concept.

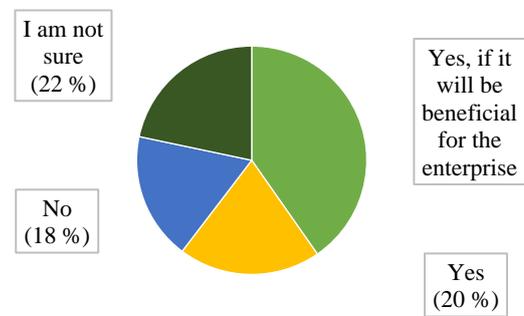


Figure 4: Percentage of responses to management's knowledge of sustainable development

2.1 Determination and verification of research hypotheses

- The following hypotheses are set out in this paper:
- H1: Most of managers in manufacturing enterprises do not have knowledge of UR.
 - H2: A significant number of enterprises do not carry out activities that contribute to UR.
 - H3: More than half of companies use indicators and measurement systems to record UR in enterprises.

The hypotheses were verified by statistical testing, specifically the binomial test at a significance level of 0.05.

2.2 Results of the research

The first hypothesis was to determine whether managers know about sustainable development. Knowledge of sustainable development is necessary for managers due to the follow-up of other measures and activities in the enterprise. Therefore, it is essential that management has knowledge of sustainable development and can use its understanding correctly in practical decisions concerning the enterprise's activities.

When verifying hypothesis H1, we compared the final value of the binomial test with the significance level 0.05. The resulting value (p-value) is 0.032, which is less than the specified level of significance. We have found that more than half of manufacturing managers do not know about sustainable development. It represents a significant limitation in implementing management decisions and measures in the enterprise in the context of sustainable development.

The second hypothesis in the field of determining the active knowledge of management about sustainable development focused on the analysis of activities performed in the enterprise, which contribute to the sustainable behaviour of the enterprise. The value of the binomial test (1) was compared with a significance level of 0.05. After a statistical evaluation, we concluded that it is not true that a significant number of enterprises do not carry out sustainable activities.

Hypothesis H3 was developed to determine the extent of using indicators and value measurement systems that show a sustainable character. In our opinion, it is necessary to establish metrics based on which the management can make good decisions in the future orientation towards sustainable development. The resulting value (0.9895) compared with the level of significance 0.05 allowed us to accept the null hypothesis, which has the wording: Most 50% of enterprises use indicators and systems of measuring and recording UR, in other words, at least 50% of enterprises do not use indicators and sustainable development measurement and recording techniques.

3. Conclusions

The survey turned out that the management of manufacturing companies in the Slovak Republic does not have sufficient knowledge about sustainable development and corporate social responsibility. As a result, company managers do not, in principle, focus on sustainable development in their activities.

In the end, we can state that management generally has a low knowledge of sustainable development, even though it consciously or unconsciously performs activities that contribute to the sustainable direction of the enterprise. In general, however, management does not have operational knowledge due to the low use rate (and development) of indicators and value measurement systems, which show a sustainable character (at least half of enterprises do not use them).

Therefore, in our opinion, it is necessary to take appropriate measures that would be able to raise awareness in the management of manufacturing enterprises about sustainable development. Enterprises can't be sustainable if they do not have sufficient information about it and are unaware of this necessity for sustainable production.

Acknowledgements

This work was supported by Grant System of University of Zilina No. 13847/2021. Scheme of a model designed for effective business management in the context of the principles of sustainable development. And by VEGA 1/0382/19 – The building of sustainable relationship with the enterprise's stakeholder groups via the creation of value with the application of information-communication technology

References

- [1] Azevedo, B.D., Scavarda, L.F., Caiado, R.G.G., *Journal of Cleaner Production*, Vol. 233, pp. 1377-1386, 2019
- [2] Govindan, K., Shankar, K.M., Kannan, D. *International Journal of Production Economics*, Vol. 227, pp. 1-13, 2020
- [3] Ali, S.S., Kaur, R., Persis, D.J., Saha, R., Pattusamy, M., Sreedharan, V.R. *Annals of Operations Research*, pp. 1-33, 2020
- [4] Klieštík, T., Valášková, K., Švábová, L., Adamko, P. *Sustainability*, Vol. 10, pp. 1-15, 2018
- [5] Mani, V., Jabbour, C.J.J., Mani, K.T.N. *International Journal of Production Economics*, Vol. 227, pp. 1-13, 2020
- [6] Brammer, S., Pavelin, S. *Business Strategy and the Environment*, Vol. 17, pp. 120-136, 2008
- [7] Ramos, T.B., Cecílio, T., Douglas, C.H., Caeiro, S. *Journal of Cleaner Production*, Vol. 52, pp. 317-328, 2013
- [8] Tu, J.C.H., Lo, T.Y., Sie, Y.J., Kao, T.F. *Sustainability*, Vol. 13, pp. 1-16, 2021

ANALYSIS OF THE RELATIONSHIP BETWEEN REVENUES AND PRODUCED NITROGEN OXIDE EMISSIONS OF MANUFACTURING ENTERPRISES IN THE SLOVAK REPUBLIC

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Abstract: Many countries perceive environmental pollution as a serious global problem. Despite government measures and strict laws, emissions are not being reduced. A large amount of emissions that are released into the air come from manufacturing enterprises. The paper focuses on the analysis of the relationship between economic and environmental indicators and the possibilities of influencing this relationship. It is also investigated how the production of nitrogen oxide emissions in Slovak republic changes over time and how the produced nitrogen oxide emissions are distributed in the regions of Slovak republic.

Keywords: manufacturing enterprises, nitrogen oxide emissions, sustainable development

1. Introduction

Rising temperatures on Earth, dynamically changing weather and deteriorating air quality are a major global problem [1]. Air pollution results in a deterioration of people's physical as well as mental health [2]. For this reason, it is necessary to address the issue of reducing emissions, especially from cars and manufacturing enterprises. Emissions were reduced in 2020 due to the ongoing COVID-19 pandemic [3]. The air has improved in several industrial parts of the world [4]. However, this period did not last long and the expansion of the industry returned to the situation as before the COVID-19 pandemic.

It is evident that it is not possible to stop and limit production to improve the quality of the environment. However, it is essential that measures are taken in enterprises to keep emissions to a minimum. Reducing the negative impact on the environment requires a lot of effort on the part of organizations, states and enterprises.

The continuous introduction of innovations, which may have a material character, e.g. technological innovation, but also intangible innovations, for example the implementation of sustainable indicators. In particular, the implementation of environmental innovation is receiving increasing attention [5].

Implementing environmental innovations that reduce emissions is a time-consuming process. Important factors in this case are: the nature of production, the type of emissions produced and management's knowledge of sustainable development and its need. Some of the research shows that there has been a recent slowdown in the uptake of environmental innovation in manufacturing enterprises [6,7]. The research results point in particular to the factors influencing this fact, and these are the impact of the COVID-19 pandemic as well as the political consequences and the instability of the market environment.

It is clear that the trend of environmental measures is declining, which can have very serious consequences for the environment. It is especially important for researchers to convince managers of the need to use metrics and indicators to record the values of sustainable development in the enterprise.

Only on the basis of a properly functioning measuring system of sustainable development values in the enterprise, the management can make the right decisions and thus ensure the sustainable behavior of the enterprise as a whole.

2. Methodology

The analysis of this paper examines the relationship between produced nitrogen oxide emissions and sales of goods and services of manufacturing enterprises in Slovakia. Within the survey methodology, hypotheses are set:

H1: The values of nitrogen oxide emissions are constant in each recorded year.

H2: Nitrogen oxide emission values do not change in the regions of Slovakia.

H3: The acquired sales values of production companies in Slovakia are affected by the production of nitrogen oxide emissions.

H4: The statistical model is not statistically significant.

The hypotheses were verified by one-way analysis of variance (ANOVA).

The alpha significance level was set at 0.05.

Table 1: The results of statistical verification (ANOVA) of hypothesis H1

SUMMARY				
Groups	Count	Sum	Average	Variance
2019	8	18103,5	2262,93	2183455
2018	8	19551,2	2443,90	4054008
2017	8	17855,1	2231,89	2592883

2016	8	17073,6	2134,20	2213331
2015	8	17408,7	2176,09	2342519
2014	8	18989,5	2373,69	3675367

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	558053,6	5	111610,7	0,04	0,99	2,44
Within Groups	1,19E+08	42	2843594			
Total	1,2E+08	47				

The resulting significance value is greater than the set level of significance, which implies that we accept hypothesis H1: The values of nitrogen oxide emissions are constant in each recorded year. Therefore, we can conclude that enterprises are not taking sufficient measures to reduce the emissions produced.

Table 2: The results of statistical verification (ANOVA) of hypothesis H2

SUMMARY				
Groups	Count	Sum	Average	Variance
Banskobystrický	6	14780,5	2463,4	20235,8
Bratislavský	6	19587	3264,5	61973,2
Košický	6	30764,2	5127,4	759390,3
Nitriansky	6	3978,1	663	26947,5
Prešovský	6	4655,9	776	12164,5
Trenčianský	6	19977,9	3329,6	367489,7
Trnavský	6	1913,5	318,9	2763,9
Žilinský	6	13324,5	2220,8	21826,9

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1,14E+08	7	1623214,9	102,03	1,81E-23	2,25
Within Groups	636395,9	40	15909,9			
Total	1,2E+08	47				

Based on the result, we reject the null hypothesis in favor of the alternative. We accept an alternative hypothesis, which reads: The values of nitrogen oxide emissions vary within the regions of Slovakia.

The next part of the analysis is to determine the dependence of selected variables using regression and correlation analysis.

The result is the determination of a regression model, the statistical significance of which will be verified at a significance level of 0.05.

Figure 1: Dependence between nitrogen oxide emissions and enterprise sales

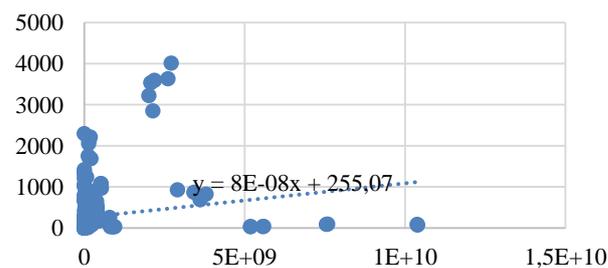


Table 3: The results of statistical verification (ANOVA) of hypothesis H3

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0,18
R Square	0,03
Adjusted R Square	0,03
Standard Error	1120693786
Observations	390

ANOVA					
	df	SS	MS	F	Sig.F
Regr	1	1,5473E+19	1,5473E+19	12	0,0005
Resid	388	4,8731E+20	1,25595E+18		
Total	389	5,02783E+20			

The final dependency is 17.5%, which means that it is a weak dependence between the variables. The correlation coefficient acquires a value of 3.1%, which indicates a weak tightness, respectively minimum probability that phenomenon B is caused by phenomenon A. In this case we can confirm the truth value of hypothesis H3: The acquired sales values of production companies in Slovakia are only slightly affected by the production of nitrogen oxide emissions.

The regression function has the form: $(f): y = 8E-08x + 255,07$.

The significance value for the regression coefficient has a value of 0.0005, i.e. lower than the determined level of significance. This is the reason for reject hypothesis H4 in favor of the alternative: The proposed model is statistically significant.

6. Conclusions

The quality of the environment is influenced by several factors. These include, in particular, industry, transport and agriculture. It is essential for researchers as well as sustainable development organizations to focus on the indicators that flow from the activities in these areas. Based on the literature, stagnation has been demonstrated in the initiative to create frameworks and instructions for the fulfillment of sustainable goals. It is therefore important to offer the management of enterprises the proven consequences that come from carrying out sustainable activities.

The performed analysis of the relationship between economic and environmental indicators showed their

interdependence, even if only to a small extent.. It was also found that the production of nitrogen oxide emissions has not changed significantly in recent years, it is constant. Therefore, it is required to create adequate measures and implementation frameworks of elements of sustainable development, designed for the management of the enterprise, in order to emissions, and not just nitrogen oxide emissions, really decrease.

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References

- [1] KHATTAK, S.I., AHMAD, M., HAQ, Z., SHAOFU, G., HANG, J. *Sustainable Production and Consumption*. Vol. 29, pp. 406-420, 2022
- [2] HE, J., LIU, H., SALVO, A. *American Economic Journal: Applied Economics*. Vol. 11, pp. 173-201, 2019
- [3] SUM H.N., MOANIBA, I.M. *Technological Forecasting and Social Change*. Vol. 122, pp. 49-62
- [4] DUAN, Y., JIANG, X. *Energy Economics*. Vol. 97, pp. 1-15, 2021
- [5] AWAN, U., SROUFE, R., KRASLAWSI, A. *Journal of Cleaner Production*. Vol. 226, pp. 172-185, 2019
- [6] HERMUNSDOTTIR, F., HÁKON HANEBERG, D., ASPELUND, A. *Technology in Society*. Vol. 68, pp. 1-10, 2022
- [7] CHOWDHURY, P., PAUL, S.K., KAISAR, S., MOKTADIR, M.A. *Transportation Research Part E: Logistics and Transportation Review*. Vol. 148, pp. 1-26, 2021

THE IMPACT OF INFLUENCER MARKETING ON CONSUMER'S BEHAVIOUR - MANIPULATION TACTICS OR INFLUENCE?

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Abstract: *The modern society is often criticized as being a society of consumerism. In fact, people are exposed and solicited by marketing everyday through diverse manners. One of the most known is advertising which became a part of people's life. This leads to strong social criticism. Since marketing is a part of people's daily life, the purpose of our thesis is to demonstrate how marketing is impacting on customer's behaviors. The continuous evolution in the marketplace today presents opportunities for technology, consumers, and brand to interact to change consumer experiences. In particular, there is an emergence of brand influencer roles afforded by consumer interactions about brands on social media. Consumers that take on such roles are known as social media influencers. Social media influencers have revolutionized the way brands view their marketing strategies. With their vast reach and informative segments, social media influencers can promote products and brands without their audience even realizing it. Furthermore, this form of advertisement is appealing to consumers since it presents an organic approach to promoting brands. This study investigates this kind of advertisement to understand how messages that social influencers send during this process drive behaviors such as consumer preferences and consumer brand wellbeing.*

Keywords: *Consumer Behaviour, Impact, Influencer Marketing, Influence, Manipulation*

1. Introduction

Marketing is an area that goes back in time and is constantly evolving. This is due to the ever-increasing competition, but also to technologies and more demanding customers. Based on this, new tools and approaches appear in marketing every year, whose role and mission is to attract the target group and promote the company's products and services in the best possible way. He has given a completely new direction to the marketing of the Internet and specifically to social networks, which, although created for a completely different purpose, are currently one of the most powerful marketing tools. In the contemporary globalised markets opinion leaders play a vital role in the process of the purchasing decision-making of consumers. Thanks to their individual skills, specific knowledge or their personality, opinion leaders have a direct or indirect influence on the attitudes and decisions of consumers. In the contemporary globalised marketing using social media, this role is taken over by the influencers who affect consumers with their thoughts, attitudes and opinions and thus, significantly influence trends in demand for particular products. Over the recent years, influencer marketing has become increasingly popular, representing a specific type of social media marketing [1].

A company that would not use this tool for promotional purposes is to find very difficult marketing on social networks nowadays has become a natural part of businesses. However, this direction is still evolving, which is also a sign of the fact that companies use celebrities to increase sales, who not only promote their products or services, but also support them [2]. As a result, there are various collaborations with personalities with a large audience who have a great influence on social networks. This method of promotion is called influencer marketing,

and the point is that a person (third party) is hired to promote products or services who have a strong audience on social networks and therefore reach [3].

Surveys in this area clearly show that the growth of influencer marketing has been huge in recent years. While in 2018 the global market share of this type of marketing was 4.6 billion dollars, in 2019 the share was around 6.5 billion dollars. Another interesting fact is that in the period 2019-2021, more than 320 new agencies and platforms were created in the world, which deal with influencer marketing. Thanks to these results, it is clear that this type of promotion will continue to grow in the coming years [4]. Slovakia is no exception and influencer marketing is already very well known and widespread. In practice, it is actively used in various campaigns of companies, and it is accompanied by several shortcomings. Shortcomings are already in the selection of a specific influencer, in the creativity of the campaign, the termination and financial evaluation of the personality. We will pay more attention to these shortcomings in the practical part of the work. It is clear that we still have a long way to go before we can approach the quality of influencer marketing to other countries. Compared to abroad, Slovakia is only at the beginning of its journey, because we realized the power and reach of influencers much later [5].

2. Defining the problem of topic

The main aim of this scientific contribution is the systematization of knowledge about the position and roles of influencers as opinion leaders in the social media environment in order to identify their typology, influence factors and the intensity of their impact on consumer decision making process, based on the comparison of knowledge from the results of global research studies and the quantitative online research study processed by

authors. The findings of the survey showed that the promotion of some products through influencers may be more advantageous than others. Influencers will have the greatest impact when buying clothes, shoes, cosmetics and, surprisingly, services. Meanwhile, people rely heavily on other factors to buy food, jewellery and electronics, but it is not excluded that influencer marketing could affect them as well. The secondary aim of this paper is to find out how influencer marketing affects consumer purchasing decisions. In order to achieve that objective, we used the basic methods of scientific research - analysis, synthesis, induction, deduction and interrogation. In order to obtain theoretical background to the researched issue, it was based on information available in professional books, magazines and electronic sources from foreign and domestic authors. In this theoretical section we used mainly methods of synthesis and analysis. As part of the marketing research, we applied a quantitative method of inquiry - questioning using an online questionnaire. Another method, which belongs to inductive-deductive methods, is the method of cognition, which we used in the evaluation of the questionnaire and based on the results formulated suggestions and recommendations. [6]

3. Basic facts of the issue

Inevitable fact is, that during the last twenty to thirty years significant changes have occurred, caused by penetrating the internet or mobile technologies into human lives. The technological development brought own changes in terms of social and societal trends, technology such as the internet or mobile phones have had a huge impact on these trends. The changes also affect the preferences and behaviour of consumers. In spite of the significant technological changes there is an assumption, according to which the essence of consumer behaviour does not significantly change, however, resources used by people will change in a significant way. Technological progress, social trends even variety of choice and improving of economic situation of population are factors which change consumers' behaviour in the market. Marketing managers are forced to react on changes of lifestyle and consumer behaviour. With technologies and especially the internet, consumers are becoming more and more informed and it is much more difficult to hit their traditional media. Segmentation can be identified as a key tool in responding to these changes. Today's era is characterized by the fact that for meeting the needs on the market consumers have an extremely large and varied range of different products. This fact encourages the perception of consumption as an important part of social life. The growth of social media has completely revamped the way people interact, communicate and engage [7]

Social media are also an integral part of this process, as they are very closely linked to influencer marketing and influencers. The social media has become such that today they are replacing not only friendships but also newspapers. Many people confuse the concept of social media and networks because it is not the same thing. The truth is that social networks are part of social media. The

role of social networks is to mediate the interaction between apatria users, such as Facebook, LinkedIn, Myspace, Instagram or Youtube. They differ in the nature of the content of the information, because some are oriented to the professional side, others are to the personal side. Although their primary goal was to provide information about user interaction, they also became a sales channel. This is also the reason why digital marketing should provide strength and reach today. [8]

Influencer marketing is based, in particular, on the confidence of consumers acquired by opinion leaders. Many of the influencers are also bloggers, that is, people who share their experiences, stories or interests with the broader internet public. They have their own circle of interests, they even have not been originally the influencers, and they just became ones. Many of them are sportsmen, actors, adventurers, or just ordinary mothers on maternity leave. Each of them can influence another group of people, and each of them is also able to promote a different product. The essence of the influencer marketing is the right product promotion. An essential factor of this form of marketing is that the influencer must be identified with the product, so he or she will not recommend a product without any experience with it, or even absence of any knowledge of it. Many people believe that influencer marketing is a bubble that will not last long and burst. Customers, brands, as well as the numbers themselves talk about something else. However, we can expect changes in this trend. Companies will benefit from an even deeper collaboration with influencers, which presents new opportunities. Influencers and agencies will establish more transparent and intensified relationships with each other. World influencers prices are starting to grow enormously, so companies are increasingly using cooperation with microinfluencers. For businesses, the number of clicks, fans, or responses is often a misleading measure.

We can trace the first influencers in the history of influencer marketing at the beginning of the 20th century, when there were only a few brands on the market that already used product marketing. Brands focused on this marketing approach created people who wanted to influence consumers' shopping decisions through emotions. As a great example, we can use the person of Santa Claus in the United States. Santa Claus, who is arguably the most popular figure in influencer marketing history as far as Western countries are concerned. Santa Claus created the Coca-Cola Company and is no longer just a brand influencer, but much more. When Santa Claus was founded, the term influencer was not used at the time, but its influence and effect in terms of purchasing decisions is comparable to influencers today. Emotions within Coca Cola's shopping behavior and for consumers to sympathize with it. That was also the reason why the person of Santa Claus was created in connection with Coca Cola. In the past, it was much easier to make a purchase decision than it is today, because there were only a few brands on the market. Influencer marketing is gradually

evolving along with growing competition and more products. [9]

4. The main results and conclusions

Any business or brand that wants to promote their product most effectively is aware that influencer can have a very positive impact on their communication campaign. Especially in recent years, influencers have been given the opportunity to express themselves and influence potential consumers. Thanks to social networks, they can quickly build a network of fans and supporters and easily communicate their opinions, ideas and experiences with products. The aim of our survey was to determine whether and how much influencers affect consumers in purchasing decisions. This survey has also identified products where consumers rely heavily on the opinion of influencers and areas where the opinions of influencers are considered the most credible, and whether the look and reputation of the influencers is important in purchasing decisions. We conducted a survey using a standardized questionnaire. The questionnaire consisted of both open and closed questions and was distributed via the Internet. The survey was attended by 320 respondents who were from different age groups and came from different regions. Answers were collected during the two-month period - from January to february. The survey showed that among all the areas in which influencers operate, respondents trust most to athletes and experts in the field. In today's consumer society, beauty and attractiveness might seem to be the most important factors, but our research has shown that consumers place more emphasis on the skills and expertise of the influencers. Companies considering influencing influencers should not forget this and reach for a professional or expert. After processing the results, we can draw the following conclusions and recommendations.

The right and more elaborate selection of influencers - as we learned from the questionnaire survey, according to our respondents, the big problem is that brands and companies in most cases do not look at the quality of influencers and its creation, but also numbers and therefore its audience size and reach. Of course, every company wants to reach as many customers as possible and therefore wants to have the best and most effective communication, but if influencer fails to identify with the product or service, it does not affect the audience well and influencer often refuses to cooperate. In order for this promotion in Slovakia to be better and more effective, companies should more consistently choose influencers with whom they will cooperate. Given how often consumers encounter influencer marketing in their area, we can call it a very successful and popular form of promotion. However, despite the widespread use of this method, it can still provide a competitive advantage. Different consumer segments will respond differently to the types of influencers the company chooses to engage. We can say that the success of influencer marketing is choosing the right personality according to whom they plan to target advertising. Large international brands usually reach for sound names from the world of

celebrities to present luxury, exclusivity and interest. However, this method is usually not possible for smaller and start-up brands, mainly because of high costs. Therefore, it is important for them to select a person with whom they can identify the target segment of our product and is considered trustworthy in their area, even though it is not known to the wider public. Influencer marketing has a great meaning as an effective branding strategy and in their marketing efforts, companies increasingly abandon traditional celebrity endorsers in favour of social media influencers, such as vloggers and instafamous personalities [9, 10]. The companies should also remember that engaging an influencer in the promotion process does not automatically mean people's trust in the quality of the product. Our research has shown that a large proportion of consumers think that influencers agree to promote a product simply because they get paid for it. People in our survey expressed the view that only an attractive or successful personality is not enough, and the success of the product is primarily up to him. For a successful marketing campaign, a combination of these two factors is therefore important: a quality product and a trusted influencer. As an influencer can evoke positive emotions and encourage consumers to buy, it can also have the opposite effect. It is relatively common for some personalities to build up negative publicity over time, and the public does not receive them with enthusiasm. The biggest risk of influencer marketing is the connection of a company with a personality who is involved in a scandal or causes too many negative reactions. [11]

Our survey also found respondents who were discouraged by such personalities from buying the product themselves, even though they were convinced of the purchase before they were promoted. Brands and companies that are thinking about influencer marketing should therefore spend sufficient time on the selection process and make sure they have enough information before making the final decision. However, it should also be remembered that not only the brand can be negatively influenced by personality, but the promotion of an inappropriate product can also harm the influencer himself. Our survey was also attended by respondents who changed their mind about a popular person so far just because they promoted an inappropriate product. The credibility and popularity of such a person is thus declining, and any other project on which it will collaborate may be at risk as it will be perceived by the public as untrustworthy. From the answers of our survey, we can conclude that at present, mainly influencers, who promote products in which animals have been harmed, are perceived negatively - fur coats.

Setting clear rules of cooperation - in order for the campaign and promotion to be successful, it is important to set rules for all cooperation that will apply to both parties. The influencer and the client will thus feel like partners trying to achieve a common goal. Giving space to influencer to create its content is beneficial not only for him, but also for the brand itself, but of course the client also has the right to intervene. It is good to determine the

extent to which this will happen at the beginning of the cooperation, in order to avoid unnecessary misunderstandings and inconveniences. Communication is also important, because the approach to influencer is more personal, it increases his trust and good mutual relations, which can also have a positive effect on promotion. It is therefore a good idea to set clear rules for the functioning of both parties at the outset, where competencies are also defined. The survey also showed that the promotion of some products through influencers may be more advantageous than others. Influencers will have the greatest impact when buying clothes, shoes, cosmetics and, surprisingly, services. Companies offering their products in these areas should therefore definitely consider such cooperation. Meanwhile, people rely heavily on other factors to buy food, jewellery and electronics, but it is not excluded that influencer marketing could affect them as well.

More offers from brands rather than agencies - even though a large proportion of paid cooperation offers come directly from brands, influencers would like this share to increase. According to them, the whole promotion is then more personal, individual and more pleasant.

Lack of long-term cooperation - Social creators consider the lack of long-term cooperation, which literally links one-off ones, to be a lack of influencer marketing in Slovakia. Influencers would accept it if brands focused more on larger campaigns, where they can work with creators for a long time. Their work can thus follow each other in a longer time horizon, which has a better effect on the audience itself.

References

- [1] D. Brown, N. Hayes, *Influencer Marketing, Who really influences your customers?* UK: Elsevier, p. 235, 2018.
- [2] E. Byrne, J. Kearney, C. MacEvilly, *The Role of Influencer Marketing and Social Influencers in Public Health. Proceedings of the Nutrition Society*, p. 76, 2017.
- [3] Influencer Marketing Hub 2019, <https://influencermarketinghub.com/what-is-an-influencer/>.
- [4] S. Kapitan, D. Silverada, *From digital media influencers to celebrity endorsers: attributions drive endorser effectiveness.* <https://link.springer.com/article/10.1007%2Fs11002-015-9363-0>.
- [5] M. De Veirman, V. Cauberghe, L. Hudders. *Marketing through Instagram influencers: the impact of number of followers and product divergence on brand attitude. International Journal of Advertising*, p. 36, 2017.
- [6] V. Jin, A. Muqaddam, E. Ryu., *Instafamous and social media influencer marketing. Marketing Intelligence & Planning*, p. 37, 2019.
- [7] S. Arora, C. Bansal, R. Kandpal, R. Aswani, Y. Dwivedi, *Measuring social media influencer index-insights from facebook, Twitter and Instagram. Journal of Retailing and Consumer Services*, p. 49, 2019.
- [8] J. Bednárík, P. Murár, A. Štefankovičová, *Mikroblogovacia služba Twitter a jej využitie v marketingovej praxi*, p. 97, 2019

[9] J. Ehrhardt, *A Brief History of Influencer Marketing.* <https://blog.influencerdb.com/brief-history-of-influencer-marketing/>.

[10] S. V. Jin, A. Muqaddam, E. Ryu. *Instafamous and social media influencer marketing. Marketing Intelligence & Planning*, p. 37, 2019.

[11] P. Schouten, L. Janssen, M. Verspaget. *Celebrity vs. Influencer endorsements in advertising: the role of identification, credibility, and Product-Endorser fit. International Journal of Advertising*, p. 24, 2019.

IMPACT OF ECONOMIC POLICY INSTRUMENTS ON IMPLEMENTATION OF DIGITALIZATION IN SLOVAKIA

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Abstract: *Given the ever-changing dynamic environment, companies need to remain competitive in the market. Digitalization is now increasingly being mentioned as one of the main elements of Industry 4.0. Its introduction into business processes will also affect the requirements for employees. The emphasis is mainly on their ICT skills. The implementation of digital technologies can also be influenced by the Government of the Slovak Republic through economic policy instruments. The article aims to define the basic concepts related to economic policy and its instruments concerning the implementation of modern digital technologies in companies in Slovakia. The impact of economic policy instruments on human capital in the digital age is also being examined. The method of content analysis of professional literature dealing with the researched issue and official documents issued by the Government of the Slovak Republic is used.*

Keywords: *Industry 4.0, digitalization, economic policy, economic policy instruments, human capital*

1. Introduction

At present, companies focus not only on making a profit but also on the company's performance and competitiveness in the market in which they operate. One way to achieve this is to introduce modern digital technologies into the company. Digitalization is one of the main elements of Industry 4.0 and helps companies in various fields. On the one hand, digitalization helps to simplify work in the company and increase work productivity and process efficiency, but on the other hand, it affects the level of corporate human capital in which it is necessary to invest. Each company must comply with a certain legislative framework and measures issued by the government of the country where the company is based. It is also called the country's economic policy. It consists of various sub-policies, which are characterized by the tools that the state uses to guide the behavior of economic operators in the country.

The article aims to define the basic concepts related to economic policy and its instruments concerning the implementation of modern digital technologies in companies in Slovakia. The impact of economic policy instruments on human capital is also examined.

2. Economic policy and its division

The authors define the term "economic policy (EP)" differently. According to Kucharčíková and Tokarčíková (2015), the EP is represented by a legislative framework and a system of institutions guiding the behavior of individual economic entities in the country [8].

The EP can also be defined as the government's approach to a country's economy. The government uses the resources at its disposal and the powers it deserves to achieve pre-determined economic and social goals. It is also an independent scientific discipline that separated

from macroeconomics in the 1930s, and its founder was J. M. Keynes [26; 22].

According to Šálka et al. (2015), Gajda et al. (2018), Bénassy-Quéré et al. (2018) and Taylor and Mankiw (2017), theoretical economic policy is implemented based on four criteria [18; 4; 1; 21]:

- *economic efficiency* - meeting the needs of society based on the best use of natural resources to avoid possible waste,
- *justice* - redistribution of resources between the poor and the rich to increase the overall satisfaction of human needs throughout society,
- *progress* - with increasing progress is possible to use natural resources more efficiently and thus produce better quality products in larger quantities,
- *economic stability* - without a stable economy, it is not possible to meet the previous criteria in a given country.

Žák (2006) states that the element division of the EP is into macroeconomic and microeconomic. While macroeconomics operates mainly in the field of resource efficiency and to achieve balance, it is divided into supply-side and demand-side measures. Microeconomics aims to increase efficiency in resource redistribution [26].

Digitalization is one of the elements of Industry 4.0 that can help companies and countries significantly increase their efficiency and competitiveness.

Lukáčik et al. (2013) supports his view. Slaný (2003) agrees with both, who describes both areas of the EP in even more detail. According to him, the macroeconomic EP focuses on achieving the element economic goals and the overall development of the country's economy. This area of the EP includes four basic policies, namely fiscal (budgetary), monetary (monetary), international (external

economic) and pension. The second area of the EP is the microeconomic EP, whose role is to increase efficiency in the redistribution of resources. It also includes other types of policies, such as competition policy, structural policy, distribution policy and social policy [16; 5].

The division of the EP into practical and theoretical is presented by Šálka et al. (2015). According to them, the practical economic policy focuses on the practical creation of different conditions for the functioning and behavior of economic operators. On the other hand, the theoretical economic policy represents ways of applying individual principles and measures of economic policyholders. The breakdown of the EP by form includes a breakdown into market economy principles, which creates a framework at the level of the whole country, e. g. the national economy, and a policy of influencing the economic process, which affects the country's economy at individual levels concerning EP objectives.

Sub-policies include three types of policies [8; 15; 7; 9]:

- *fiscal policy (restrictive, expansionary)* - achieving goals through the public budget. It uses automatic stabilizers (subsidies, progressive income tax, unemployment insurance) and intentional instruments (tax rates, transfer payments).
- *monetary policy (restrictive, expansionary)* - influencing the amount of money in circulation through direct (administrative measures) and indirect (required minimum reserves, discount rate, open market operations) instruments,
- *foreign trade policy (protectionist, liberal)* - measures to regulate the quantity and movement of goods and services in foreign trade through non-economic (import and export quotas, export subsidies, invisible import barriers) and economic instruments (customs, import surcharge, central bank intervention).

In addition to these three types, structural and innovation policies are also important in supporting the introduction of digitalization.

Slaný (2003) also presents the division of the EP in terms of the tools used in a system-building (established order of functioning of the entire economy - centrally managed policy, market policy) and a regulatory EP (regulation of the behavior of economic entities) [16].

In addition to the government, other states and non-state institutions are the bearers of the EP [26]. Šulc (1993) states that EP holders can be divided into legislative institutions, governmental and other institutions, the issuing bank, market economy institutions, influence institutions and court institutions. These are the parliament, the government, the ministries, the local government, the customs, tax and trade license offices, the national bank, the antitrust office, the courts, trade unions, employers' organizations, political parties, or the social insurance company [19]. In addition, however, it is

important to note that there are also bearers at the international level. In the case of the Slovak Republic (SR), they are e. g. The European Union, the United Nations, and the International Monetary Fund [18].

3. Materials and Methods

The article uses various scientific methods, such as content analysis of professional literature and government documents of Slovakia. They examine the impact of economic policy and its instruments on human capital and the take-up of digital technologies in business. The method of synthesis of findings and comparisons is also used in the article.

4. Results – instruments of fiscal and monetary policy to support digitalization in the Slovak Republic

Informatization of all areas of people's lives is a very important issue in the European Union today. Therefore, it is important to look at how the government of the Slovak Republic (SR) and other state institutions help businesses and citizens in Slovakia with digitalization.

4.1. Digitalization in enterprises

The Government of the Slovak Republic defined the primary goal of the economic policy to increase the competitiveness of companies in the Slovak Republic in its program statement for 2021 to 2024. The element conditions for achieving this goal are also defined, including economic freedom and an efficient state [25].

The EP, together with the economic development in the SR, was also assessed by the Council for Budget Responsibility. It concluded that insufficient incentives to support crisis management (e. g. the COVID crisis) are much more costly than expected because the three-element characteristics of the stimulus are not met. It should be one-time, targeted and intergenerationally fair. They found that in terms of fiscal stimulus, the SR is behind the European Union average and is almost at the bottom of the ranking. Because of this, they propose to the government that at a time when the Slovak economy is thriving, they will reduce the expenditures paid from the state budget. And they should use the obtained savings at times when the economy enters a recession and a possible bottom. The pumping of the Recovery Fund will help stimulate the economy in Slovakia from 2022 as it will be a net inflow of funds [20].

The way of digitalization support in the SR also consists of the possibility of additional depreciation that can be deducted from the tax base up to 55% of the investment. It is made possible by the amendment to the Income Tax Act. It is a temporary instrument of the fiscal policy of the SR, which, however, is automatic, which means that it is not necessary to ask for it, which will reduce the administrative burden on companies. The goal is to support companies to invest in modern digital technologies, which will ensure greater competitiveness of companies in Slovakia. The condition is to invest more than one million euros between 2022 and 2025 [2].

The opinion of Kosno (2021) is also interesting. He found in the analysis that the SR lags other European countries in digitalization. At the same time, it is pointed out that the development of the digital transformation can bring Slovakia an increase in GDP by 2025, amounting to 21.7 billion euros. However, a mutual agreement was reached between the organizations and the Ministry of Economy of the Slovak Republic (ME of SR) when they agreed that the state insufficiently supports innovation in companies, but it is not permissible for entrepreneurs to come and ask for money. The reason for this agreement was the subsidy case from 2016 when the ME of SR also provided subsidies to companies that do not implement anything in the scope of science. The emphasis is on industrial investment to be effective. Another way to support companies is subsidies from the ME of SR companies. Subsidies are among the transfer payments, which are a deliberate tool of fiscal policy. In the article, the author points out that Slovakia supports digital connectivity by changing legislation and the process environment. It will create the so-called qualified demand, which means that companies will know what they need and where they will be able to find it. The possibility of supporting the digital transformation also lies in increasing the attractiveness of commercial bank loans. On the one hand, the ECB can, at low-interest rates, create space for businesses to draw on cheap loans for the purchase of digital technologies. On the other hand, the state guarantee and fiscal policy reduce the administrative burden on companies that must submit several forms and documents when applying for a loan [6].

In total, the Ministry of Investment, Regional Development, and Informatization of the SR wants to support companies in Slovakia in digitalization in the amount of 580 million euros which they should use to purchase digital technologies to be able to respond to the challenges of Industry 4.0. Companies will thus ensure a certain level of competitiveness in the domestic and foreign markets. The money allocated to these activities can be obtained by companies in the form of grants and subsidies [14].

The form of digitalization support in Slovakia was also implemented by Eximbanka SR in cooperation with the European Investment Bank. They supported small and medium-sized enterprises by providing loans to the legal entities. The support consists in the favorable interest rates which belong to a given type of loan, which are instruments of monetary policy. Firstly, it is about support in the form of organized workshops, which are intended to increase knowledge about the possibilities of drawing loans from the European Investment Bank. In 2018, Eximbanka SR provided small and medium-sized enterprises with this type of loan totaling 22 million euros [3]. Businesses can use this funding to upgrade and purchase new digital technologies or provide training and courses for their employees who need to increase their education, given Industry 4.0.

The Renewed and Resilience Plan of the SR, which contains specific goals related to digital transformation in the SR, also deals with the researched issues. The objectives were divided into the areas of e-government, cyber security, digital economy, and digital skills. Reforms and investments that the Slovak government will provide to economic entities and other institutions are related to each goal and area. Meeting the targets is expected to increase the competitiveness of universities, which would help students prepare for the current market conditions associated with Industry 4.0. Again, the aid consists only in changing legislation, reducing administrative burdens, and providing funding [13; 17].

4.2. Human capital and digitalization

In 2019, a strategy was approved in Slovakia to ensure that the SR becomes a globally competitive country by 2030. It points to global trends that need to be implemented in Slovakia in companies but also in states institutions, and other organizations. All defined global trends are related to digitalization and digital transformation. Human capital, which has an important role to play in increasing competitiveness, has not been left out either. The Government of the SR notes that it is necessary to increase investments to support innovation in the SR. The Government of the SR makes it through policies, regulations, and changes in legislation, but also financial incentives or tax cuts for innovation [24]. The government document Concept of Smart Industry of 2016 also deals with the support of the business environment concerning digitalization and human capital. Its main goal is to support the industry through modern digital technologies and thus help Slovakia to better adapt to change. The document already points out at that time the lack of a professionally qualified workforce, which must have digital and ICT skills and knowledge. Within human capital, it is very important to adjust the education system. For this reason, the government has planned to create new, more appropriate curricula but also study programs that will be able to prepare students for internships, which is an EP measure in the form of legislative and administrative measures. The change in curriculum will provide the highly qualified staff needed for Industry 4.0. [11].

The primary document for research, development and innovation in Slovakia is RIS3 from 2013. It is also a key document in human resources and human capital. Significant support for the business environment occurred after 2004 when the government introduced the so-called flat tax for small and medium-sized enterprises. Until 2013, state institutions did not sufficiently support the innovation environment in the SR. It was due to the under-utilization of venture capital, which was not competitive at the level expected. The change took place in 2013. At that time, the level of tax rates was adjusted [12]. Changing the level of tax rates is one of the intentional fiscal policy measures. As their size decreased, it was an expansionary fiscal policy. If the corporate tax rate is reduced, businesses can use that amount of money to modernize

their processes, e. g. in the form of the purchase of digital technologies.

The document Product Lines for the Digital Slovakia and Creative Industries Domain issued by the Office of the Deputy Prime Minister for Investment and Informatization (2018) states that digitalization will affect all areas of the economy and requires the availability of a 5G network. However, it has a very significant impact on the labour market, where it can cause major changes (job transformation, job losses, cheaper jobs). Therefore, it is necessary to provide highly qualified employees in companies. According to a survey published in the document, up to 90% of jobs in Europe require at least a minimum level of digital skills. By comparison, the survey shows that there are still 100 million people in Europe who do not even use the internet. It was also found that up to 45% of Europeans and 37% of European Union staff lack digital skills. Of the total number of people without digital skills, up to 42% are unemployed. Almost half (40%) of employers in the EU have difficulty finding a sufficiently skilled workforce [23].

5. Conclusion

Each company must, during its existence, comply with the legislation and measures determined by the government of the country. The functioning of the business environment can be regulated by the state through economic policy instruments. The monetary policy makes it easier for businesses to access loans in commercial banks that have lower interest rates so that their businesses can manage to repay better.

As part of its fiscal and structural policy, the Government of the SR places emphasis on supporting companies to remain competitive even in a global environment. It points out the importance of introducing modern digital technologies into business processes in its documents. These technologies allow companies to keep up with the competition. However, despite this goal, Slovakia is at the bottom of the rankings in terms of digitalization. At the same time, the importance of digitalization is also supported by claims that speak of an increase in GDP by several per cent.

In Slovakia, companies are supported financially and non-financially. Within the financial support, these are mainly subsidies which, however, due to the subsidy case from the past, the government uses less. Rather, it offers companies other support options, such as the possibility to write off up to 55% of the value of the investment or the flat tax it has provided in the past. In the case of non-financial assistance, the government focuses on reducing the administrative burden on companies, changing legislation or school reform. It is school reform that is linked to human capital, which is essential for business growth and development. The Slovak government wants to provide qualified personnel by changing the curriculum, introducing new subjects focused on ICT, and connecting the educational process with practice. The reason for this

decision is that most people in Europe have only the basic digital knowledge and skills that are essential for Industry 4.0.

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References

- [1] Bénassy-Quéré, Coeuré, B., Jaquet, P., Pisani-Ferry, J. *Economic Policy Theory and Practice*. Oxford University Press, 2018
- [2] https://www2.deloitte.com/sk/sk/pages/podpora-investicii/Articles/nova-moznost-danovej-uspory-pri-vyznamnych-investiciach-s-konceptom-industry-4-0.html?gclid=CjwKCAiArOqOBhBmEiwAsgeLmfKlAS4t-4VvdQowwyv4WIUQ8Ctwo1U6voo-jV4M-iu4UwhFLBf4pRoCY4sQAvD_BwE
- [3] https://www.eximbanka.sk/slovenska-verzia/o-nas/aktuality-a-udalosti/aktuality/eximbanka-sr-aktivne-podporuje-msp-astredne-velke-podniky-zo-zdrojov-eib.html?page_id=211404
- [4] Gajda, W., Szopiik-Depeczyńska, K., Kedzierska-Szczepaniak, A., Szczepaniak, K., Cheba, K., Ioppolo, G. *Innovation in sustainable development: an investigation of the EU contet using 2030 agenda indicators*. In: Land Use Policy. Vol. 79, pp. 251-262, ISSN 0264-8377, 2018
- [5] Kliková, Ch. *Hospodářská politika*. Institut vzdělávání Sokrates, ISBN 9788086572765, 2012
- [6] Kosno, L. (2021). <https://zive.aktuality.sk/clanok/150073/firmy-ukazali-statu-ake-projekty-digitalizacie-by-mal-realizovat-sulik-za-dotovanie-priemyslu-nie-je/>
- [7] Krugman, P. R., Obstfeld, M., Melitz, M. J. *International Economics: Theory and Policy*. Global Edition, 2017
- [8] Kucharčíková, A., Tokarčíková, E. *Základy ekonomie*. EDIS, Žilina. Pp. 198. ISBN 978-80-554-1105-7, 2015
- [9] Langdana, F. K. *Macroeconomic Policy: Demystifying Monetary and Fiscal Policy*. Springer, 2016
- [10] Lukáčik, J. et al. *Hospodárska politika teória a prax*. Sprint dva, Bratislava, ISBN: 978-80-89393-86-2, 2013
- [11] <https://www.mhsr.sk/inovacie/strategie-a-politiky/smart-industry>
- [12] MIRRI SR. (2013). <https://www.mirri.gov.sk/wp-content/uploads/2018/10/SK.pdf>
- [13] MIRRI SR. (2021). <https://www.mirri.gov.sk/plan-obnovy/plan-obnovy-a-odolnosti/>
- [14] <https://epale.ec.europa.eu/sk/blog/priority-digitalizacie-v-plane-obnovy-odolnosti-na-slovensku>
- [15] Parkin, M. *Macroeconomics*. Addison Wesley, 12. ed., 2016
- [16] Slaný, A. *Makroekonomická analýza a hospodárska politika*. C. H. Beck, Praha, pp. 83-109, ISBN 80-7179-738-3, 2003
- [17] <https://www.slovenskoforme.sk/>
- [18] Šálka, J., Dobšínská, Z., Sujová, Z. *Hospodárska politika*. Technická univerzita vo Zvolene. Pp. 10-23. ISBN 978-80-228-2818-5, 2015

- [19] Šulc, Z. *Hospodářská politika*. Consus, Praha. ISBN 80-901004-7-3, 1993
- [20] https://www.rrz.sk/wp-content/uploads/2022/01/RR_Z_CFO_2021.pdf
- [21] Taylor, M., Mankiw, G. *Economics*. Cengage, 2017
- [22] Urban, I. et al. *Hospodářská politika*. Victoria Publishing, Praha. 155 s. ISBN 8085865-01-07, 1994
- [23] Úrad podpredsedu vlády SR pre investície a informatizáciu. (2018). https://www.mirri.gov.sk/wp-content/uploads/2018/10/digit_creativ_domena_final_22032018_pp.pdf
- [24] Vláda SR. <https://www.mirri.gov.sk/sekcie/informatizacia/digitalna-transformacia/strategia-digitalnej-transformacie-slovenska-2030/index.html>
- [25] Vláda SR. *Programové vyhlásenie vlády Slovenskej republiky na obdobie rokov 2021–2024, 2021*
- [26] Žák, M. *Hospodářská politika*. Vysoká škola ekonomie a managementu, Praha, 2020

NEW APPROACHES TO WATER RESOURCE MANAGEMENT IN THE SMART CITIES WATER CONCEPT

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Abstract: *Water Smart Cities reflect the trend of climate change, but it is necessary to implement new approaches to water resources management, which will also reflect other trends, such as water stress levels, urbanization or technology development.. The aim of the article is to identify the latest approaches to water resources management in the concept of Water Smart Cities, summarize the findings of the analysis and point out the benefits of their use for today's cities. By analyzing the relevant articles, 12 innovative approaches and technologies for water management in the urban environment were identified. Their benefits are mainly lower consumption, efficient management, prediction, monitoring or protection of biodiversity, quality and quantity of water resources. The main findings of the article can serve as an analytical basis for strategic management of cities, academia, water institutions or communities of interested citizens.*

Keywords: *water management, Smart City, technologies, limited water resources*

1. Introduction

Climate change, urbanism, population growth, migration and pollution are elements that affect the construction of resilient places prepared for water stress. Technologies and approaches that have emerged in the past can no longer reflect the current state and requirements of intelligent systems. For this reason, it is necessary to focus on the latest approaches to water resource management in the Smart City concept. The aim of the article is to identify these latest approaches, summarize knowledge about them, outline their benefits, and thus mediate best practices for other cities, strategic management of agglomerations, water institutions, communities and academia. The water situation is critical, it is necessary to constantly look for new and innovative solutions not only on the basis of technological aspects, but also environmental, social, managerial and demographic criteria, conditions and predispositions. The end result should be lower water consumption, efficient management, sustainability and, above all, the preservation of a valuable resource for future generations [11, 8, 14].

2. Methodology

Relevant publications for article processing were selected in the Web of Science and Scopus databases. The selection was conditioned by a thematic focus on the keyword "Water Smart Cities". In terms of timeliness, only articles from 2022 were selected in the total number of 40, which reflects the aim of the article, i. j. identify new approaches to water resource management in the Smart City concept. After eliminating duplicate articles, at the end of March 2022, 17 articles were analyzed that met all the selection criteria. In addition to the method of secondary analysis, the methods of summarization, induction, deduction and comparison were also used in the article.

3. Results

Monitoring is a key function of strategic management to ensure the quality and quantity of limited water resources.

New approaches to monitoring the status of water resources use the SmartWater framework. The framework consists of four layers, i. e. sensor-cloud data collection, data management, water plan storage layers, and water analysis with new technologies from Google, such as knowledge charts. Processes include intelligent aquatic modeling, up-to-date information and improvement through corrective and preventive action [11].

A large number of experts and strategic city managers use Internet of Things technology to collect data in Water Smart Cities. Its advantage is real-time data, fast feedback or effective monitoring. However, it does not cover the need to monitor water pumps, detect water leaks or provide water level data. This user information at the individual, collective and system levels is mediated by a new management approach based on IoT-WST, i. e. IoT-controlled water storage tanks [8].

Msamadya et al. in addition to IoT-WST, they recommend implementing smart water metering technology, i. e. SWM [14]. The technology can eliminate the limitations of management in meeting water requirements and in addition to the technological aspect, it also reflects the social, demographic or systemic aspect [14].

To this day, the problem of uneven water distribution in the distribution of watercourses in urban agglomerations appears. The research by Hoefsloot et al. from 2022 argues the benefits of using a new approach to data management, the so-called SEDAPAL (water and sewage services). This data technology serves to achieve an open, interconnected, sustainable and reliable concept of building Water Smart Cities. The output is decision support based on relevant data, which will later become information [7].

Climate change and urban trends also have a major impact on irrigation. For cities of the future, researchers Kumar Singh et al. created new weather control solutions based on

current IoT and machine learning technologies with an innovative element of the meteorological automated station based on LoRaWAN, t. j. Long Range Wide Area Network [10, 5].

Forecasting Urban Water Consumption (UWC) is an essential element of prediction-based Smart Cities management. Predicting problems before they arise, can significantly streamline management processes implemented in the urban environment. The new management model uses a prediction algorithm based on elements of rapid urbanism and the growing level of water stress [13].

The limitation of construction space in cities reflected the need to build roof gardens in order to capture rainwater. A new approach is water management based on Urban Rooftop Agriculture (URTA), which operates on the principle of drip irrigation. In comparison with previous methods from previous years, the effect of URTA was reflected in an increase in the efficiency of management of limited water resources by 33% [2].

In addition to drinking water, it is essential to study sea levels in coastal cities. In 2022, a specific type of Internet of Things technology began to be used, the so-called The Underwater Internet of Things (UIoTs). Underwater sensors and objects can thus collect real-time data, support decision-making, planning and protect the biodiversity of marine life. The advantages are the speed, simplicity and efficiency of data acquisition analysis for various stakeholders [1, 17, 6].

The evaluation of the quality of water resources is carried out within the new approaches through the process of analytical hierarchy (AHP). Researchers in India argue the need to manage limited water resources in a combination of governmental and non-governmental measures with citizen involvement. This emphasizes the connection between the technological, environmental and social phases of Smart Cities management [12].

According to new approaches, the prediction of consumption, reuse and efficient management of water resources is based on Long Short-Term Memory (LSTM) technology. This technology has shown benefits, especially in Norway, where the prediction process has been reduced by 5 minutes and water consumption has been significantly reduced in an associated manner [15].

New in Water Smart Cities are the approaches and technologies associated with the Covid-19 pandemic. Current epidemiology and its monitoring are based on wastewater technology (WBE) with the aim of early warning by examining water in urban communities. Outbreak prediction is based on the innovative Digital Urban Environment Fingerprinting Platform (DUEF) [9, 4, 16, 3].

4. Benefits Of New Management Approaches In The Water Smart Cities Concept

A summary of new management approaches in the Water Smart Cities concept, including their benefits, can be found in the following Table 1.

Table 1 Summary of new management approaches in the concept of Water Smart Cities and their benefits

New approach/technology	Utilization	Benefits
SmartWater	collection, data processing, origin of information	support for management, decision-making, quality assurance and quantity of water resources
IoT-WST	monitoring of water pumps, detection of leakage of water sources or provision of water level data	feedback, monitoring, process improvement
SWM	elimination of restrictions on the demand for water resources from the management point of view	it reflects not only the technological but also the social and demographic aspects
SEDAPAL	data management	management and decision support
LoRaWAN	new control solutions	effective monitoring
UWC	prediction	solving problems before they arise, streamlining management processes
URTA	drip irrigation water control	increase management efficiency by 33%
UIoTs	deep sea water monitoring	biodiversity protection, database of relevant data
AHP	water quality evaluation	governance combined with government and citizens, the benefits of the social aspect
LSTM	consumption prediction	reduce the prediction process by 5 minutes
WBE	monitoring	Covid-19 pandemic early warning system
SmartWater	collection, data processing, origin of information	support for management, decision-making, quality assurance and quantity of water resources
IoT-WST	monitoring of water pumps, detection of leakage of water sources or provision of water level data	feedback, monitoring, process improvement

Source: own processing according to section Results

All new approaches and technologies use a combination of technological, social and environmental aspects with the effect of reducing water consumption, providing relevant data, increasing the efficiency of management, decision-

making and planning processes, including the process of predicting problems before their corrective measures, thus saving costs and time.

5. Conclusion

The maturity of the city is not only physical but also water infrastructure. Based on the analysis of relevant articles, 12 technologies were identified, which form an innovative basis of water management in the Smart Cities concept. Approaches, frameworks and technologies in the form of SmartWater, IoT-WST, SWM, SEDAPAL, LoRaWAN, UIoTs, WBE and the DUEF platform were created for the monitoring process in 2022. Their benefits are management and decision support, relevant data, early warning systems, process improvement and, ultimately, streamlining overall management in a holistic sense. Approaches using, for example, UWC or LSTM technologies have been developed to predict problems. The quality of watercourses in 21st century cities will be ensured by URTA systems or the AHP management method. Monitoring in turn mediates the quantity of water resources. The identified approaches are examples of best practice in coping with growing levels of water stress and call for the importance of dynamic changes in the environment, to which today's cities should respond in a timely manner.

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References

- [1] ALHARBI, Y. – AHMAD, A. (2022) Underwater Internet of Things to Analyse Oceanic Data, IETE Journal of Research, DOI: 10.1080/03772063.2022.2027286
- [2] BEGUM, M.S. – KUMAR BALA, S. – SAIFUL ISLAM, A.K.M. (2022). Effect of Performance of Water Stashes Irrigation Approaches on Selected Species of Plant's Water Productivity in Urban Rooftop Agriculture with Respect to Climate Change. *Water* 2022, 14, 7. <https://doi.org/10.3390/w14010007>
- [3] BOIOCCHI, R. – BERTANZA, G. (2022). Evaluating the potential impact of energy-efficient ammonia control on the carbon footprint of a full-scale wastewater treatment plant. *Water Sci Technol* 1 March 2022; 85 (5): 1673–1687. doi: <https://doi.org/10.2166/wst.2022.052>
- [4] CALDEIRA, A. et al. (2022). Water Management in Several Types of Soil – A Hands-On Science Experiment for Students. In: Auer, M.E., Hortsch, H., Michler, O., Köhler, T. (eds) *Mobility for Smart Cities and Regional Development - Challenges for Higher Education*. ICL 2021. Lecture Notes in Networks and Systems, vol 390. Springer, Cham. https://doi.org/10.1007/978-3-030-93907-6_102
- [5] GUMA, P. K. – WIIG, A. (2022) Smartness Beyond the Network: Water ATMs and Disruptions from below in Mathare Valley, Nairobi, *Journal of Urban Technology*, DOI: 10.1080/10630732.2022.2037180
- [6] HAN, C. – SU, G. – BAO, L. – MESSER, H. (2022). Water Vapor Density Retrieval Studies Using Commercial Millimeter-Wave Links at 38 GHz and E-Band. *Remote Sens.* 2022, 14, 946. <https://doi.org/10.3390/rs14040946>
- [7] HOEFSLOOT, F. I. – RICHTER, CH. – MARTÍNEZ, J. – PFEFFER, K. (2022). The datafication of water infrastructure and its implications for (il)legible water consumers, *Urban Geography*, DOI: 10.1080/02723638.2021.2019499
- [8] JAN, F. – MIN-ALLAH, N. – SAEED, S. – IQBAL, S. Z. – AHMED, R. (2022). IoT-Based Solutions to Monitor Water Level, Leakage, and Motor Control for Smart Water Tanks. *Water* 2022, 14, 309. <https://doi.org/10.3390/w14030309>
- [9] KASPRZYK-HORDERN, B. – ADAMS, B. – ADEWALE, I. D. – AGUNBIADE, F. O. – AKINYEMI, M. I. – ARCHER, E. – BADRU, F. A. – BARNETT, J. – BISHOP, L. J. – DI LORENZO, M. – ESTRELA, P. – FARAWAY, J. – FASONA, M. J. – FAYOMI, S. A. – FEIL, E. J. – HYATT, L. J. – IREWALE, A. T. – KJELDSSEN, T. – LASISI, A. K. S. – LOISELLE, S. – LOUW, T. M. – METCALFE, B. – NMORMAH, S. A. – OLUSEYI, T. O. – SMITH, T. R. – SNYMAN, M. C. – SOGBANMU, T. O. – STANTON-FRASER, D. – SURUJLAL-NAICKER, S. – WILSON, P. R. – WOLFAARDT, G. – YINKA-BANJO, C. O. (2022). Wastewater-based epidemiology in hazard forecasting and early-warning systems for global health risks, *Environment International*, Volume 161, 2022, 107143, ISSN 0160-4120, <https://doi.org/10.1016/j.envint.2022.107143>.
- [10] KUMAR SINGH, D. – SOBTI, R. – JAIN, A. – KUMAR MALIK, P. – LE, D.-N. (2022). LoRa based intelligent soil and weather condition monitoring with internet of things for precision agriculture in smart cities. *IET Communications* 2022, 16(5), pp. 604 – 618. <https://doi.org/10.1049/cmu2.12352>
- [11] MEZNI, H. – DRISS, M. – BOULILA, W. – BEN ATITALLAH, S. – SELLAMI, M. – ALHARBI, N. (2022). SmartWater: A Service-Oriented and Sensor Cloud-Based Framework for Smart Monitoring of Water Environments. *Remote Sens.* 2022, 14, 922. <https://doi.org/10.3390/rs14040922>
- [12] MISHRA, A. P. – SINGH, S. – JANI, M. – SINGH, K. A. – PANDE, CH. B. – VARADE, A. M. (2022). Assessment of water quality index using Analytic Hierarchy Process (AHP) and GIS: a case study of a struggling Asan River, *International Journal of Environmental Analytical Chemistry*, DOI: 10.1080/03067319.2022.2032015
- [13] MOUSAVI-MIRKALAEI, P. – ROOZBAHANI, A. – BANIHABIB, M.E. et al. (2022). Forecasting urban water consumption using bayesian networks and gene expression programming. *Earth Sci Inform* 15, 623–633 (2022). <https://doi.org/10.1007/s12145-021-00733-z>
- [14] MSAMADYA, S. – JOO, J.C. – LEE, J.M. – CHOI, J.S. – LEE, S. – LEE, D.J.; GO, H.W. – JANG, S.Y. – LEE, D.H. (2022). Role of Water Policies in the Adoption

of Smart Water Metering and the Future Market. *Water* 2022, 14, 826. <https://doi.org/10.3390/w14050826>

[15] NGUYEN, L.V. – TORNYEVIADZI, H.M. – BUI, D.T. – SEIDU, R. (2022). Predicting Discharges in Sewer Pipes Using an Integrated Long Short-Term Memory and Entropy A-TOPSIS Modeling Framework. *Water* 2022, 14, 300. <https://doi.org/10.3390/w14030300>

[16] SIMÕES, M.G. – FARRET, F.A. – KHAJEH, H. – SHAHPARASTI, M. – LAAKSONEN, H. (2022). Future Renewable Energy Communities Based Flexible Power Systems. *Appl. Sci.* 2022, 12, 121. <https://doi.org/10.3390/app12010121>

[17] WILLEMS, J. J. – VAN POPERING-VERKERK, J. – VAN ECK, L. (2022) How boundary objects facilitate local climate adaptation networks: the cases of Amsterdam Rainproof and Water Sensitive Rotterdam, *Journal of Environmental Planning and Management*, DOI: 10.1080/09640568.2022.2030686

CASE STUDIES - POSSIBILITIES OF USING UAVS IN HEALTHCARE

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Abstract: Modern technologies are ever more being introduced in various industries, including public administration and the well-being of the population. They are becoming an important part of business development—a tool bringing cost savings and improving competitiveness. In addition, they can help in the non-profit sector that has a significant impact on the quality of life of the country's population. Drones are unmanned devices that are not used for hobby purposes only at the moment. They can significantly facilitate various transports and monitoring operations. Healthcare is the area where drones often play a key role in saving lives. Unmanned devices can transport a defibrillator to its destination and save a life, or they can be very effectively deployed to transport medical supplies. Technological advances are also proving their worth in saving lives. The article deals with the possibilities of the use of drones (UAV devices) in healthcare on the basis of the case studies analyzed. The case studies focus on real-life experiences where drones have proved to be suitable for medical and logistics tasks.

Keywords: management, healthcare, case studies, drones, UAV

1. Theoretical Review

A drone is an aircraft capable of flying without a pilot on board. The acronyms UAV (Unmanned Aerial Vehicle), UAS (Unmanned Aerial System), or RPAV (Remotely Piloted Aircraft Vehicle) are also used in foreign language expert articles as well as in Slovak, but the definition may differ slightly. Unmanned aerial vehicles do not need any pilot on board and can be operated autonomously or remotely by a pilot (Gupta et al. 2013). The most precise meaning is the acronym UAS (Unmanned Aircraft System), which incorporates the fact that these complex systems include ground stations and other devices in addition to the flying drones, which are an integral part of the system. Generally speaking, the acronym UAS describes the entire system, which includes aircraft, control stations, and data links (Gupta et al. 2013). Apart from the inconsistency of the terms, all the acronyms above identically refer to the same equipment.

Unmanned aerial vehicles can be classified into different groups depending on a variety of parameters, such as operating altitude, range, communication range, payload, size of the aircraft, material used, and other attributes. Worldwide, drones are used by military forces, with each force using a separate classification due to specific tactical deployment parameters. The article will only address the classification of drones for civilian needs.

The classification by the degree of autonomy deals with the control method of these devices. Classification by the degree of autonomy is particularly necessary when considering the future use of such devices with respect to the advanced level of control. Three autonomy tiers are available to the pilot to control the drone:

- No autonomy (Ground control or remote piloting): requires the pilot to be in control of the drone all the time. These drones are often called remotely piloted

vehicles because they require constant input from the user. Such drones are essentially advanced radio-controlled aircraft that use the same basic techniques as RC vehicles. (Gupta et al. 2013)

- Partial drone autonomy: is specific to drones using guidance systems. Partial drone autonomy can be defined as a flight requiring user inputs during critical processes. The user must take full control of the aircraft during pre-flight setup, take-off, landing, and during operation of system undefined events. When in the air, the autopilot function can be activated, and the aircraft will follow a set of pre-programmed waypoints. However, the user is present and in charge of the drone during the entire operation and can take control at any time. (Gupta et al. 2013)
- Full autonomy: is one that, in theory, requires no actions by the user to achieve the objective once it takes-off. (Gupta et al. 2013)

1.1 UAV market

The major segments that make up the global drone market are the militarized, commercial, and consumer segments. The global commercial drones market size has been estimated at €11.85 billion in 2020 (Grand View Research 2021). The drone market is expected to expand at a compound annual growth rate of 57.5% from 2021 to 2028 (Grand View Research 2021). In units of volume in this segment, demand was recorded at 689.4 thousand units for 2020 (Grand View Research 2021). Figure 1 shows the predicted exponential growth in the number of units sold in the commercial drone market (Castellano 2018). The major players in the commercial drone market are DJI, Parrot SA, Aerovironmen, PrecisionHawk, Intel, and Draganfly. As of March 2021, the Chinese company DJI was the world's leading drone manufacturer. Based on sales volume, the company had a market share of 76%, followed by Intel, which had a market share of around 4% (Slotta 2022). The drone market is also appealing to

investors, as supported by the statistics indicated in Figure 2, which shows investments up to 2017 for the most attractive drone startup companies.

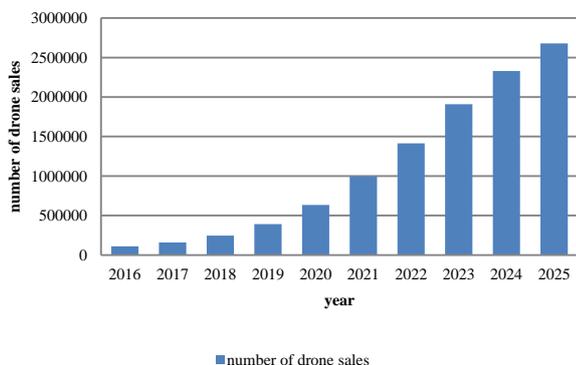


Figure 1: Global Market Drone Sales Estimate

Depending on the drone type, the rotary drones industry accounted for the largest share of nearly 80.0% in terms of volume in 2020 and is expected to continue to dominate the market in the coming period (Grand View Research 2021). The hybrid drone segment is expected to experience the fastest compound annual growth rate of approximately 64.0% between 2021 and 2028 (Grand View Research 2021).

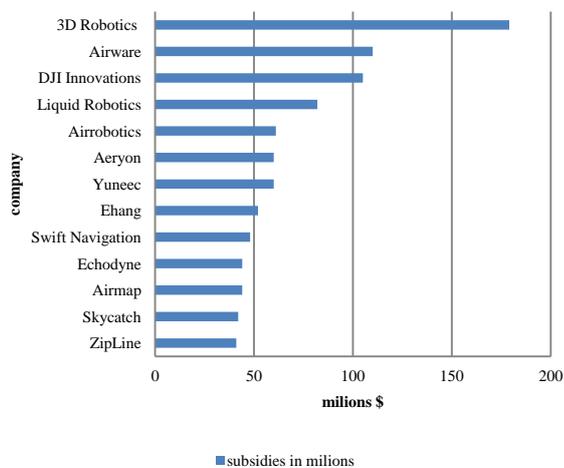


Figure 2: Drone Startup Companies Investments

When it regards the consumer drone market, the global consumer drone market is expected to grow from €2.7 billion in 2020 to €6.7 billion by 2030 (Vailshery 2021). The total number of consumer drone shipments worldwide was approximately 5 million units in 2020 (Vailshery 2021). This number is expected to increase over the next decade, reaching 9.6 million consumer drone units shipped globally by 2030 (Vailshery 2021).

2. Methodology

The article deals with the possibilities of the use of drones (UAV devices) in healthcare on the basis of the case studies analyzed. The case studies focus on real-life

experiences where drones have proved to be suitable for medical and logistics tasks. A basic review of the relevant scientific literature was done to produce the article and achieve the objective stated. It includes the classification of drones as devices and the perspective of different authors mainly. As case studies are a qualitative approach to research, it was necessary to gather sufficient sources of information to analyze the issue. These are mainly available researches and projects already carried out on the deployment of drones in the field of healthcare. Analyzes of primary and secondary source documents were used to a greater extent. The method of generalization and induction was used to stipulate the conclusions.

3. Examples of Drone Application in Healthcare

Studies suggest that the transport of blood products by drones is feasible, but a suitable temperature environment must be provided (Amukele et al. 2017). The application of drones for the supply of blood products (blood, plasma, platelets) has proven to be a convenient way to deliver blood products to rural areas.

Ground transportation of medical supplies can be challenging in countries with poorly developed or overwhelmed road infrastructure. In countries like Rwanda, where road infrastructure poses a serious problem in transportation, drones are an important way of delivering blood products. Around 25 to 40% of all temperature-sensitive medical supplies sent from urban centers to rural health clinics are spoiled in Rwanda due to unreliable supply chain infrastructure (Mhlanga et al. 2021). As a result, rural clinics are often without the necessary products, ultimately endangering the lives of patients.

Zipline a US-based medical logistics company, is dedicated to solving the problem of access to medical supplies. Zipline deploys drones to deliver blood and other routine and emergency medical products from distribution centers to district hospitals and rural health centers. The principle of this system is to establish a communication network between the center and other clinics. Health workers from remote areas order blood via text message when needed. The order will be handled within 10 minutes of receipt. The order can be tracked by both the customer and the logistics center. At the target location, the blood shipment is dropped by parachute to the health care providers waiting at the spot. Results showed a reduction in blood delivery time from 4 hours (traditional method) to 30 minutes (using drones) (Ling and Draghic 2019). "Zip" drones (see Figure 2) are fixed-wing drones that feature an increased range of up to 159 km and can carry up to 1.76 liters of blood (Ling and Draghic 2019). The results of the study by Mhlanga and the team suggest that the assistance of the government and other stakeholders is essential for the creation of such an aviation infrastructure. The costs of purchasing, building, and maintaining the infrastructure, as well as operating the drones, can be significant. One of the Zipline founders stated in 2017 that Zipline drones could reduce net costs in emergency situations, but the solutions

were more expensive than traditional methods when using drones for restocking purposes. However, there are some indications that, if undertaken on a large scale, restock operations could increase the availability of medical products and reduce the average cost of transport. (Mhlanga et al. 2021; Ling and Draghic 2019)

3.1 Laboratory Logistics

Healthcare shipments are often urgent, and the delivery speed is critical. The time between delivery by traditional means, i.e. road transport is significantly reduced by drone transport. Another added value of using drones to transport samples is the flexibility, environmental friendliness, and lower dependence on the traffic situation. As with blood products, laboratory samples are often temperature-sensitive. For this reason, the US company Matternet, together with the Swiss Post, decided to launch a pilot project in 2017 for the delivery of medical shipments in Switzerland. (Swiss Post 2020)

Medical supplies are carried by M2 drones, which are specially modified types of quadcopters. The M2 drones are designed to carry payloads of up to 2 kilograms and 4 liters over a distance of up to 20 kilometers. Matternet uses a cloud platform to run the service. This cloud-based platform records customer requests, generates routes, and monitors and manages all operations. Stations are installed at the destinations to land the drones as well as to automatically replace the batteries when needed. In addition to Switzerland, Matternet is working with medical sample delivery in Japan, Germany, and the USA. (Ackerman 2019)

The difference between bringing blood products to remote areas in Rwanda and drones for transporting laboratory samples in Switzerland lies in the different drone types that are being deployed. While long-distance delivery in rural areas is provided by drones with gliding flight, which allows for a longer range and lower energy consumption, drones for transporting laboratory samples in urbanized areas require stopping in the air above the destination or landing at that location directly.

3.2 Defibrillation Equipment Transport

Out-of-hospital cardiac arrest (OHCA) is a worldwide health problem. The annual incidence of OHCA in Europe ranges between 67 and 170 people per 100K inhabitants (Gräsner et al. 2021). A victim's chance of survival in cardiac arrest decreases by 7% to 10% for every minute that passes without defibrillation (American Heart Association 2012). Although automated external defibrillators (the AEDs) have become widespread in public places such as shopping malls, airports, schools, and sports venues, they are not as widespread as one might think. Another frequent occurrence of these facilities is community centers or volunteer fire stations. On the other hand, most OHCA cases take place in the home environment and not in public. However, even when AEDs are in close proximity (within 100 m), they are not used in 40% of cases (Zègre-Hemsey et al. 2018).

A study conducted in Sweden suggests that a positive response can be observed in bystanders when operator-assisted AED drone delivery is deployed. Study participants considered drone delivery of AEDs to be safe and feasible (Sanfridsson et al. 2019). Another Swedish study confirmed that AEDs can be carried by drones in actual OHCA cases with an AED delivery success rate of 92%. AED-equipped drones were used at 12 suspected OHCA cases during the reporting period, with a median distance from the site of 3.1 km. Also, this study proved the time efficiency of this delivery—in 64% of AEDs the drones arrived before the ambulance. (Schierbeck et al. 2021)

In 2021, a real-life drone-based AED delivery operation was launched in the Gothenburg region, covering approximately 80K inhabitants. The procedure is that when a call is received on the emergency number 112, it is decided whether it is an OHCA case. Then follows the drone preparation, route planning, confirmation of weather conditions, obtaining flight clearance from Air Traffic Control, and acceptance of the mission by the remote pilot. The flight is performed at an altitude of 60-80 meters depending on the terrain and at an average flight speed of 70 km/h (EENA and Everdone 2021). The maximum one-way flight radius is 5 km. Flight operations are remotely monitored from the Everdrone Mission Control Centre. Drones are deployed along with an ambulance as an adjunct to standard care. The drones are designed to operate in dry conditions with wind force not exceeding 8 m/s. Although the flight is monitored remotely by the pilot, the entire take-off and flight procedure is fully autonomous. If necessary, the pilot can manually maneuver the UAV remotely using the cameras to ensure successful delivery. Many experts participating in the project agree on the relevance of this use for non-urban areas or situations where rapid medical assistance cannot arrive in time. Also, the study points to the lack of or insufficient legislative framework as one of the main obstacles to the mass deployment of drones in OHCA cases. (EENA and Everdone 2021)

4. Conclusions

The use of drones has proven to be a suitable way of delivering small medical supplies and supplying hard-to-reach locations. Drones are particularly useful in medical logistics because of the shorter response time in emergency situations. Experience shows that the implementation of drone systems is not necessarily associated with the large upfront costs that large companies have, but the implementation can also be done at local levels. A large number of pilot projects are currently underway involving the use of drones to transport samples, small medical supplies, and other pharmaceutical products. Preliminary results suggest that the use of drones is feasible, but implementation requires close collaboration with multiple stakeholders, including regulatory authorities. It is important to remember that the mere possibility of using drones for transportation does not necessarily mean that they are preferable. Much more

information is needed to truly understand the full impact of these technologies in the healthcare field. It should also be noted that several studies mention legislative barriers as the biggest problem in deploying drones for commercial purposes. Most companies or projects operating with drones fall under the legislative exemption.

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References

- [1] ACKERMAN, Evan, 2019. Swiss Post Suspends Drone Delivery Service After Second Crash. IEEE SPECTRUM [online] [accessed. 03/03/2022]. Available on: <https://spectrum.ieee.org/swiss-post-suspends-drone-delivery-service-after-second-crash>
- [2] AMERICAN HEART ASSOCIATION, 2012. Automated External Defibrillator - Implementing an AED Program [online]. [accessed. 03/03/2022]. Available on: http://www.heart.org/idc/groups/heart-public/@wcm/@ec/c/documents/downloadable/ucm_438703.pdf
- [3] AMUKELE, Timothy K., James HERNANDEZ, Christine Lh SNOZEK, Ryan G. WYATT, Matthew DOUGLAS, Richard AMINI and Jeff STREET, 2017. Drone Transport of Chemistry and Hematology Samples over Long Distances. American Journal of Clinical Pathology [online]. 2017, vol. 148, no. 5, pp. 427–435. ISSN 19437722. Available on: doi:10.1093/ajcp/axq090
- [4] CASTELLANO, Francesco, 2018. Commercial Drones Are Revolutionizing Business Operations [online]. [accessed. 03/03/2022]. Available on: <https://www.toptal.com/finance/market-research-analysts/drone-market>
- [5] EENA and EVERDONE, 2021. EENA_Everdrone_project_FINAL [online]. [accessed. 03/03/2022]. Available on: <https://eena.org/knowledge-hub/documents/using-aed-equipped-uav-to-enhance-cardiac-arrest-response/>
- [6] GRAND VIEW RESEARCH, 2021. Commercial Drone Market Size, Share & Trends Analysis Report By Product (Fixed-wing, Rotary Blade, Hybrid), By Application, By End-use, By Region, And Segment Forecasts, 2021 - 2028 [online] [accessed. 03/03/2022]. Available on: <https://www.grandviewresearch.com/industry-analysis/global-commercial-drones-market>
- [7] GRÄSNER, Jan Thorsten, Johan HERLITZ, Ingvild B.M. TJELMELAND, Jan WNENT, Siobhan MASTERSON, Gisela LILJA, Berthold BEIN, Bernd W. BÖTTIGER, Fernando ROSELL-ORTIZ, Jerry P. NOLAN, Leo BOSSAERT and Gavin D. PERKINS, 2021. European Resuscitation Council Guidelines 2021: Epidemiology of cardiac arrest in Europe. Resuscitation [online]. 2021, vol. 161, pp. 61–79. ISSN 18731570. Available on: doi:10.1016/j.resuscitation.2021.02.007
- [8] GUPTA, Suraj G, Mangesh M GHONGE and P M JAWANDHIYA, 2013. Review of Unmanned Aircraft System (UAS) [online]. Available on: www.ijarcet.org
- [9] LING, Geoffrey and Nicole DRAGHIC, 2019. Aerial drones for blood delivery. Transfusion [online]. 2019, vol. 59, no. S2, pp. 1608–1611. ISSN 15372995. Available on: doi:10.1111/trf.15195
- [10] MHLANGA, Mduduzi, Tea CIMINI, Modestus AMAECHI, Chinedum NWAOGWUGWU and Anita MCGAHAN, 2021. From A to O-Positive: Blood Delivery Via Drones in Rwanda [online]. Available on: www.mastercardcenter.org
- [11] SANFRIDSSON, J., J. SPARREVIK, J. HOLLENBERG, P. NORDBERG, T. DJÄRV, M. RINGH, L. SVENSSON, S. FORSBERG, A. NORD, M. ANDERSSON-HAGIWARA and A. CLAESSION, 2019. Drone delivery of an automated external defibrillator - A mixed method simulation study of bystander experience. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine [online]. 2019, vol. 27, no. 1. ISSN 17577241. Available on: doi:10.1186/s13049-019-0622-6
- [12] SCHIERBECK, Sofia, Jacob HOLLENBERG, Anette NORD, Leif SVENSSON, Per NORDBERG, Mattias RINGH, Sune FORSBERG, Peter LUNDGREN, Christer AXELSSON and Andreas CLAESSION, 2021. Automated external defibrillators delivered by drones to patients with suspected out-of-hospital cardiac arrest. European Heart Journal [online]. 2021. ISSN 0195-668X. Available on: doi:10.1093/eurheartj/ehab498
- [13] SWISS POST, 2020. Drones A vision has become reality. Swiss Post [online] [accessed. 03/03/2022]. Available on: <https://www.post.ch/en/about-us/innovation/innovations-in-development/drones?shortcut=opp-en-ab-out-us-company-innovation-swiss-post-s-innovations-for-you-drones#droneLogistics>
- [14] VAILSHERY, Lionel Sujay, 2021. Drone reports [online] [accessed. 03/03/2022]. Available on: <https://www.statista.com/aboutus/our-research-commitment/2816/lionel-sujay-vailshery>
- [15] ZÈGRE-HEMSEY, Jessica K., Brittany BOGLE, Christopher J. CUNNINGHAM, Kyle SNYDER and Wayne ROSAMOND, 2018. Delivery of Automated External Defibrillators (AED) by Drones: Implications for Emergency Cardiac Care [online]. 1. November 2018. B.m.: Current Medicine Group LLC 1. Available on: doi:10.1007/s12170-018-0589-2

MEASUREMENT MANAGEMENT AND METROLOGICAL ORDER IN THE ORGANIZATION

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Abstract: Metrology and measurement in the organization provides significant support for quality management and control of production processes. To address and keep this structure, metrological rules are developed in organizations. The measurement management system provides measuring equipment and measuring processes to achieve quality goals with an emphasis on risk management. The metrological order form a structure for employees and the meters they use. To perform this activity, the position of metrologist is usually established within the organization. The metrologist is responsible for compliance with metrological legislation. Within the measurement management, metrological rules delegate individual activities through a matrix of responsibilities. The function of measurement management in the organization and the related metrological order are described in the present paper.

Keywords: quality, measurement management, metrological order, metrology, organization

1. Introduction

Proper metrology and overall quality assurance in organizations is important for the objective assessment of evidence-based phenomena. This is the reason for developing quality management systems, measurement management systems, specifications for the security of meters, their metrological control and other elements important in practice. [1; 2] For the very provision of metrology within companies, there are metrological rules, the task of which is to create and maintain a metrological order. This order is ensured by the correct use of measuring units, securing suitable meters, storing and keeping them in working order. It is also important to ensure the uniformity and accuracy of measurements using appropriate measurement methods. It is necessary to carry out constant metrological supervision of the meters. [3]

2. Measurement management

Measurement management draws on fact-based decision-making process, i.e. a process based on the analysis of data and information. The crucial focus is on accuracy, suitability, reliability, software security, specifications of metrological equipment, connection to national and international standards, calibrations, equipment certificates and their storage [2]. The goal of measurement management is to manage and prevent the risk that measuring equipment and related processes would affect quality. Key processes in this regard include resource management, metrological confirmation and implementation of measurement processes, and analysis and improvement of measurement management [1]. This structure is treated in accordance with ISO 10012 [4].

Resource management takes into account human resources, i.e. people who provide individual activities, including their competence and professional preparedness in this area to perform activities. This also includes information resources, which include: individual procedures, software, and documentation of measured data

with their evaluation. Equally important is the identification of the status of the measuring devices. The resource management also encompasses material resources such as measuring equipment and the environment in which the entire measurement is performed. This environment requires definition and monitoring as well. [1; 5]

Metrological confirmation serves to ensure metrological characteristics, i.e. correspondence between the measuring equipment and the requirements imposed on it. This includes calibration of measuring equipment, metrological verification and decisions on their use. The term "metrological characteristics" means the range of measurements, repeatability of measurements, stability, hysteresis, drift, effects of influencing quantities, sensitivity, resolution, error, and more. It is also important to set confirmation intervals adequately, taking into account the nature and the number of influencing factors, such as manufacturer's recommendations, data from previous confirmations, scope and complexity of use, susceptibility to wear and drift, ambient conditions, number of comparisons with other measuring devices, and others. The confirmation interval can be reviewed and adjusted according to the user's needs. All the information must be archived. A well-kept meter registration card is of great importance. [1; 5]

Table 1 Meter registration card, sample.

Source: Author's own research.

Page .../...	
Person responsible for the meter:	
Workplace (workplace identification):	
Meter registration card	
Meter type:	<ul style="list-style-type: none"> ▪ specified gauge ▪ working gauge ▪ working standard

Name and type designation:		
Measured quantity (unit):		
Measuring range:		
Definition:		
Accuracy class:		
Manufacturer:		
Supplier:		
Servicing company:		
Serial number:	Inventory number:	
Date of manufacture:	Condition as delivered:	
Date of registration:	Date of meter deregistration:	
Meter location:		
Type of confirmation used:	<ul style="list-style-type: none"> ▪ verification ▪ external calibration ▪ internal calibration ▪ confirmation through a service organization or reference material 	
Confirmation intervals:		
Confirmation organization:		
Meter notes, other remarks:		

For a properly conducted measuring process it is important to meet the set requirements. To deal with the balance of measurement uncertainties, the capability of the measurement process and the quality of the final product, which we can monitor in the form of control of the measurement process. We must then plan, validate, implement, document and control the processes. [1]

For quality management, it is necessary to take into account the measured data, which, based on the analysis and subsequent improvement, confirm the compliance of the measurement with the requirements. This activity uses process auditing and monitoring, management of potential nonconformities and related improvements. To this end, control methods should employ control diagrams, trend diagrams, interlaboratory comparisons, internal audits, and above all customer feedback. With these activities completed, some the following corrective measures can be adopted:

- adjusting the intervals between checks,
- repair or disposal of non-conforming equipment,
- elimination of measuring equipment uncertainties,
- adjustment and/or increase in the number of monitored factors,
- emphasis on increasing staff competence. [1]

3. Metrological order

In every organization, metrology forms an important part of quality management and production processes. To ensure correct setting of the system, metrological rules are introduced in companies. It is an internal directive that defines responsibilities and procedures in the defined scope and responsibility for metrology, purchasing, marking and registration of meters in the company,

methods of metrological control (calibration or verification), storage and complex handling of meters and, last but not least, forms of metrological following higher order standards. [3; 6]

The metrological rules are valid and binding for all users of measuring devices and for the organization's metrologists. The purpose of the metrological order is to describe the work with meters that every manufacturing company uses. The company metrologist is responsible for observing and updating the metrological order. This person is trained in this field; he/she is trained on a regular basis. It is vital to know and get acquainted with all the meters that are applied in the company and also their intended use. The metrological order usually consists of: objectives, terms, concepts and definitions, responsibilities and powers, division of meters, choice of meters, records and their marking, issuance of meters, calibration and verification of meters, method of decommissioning of meters, related documents and their necessary annexes. [6]

The appendices to the metrological order consist mainly of the meter registration card, a list of working meters, both specified and unspecified, and a list of reference materials. The appendices feature samples of individual operating forms. The matrix for ensuring the responsibility of metrology in the organization is critical in this area. [3; 6]

Metrology and quality go hand in hand in many companies, a metrologist is a technical worker who must have knowledge in the field of measurement technology, metrology and quality, production processes, quality systems and standards, including knowledge of mathematical statistics. Since the metrologist himself/herself is not able to maintain and control everything in practice, he/she delegates responsibility to individual users of meters; this is governed by well-established metrological rules and a clear matrix of metrological security-related responsibilities in the organization. Such a model structure in the matrix (Table 2) describes the individuals and departments in the organization and sets out who is responsible for what and who works with whom in this area, which increases the efficiency and effectiveness of quality management in the organization. [3; 7]

3.1 Matrix of metrological security-related responsibilities in the organization

The matrix of responsibilities for metrological security determines the scope of responsibilities in the given area for individual departments in the organization. It defines who is responsible for what, who sets and controls what, who organizes and who informs whom. [8] To ensure the quality of the measuring equipment, we need to have a system with which we can achieve the required accuracy. The aim is therefore to achieve metrological conditions so that the measuring equipment corresponds and, above all, suits the intended use and the final and required quality [9; 10].

Table 2 Matrix of metrological security-related responsibilities in the organization.

Source: [3]; Author's own research.

"R" – responsibility; "C" – cooperation	Organization management	Quality manager	Metrologist	Production preparation and planning	Production	Quality department	Purchasing department	Human resources	Meter users
Metrological order, legislative requirements	C	C	R						
Metrological traceability			R						
Purchase of new meters	C	C	R	C	C	C	C		C
Meter records			R						C
Calibration deadlines			R	C	C				
Calibration and verification of meters			R						C
Measuring methods and procedures, reliability of meters			R	C	C	C			C
Metrology training		C	R					C	C
Handling of meters			C						R
Audits		R	C						
Checks and revisions of metrological order	C	R	C						

3.2 Metrological control of measuring instruments

It forms a set of rules for the systematic handling of meters within their life cycle with regard to the nature of their use. These rules take into account the needs of the organization, legal requirements and customers' requirements as well. Various software tools are used to support metrology in the organization. [3; 9]

The life cycle of a meter is a comprehensive overview of the meter throughout its use. Thus, from the purchase of the meter, through the introduction of a new meter, its registration and identification, the subsequent steps of metrological control in the form of calibration or verification, commissioning of the meter for users of meters in the organization, its maintenance, storage and regular metrological control to decommissioning and disposal. [2; 3]

For this reason, it is necessary to have software in the organization with a quality set of metrology programs that would facilitate the work for metrology management in the organization, from the implementation, selection and use of meters throughout their life cycle in the given conditions. The key requirements for users are: simplicity, clarity, fast and logical search for meters based on selected criteria, with notification of the date of the next

metrological intervention - monitoring of specified confirmation intervals, with appropriate records, archiving until the meter is taken out of use. [3; 6]

4. Conclusions

Measurement management and metrological order in the organization are important supporting elements for quality assurance as a whole. The metrological order is a quality-related document, which is supported by records such as the meter registration card, calibration sheet, meter traceability scheme and the matrix of responsibilities in the organization. All of these are controlled documents of the organization that must be approved, registered, maintained and regularly updated. Verification of the application of this documentation is subject to audits. [3] Properly managed metrology is an integral part of an organization's management system, and all of this is reflected in quality products and services. The aim is a returning customer, not a returning product. [7] Users are fully responsible for the consequences of non-compliance with the metrological order, which should not be underestimated in the production organization. Therefore, all employees and/or meter users, if applicable, should be demonstrably acquainted with the metrological order of the organization. Mathematical statistics and the probability of maintaining the production process in a steady or required state are used for quality management and related measurement management, especially in mass and serial production, which is represented by process monitoring and control by statistical methods based on properly secured measurement within the organization [11]. Recently, the area of digitization of final metrological activities has been a trend. The requirements of industry within the framework of the transition to the digital age and their relation with the digitization of provided metrological services are described in the present article [12].

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References

- [1] Palenčár, R.; Kureková, E.; Halaj, M. *Meranie a metrológia pre manažérov. (Measurement and metrology for managers)*. Bratislava: STU v Bratislave (Slovak University of Technology in Bratislava), 2007. 252 p. ISBN 978-80-227-2743-3.
- [2] Musil, S.; Ďuriš, S. *Metrológia a kvalita. (Metrology and quality)*. Bratislava: SMÚ – Slovenský metrologický ústav (Slovak Institute of Metrology), 2002. 150 p. ISBN 80-89112-00-5.
- [3] Krylová, R. *Metrológie v organizaciách. (Metrology in the Organization). Řízení metrológie v organizaciích K 579-22. (Metrology Management in Organizations K 579-22)*. Praha: ČMS – Česká metrologická společnost, 2022. 10 p.

- [4] STN EN ISO 10012. *Systémy manažérstva merania – Požiadavky na meracie procesy a meracie zariadenia. (Measurement management systems – Requirements for measurement processes and measuring equipment)*. Bratislava: Slovenský ústav technickej normalizácie, 2004. 36 p.
- [5] [2022-04-16], <https://www.qualitymag.com/article/s/95520-measurement-management-the-applicable-standards>
- [6] [2022-04-11], <https://www.metrie.cz/metrologie/cz>
- [7] Hekelová E.; Paulová, I. *Metódy zlepšovania efektívnosti a účinnosti TQM. (Methods for improving the efficiency and effectiveness of TQM)*. Bratislava: Vydavateľstvo STU, 2008. 304 p. ISBN 978-80-22728-57-7.
- [8] [2022-04-10], <https://www.lubosskopal.com/metrologicky-rad>
- [9] Palenčár, R.; Kureková, E.; Vdoleček, F.; Halaj, M. *Systém riadenia merania. (Measurement control system)*. Bratislava: STU v Bratislave (Slovak University of Technology in Bratislava), Grafické štúdio Ing. Peter Juriga, 2001. 208 p. ISBN 80-968449-7-0.
- [10] Nenadál, J. et al. *Moderní management jakosti: principy, postupy, metody. (Modern quality management: principles, procedures, methods)*. Praha: Management Press, 2008. 377 p. ISBN 978-80-7261-186-7.
- [11] Tůmová, O.; Tůma, F. *Regulační diagramy a jejich využití v řízení kvality i v metrologii. (Control diagrams and their use in quality management and metrology)*. In *Metrologie (Metrology)*. Roč. 30, č. 3 (2021), p. 15 - 21. ISSN 1210-3543.
- [12] Halaj, M.; Sammarah, G. *Digitalizácia v priemyselnej metrológii – úvod. (Digitalization in the industrial metrology – an introduction)*. In *Metrológia a skúšobníctvo (Metrology and testing)*. Roč. 26, č. 2 (2021), s. 3 - 8. ISSN 1335-2768.

THE IMPORTANCE OF COMMUNICATION IN THE SUSTAINABILITY OF LOCAL GOVERNMENTS

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Abstract: *Today's world faces a lot of problems and some of them are strongly connected to communication, giving and receiving information. Local governments, being the closets governmental units to citizens, need to understand their importance and the influence they have on people. This paper deals with the problematics of local governments and their communications connected to sustainability. Organisations all over the world are trying to implement sustainability into their management and local governments are not any exception. Views of various authors are discussed in topics like communication in local governments, the influence of communication on their sustainability and the advantages the sustainable communication management can bring to the local governments. The main goal of this paper is to bring out the current state of problematics in terms of literature review supported by data from research. Discussed authors agree on supporting the digital communication via various media and using social media. One of the most important findings is that local governments need to maintain the communication on a certain level even after giving the needed information and thus provide non-stopping support for their citizens.*

Keywords: *Local government, Public administration, Communication, Sustainability*

1. Introduction

Being the institutions closest to the citizens, local governments have to deal with lots of challenges nowadays. Beginning with taking actions during the pandemic, holding decisions, or communicating. The latter is even more important these days due to a high risk of fake news and hoaxes [4]. Mayors and other representatives are obliged to be seen as responsible and deliberate. Communication can also be perceived as a part of sustainable development. Some authors even argue that communication is an essential part of an institutional sustainability. Local governments are not an exception. Thus, it is important to determine to what extent is communication truly substantial for their sustainability.

This article deals with the problematics of communication and its role in local governments' sustainability. The aim of this paper is to define the main advantages of effective communication in local government based on a current theoretical background of sustainability and communication itself.

2. Literature review

2.1 Local self-governments

The term *local self-government* is a designation for an area or territory that has its own administration and brings together the inhabitants who live in the area. The issue of establishing self-governments is not globally uniform, it may differ between countries. The international vocabulary of *Cambridge Dictionary* defines *local government* as 'a control and organization of towns and small areas, and the services they provide, by people who are elected by those living in the area' [2]. Nižňanský argues that territorial self-government, whether general or local government, does not carry out activities on behalf of the state, but on behalf of citizens. Self-government is

therefore relatively independent of state administration [10].

The local government also has certain powers in order to ensure the smooth running of regional management. These are as follows [10]:

- *Legislative* - resolution on generally binding regulations,
- *Decision-making inside and outside* - decides on property, territorial development, economic activities in the territory, territorial planning, taxes and fees,
- *Control* - controls its own equipment, assets and finances,
- *Sanctions* - imposes sanctions in the area of offenses,
- *Creative* - establishes its own initiative, control and executive institutions or organizations.

One of the documents that local governments in Slovakia need to have is *Economic and social development program* based on the law on regional development support [1]. Mandatory parts of the document are [12]:

- Analysis of economic development and social development of self-government, main directions of its development, setting goals and overriding needs,
- Roles and primary needs in the development of technical infrastructure, social infrastructure, care for the environment, education, culture and other areas according to paragraph 3, paragraph 2 of Act No. 539/2008 Coll.,
- Proposal for financial and administrative security.

This document must be accessible to all citizens; thus, the communication is essential.

The education of representatives is on a voluntary basis in local governments which can sometimes lead to lack of professional and social competences, resulting in a lower state of sustainability [8]. Based on the findings, it is possible to state that managerial skills and their correct application in management and decision-making are a key aspect of the effectiveness of local government [8].

2.2 Sustainability and communication in local governments

When deciding to implement elements of social responsibility in the strategy, the organization (business or local government) should focus its efforts on the following factors [6]:

- Vision,
- Mission,
- Declaration of values,
- Code of conduct,
- Conflict resolution procedures,
- Control and supervision procedures,
- Implementation and monitoring of compliance with standards and norms.

All the stated factors need to be communicated well, in order to be understood by the stakeholders. Thus, the communication performance is significant for the local government. The highest effectiveness and quality of the communication may be achieved when [15]:

- Mutual information channels between management and employees, the office and the organizations in the founding competence (FC), the deputies and the office or the deputies and organizations in the FC are functioning and reliable,
- Employees of offices and organizations in FC have enough arguments for various changes and decisions in self-government,
- Responsible persons in communication are able to obtain the necessary information on problems in self-government and can respond to questions from the stakeholders.

The communication in any organization (including local governments) is one of the most important pillars of its management. It is important to develop and improve in-house communication systems that are part of the company's management systems. These systems are based on three components: *communication tools*, *communication skills* and *communication competence* [15]. The main purpose of communication is to exchange information between certain parties, which are, in this case, local governments and their stakeholders [7]. Building of the relationship with the community and other stakeholders has increased in the past years which has led to focusing more on communication in local governments [7].

The communication in local government can have various forms. According to Kubica, those are [9]:

- Answering questions from journalists,
- Submission of information at council meetings,
- Responding to requests for information pursuant to Act no. 211/2001 Coll. on free access to information,
- Meeting of local government representatives with citizens,
- Organizing cultural, social and sporting events,
- Activities of associations,
- Equipping the site (citizens' requests) during the office hours of the office.

The connection of communication to sustainability is non-negotiable. Without communication, the necessary processes could not work in companies, but also in public sector organizations. Heller argues that "*effective communication is the foundation of leadership and management*" [5]. He also describes communication in the organization as continuous and two-way, so it is not reserved for bottom-up or top-down communication. Depending on the effectiveness of communication management, the communication can contribute to increasing the sustainability of self-government [14]:

- Rapid and objective mediation of communication acts and processes, including feedback, and their transfer to all levels of management,
- Fixing communication competencies and communication roles in individual communication levels in management levels,
- Creating a communication environment for all employees involved in management processes.

In order to achieve the higher level of sustainability, the communication needs to be clear, transparent and precise. It is also essential that the local government appropriately chooses the communication channels that it will use to communicate with its employees as representatives of the internal environment, as well as the channels for communication with external stakeholders.

In his study, Gomes [3] evaluated various stakeholder groups in English municipalities. The result was a comparison of stakeholder significance based on a chi-square calculation. The following stakeholders have thus proved to be significant:

- Local businesses,
- Self-government employees,
- Mayors and mayors,
- Residents,
- State,
- Higher-level authorities (ministries),
- Lower-level authorities (municipalities),
- Defense components,
- Self-government management,
- Suppliers,
- Medical facilities,
- Service users,
- Various pressure groups (eg environmental).

However, according to the findings so far, one of the main stakeholders in the communication of the municipality is the group of employees who not only represent the municipality, but also continue to act as informal communicators.

Wang and co-authors [16] also claim that the most important carrier of communication is the local government representative. Therefore, it emphasizes the right *leadership*, which, according to the authors, can achieve a higher level of communication and management in self-government. It also describes two different approaches to improving sustainability. The first is *bottom-up* communication, which actively involves local people in planning and deploying sustainable activities, while emphasizing the importance of supporting citizens throughout the process. The second approach described is *top-down* communication, it uses professional expertise to support sustainability decisions.

Okon [11] recommends local governments to apply the principles called CARE to their communication. These are the following points:

- C - *communicate* immediately when the need arises, do not delay the sharing of information with any IB,
- A - choose the *appropriate* communication, know the recipients of the communication and the current situation,
- R - *recognize and reward* engagement in communication and stimulate discussion,
- E - to *express support*, to be interested in the challenges and problems that the people with whom the communication takes place have.

3. Methods

The main goal of this paper was to bring out the current state of problematics in terms of literature review. The references used came mostly from databases such as Scopus or Web of Science but also some Slovak websites were used. To support the theoretical findings, data from existing research were used and analyzed.

The sustainability of local governance in general is a topic which needs more research and results.

4. Results

During last year, there was research brought up by Association of Self-Governing Regions of Slovakia. It was focused on awareness of regions, regional development, and cohesion policy, although, it is possible to find some interesting results concerning the state of communication of Slovak local governments (regions) and to make conclusions.

The survey involved 1,000 respondents aged 18 and over. There was a set of questions focused on information sources or local governmental representatives. The whole results may be seen online [13].

Out of all the results, for the purpose of this paper, following are the most interesting.

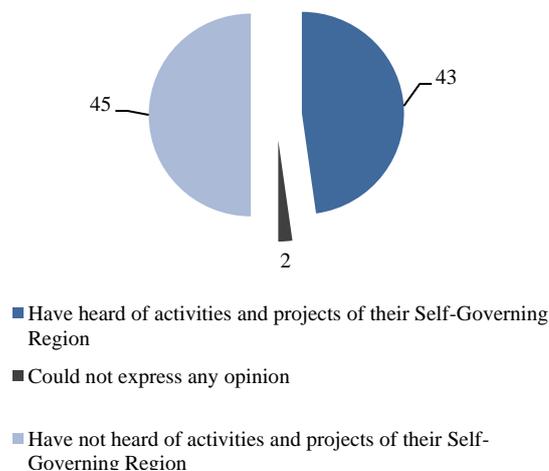


Figure 1: Awareness and information about the activities of the region (in percent) [13]

The above graph describes the state of awareness of respondents about the activities of their self-governing region. Based on the results, it can be assessed that almost half of the respondents do not feel sufficiently informed. It can therefore be stated that for the sustainability of the self-governing regions of the Slovak Republic, it is necessary to increase the awareness of citizens, and also improve the level of communication towards them.

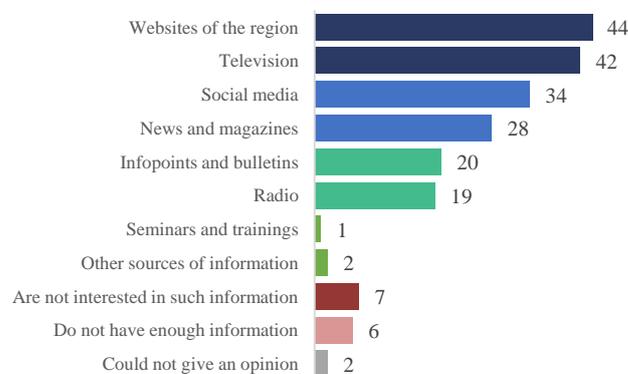


Figure 2: Sources of information on regional local government activities [13]

Most respondents get their information from websites, followed by television and social media. Thus, these communication channels may be the most effective when it comes to communication with citizens. Digital communication is therefore preferred. Only 13 % of respondents do not have any interest in information from their regions or do not feel informed enough.

Other interesting findings include that 41% of respondents think that the local authorities should decide on EU projects, 22% would assign responsibility to the local

government. However, when it comes to communication about EU projects and policies, according to 18% of respondents, city and municipal representatives are the most suitable, 12% of respondents prefer regional representatives. [13]

5. Conclusion

Giving information to citizens is one of the most important roles of local governments. The information process can only be effective with effective communication. The right channels need to be used for each group of stakeholders. It is also essential for the certain local government office to know the citizens and their needs. Well processed communication can lead to increasing the sustainability of the local government.

Based on the findings, in order to achieve a sustainable communication, the local government needs to:

- Define and know its main stakeholders,
- Analyze economic and social development, therefore know the needs of the stakeholders,
- Combine and understand its own communication skills, tools and competence,
- Be engaged in the communication process fully,
- Support the digital communication via various media,
- Try to maintain the communication on a certain level even after giving a needed information.

Local governments can be sustainable. Although, there are a lot of factors included. Communication is one of them, alongside transparency. There is a big challenge for local governments, to keep in touch with their citizens, and understand them. Using modern technologies may be the right way, when used precisely. Social media are still on their rise, which was also shown in the results of research. The most popular and effective way of receiving information from the local government is its website. It is therefore crucial to keep the information updated, have the websites user-friendly and focus on the quality of information given.

To sum up, communication needs to be a part of a sustainable development. No matter when speaking of a business or of a local government.

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References

[1] Babiak, R., *Local government development program*. (in Slovak: *Program rozvoja obce*). Dokumenty pre obce. [Online] 2021. Available at: <https://www.dokumentyprerobce.sk/ponuka/program-rozvoja-obce>

[2] Cambridge University Press, *Local Government*; in *Cambridge Dictionary*. [Online] 2021. Available at:

<https://dictionary.cambridge.org/dictionary/english/local-government>

[3] Gomes, R. C., *Who Are the Relevant Stakeholders to the Local Government Context? Empirical Evidences on Tenvironmental Influences in the Decision-Making Process of English Local Authorities*. Brazilian Administration Review, 2004, 1.

[4] Hanley, M., Munoriyarwa, A., *Fake News*; in *Digital Roots: Historicizing Media and Communication Concepts of the Digital Age*, Berlin, Boston, De Gruyter Oldenbourg, 2021, DOI: 10.1515/9783110740202-009

[5] Heller, R., *The Manager's Handbook*. London. Gardners Books, 2002. ISBN 978-0751312379

[6] Jablonski, A., *Corporate social responsibility in value based management*. Dąbrowa Górnicza: Academy of Business in Dąbrowa Górnicza, 2009. ISBN 978-83-88936-85-2

[7] Kamberi, F. (2020): *Communication between the community and local government – Case the Municipality of Pristina*; in *Traektoriâ Nauki = Path of Science*, Vol. 6, No. 5, 2020. ISSN 2413-9009, DOI: 10.22178/pos.58-6

[8] Kaliňák, M.; Balážová, E.; Tej, J.; Sotolař, J.; Mrázová, K.; Mihályi, G.; Šveda, D., *Analysis of possibilities to increase the potential of local self-government in the implementation of economic policies of cities and municipalities*. (in Slovak: *Analýza možností na zvýšenie potenciálu miestnej územnej samosprávy pri realizácii hospodárskych politík miest a obcí*). Združenie miest a obcí Slovenska. [Online] 2017. Available at: www.zmos.sk

[9] Kubica, P., *Effective communication of local government*. (in Slovak: *Efektívna komunikácia samosprávy*). Bratislava. Vydavateľstvo Spolku slovenských spisovateľov, 2008. ISBN 978-80-8061-316-7

[10] Nižňanský, V., *Self-government of a higher territorial unit*. (in Slovak: *Samospráva vyššieho územného celku*). Bratislava. Nadácia otvorenej spoločnosti, 2002. ISBN 80-968784-0-3

[11] Okon, P. E., *The Role of Communication in the Effective Administration of Local Governments in Cross River State of Nigeria*. Public Policy and Administration Research, 2017, 7.

[12] RRAK, *What is Economic and social development program* (in Slovak: *Čo to PHSR je?*). Regionálna a rozvojová agentúra Kysuce. [Online] 2020. Available at: <http://www.rrakysuce.sk/vybrane-dokumenty/204-co-to-phsr-je>

[13] SK8: Association of Self-Governing Regions of Slovakia, *Awareness of regions, regional development, and cohesion policy*. Median SK. [Online] 2021. Available at: <https://files.vlastnawebstranka.websupport.sk/1d/e0/1de0a0b2-df93-4d0f-9258-4f79afb55a81.pdf>

[14] Szarková, M., *Communication tools in a business management system*. (in Slovak: *Komunikačné nástroje v systéme riadenia podniku*). Bratislava. Ekonóm, 2008. ISBN 978-80-225-2525-1

[15] Szarková, M., *Communication in management*. (in Slovak: *Komunikácia v manažmente*). Bratislava. Ekonóm, 2011. ISBN 978-80-228-3251-8

[16] Wang, X., Wart, M. V., Lebrede, N., *Sustainability Leadership in a Local Government Context*. Public Performance & Management Review, 2014, 37 (3)
<https://files.vlastnawebstranka.websupport.sk/1d/e0/1de0a0b2-df93-4d0f-9258-4f79afb55a81.pdf>

FORMULA FOR CALCULATION OF THE FINANCIAL CONTRIBUTION TO RECOGNIZED SPORTS: THE FUNCTION, ROLE, AND THE IMPACT ON THE MANAGEMENT OF SPORTS ORGANIZATIONS

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Abstract: The formula for calculating the allowance for recognized sport in Slovakia is discussed in the article. The formula represents a mechanism which automatically allocates state contributions to the national sports federations of recognized sports, its parameters, the method of calculating the contribution and the specifics. Moreover, the shortcomings of the funding system of sports are discussed throughout the article. The impacts on sports organizations' management are explained. Most of the content is derived from the Slovak law documents, and other related articles published by sports management experts. The article is practically oriented, and it provides the reader with practical insight of the sports funding system in Slovakia.

Keywords: financing of sport, state resources, The Ministry of Education, sport management

1. Introduction

To Act no. 440/2015 Coll. on Sports and on Amendments to Certain Acts (hereinafter referred to as the "Act") a calculation was taken over, which establishes the amount of the contribution to national sports associations (hereinafter referred to as "NSA, union, unions") not based on subjective determination but from specific measurable data. The formula was not defined by law for the first time. Members of the working group defined the principle of the formula and its parameters in 2011., with minor changes this has already been used for the distribution of subsidies of the Ministry of Education, Science, Research and Sport of the Slovak Republic (hereinafter "Ministry of Education") by the sports association since 2012 based on the wording of calls published by the Sports). In the law, the formula underwent only minor modifications and clarifications, which mostly improved and corrected it. The formula has gradually reduced the differences between previously subjectively determined contributions to individual sports, which has already been reflected in the fact that once unduly overestimated sports grew more slowly. One of the main aims was to unite all the funds flowing into sport into one common package (which, however, was not fully achieved in the end) and to lay down clear, transparent, and fairest rules for its distribution.

1.1 The amount of funds for sports has increased over the years

Since 2016, the law has guaranteed a minimum amount, which is distributed from the state budget for sports. This amount cannot decrease compared to the previous years and at the same time the state budget funds were redistributed to sports in the amount of the levy from the operation of lottery games for the previous year: in 2016 25 %, in 2017 50 %, in 2018 75 % and from 2019 100 % of this levy. Thus, based on the current wording of the law, 2019 is the last year in which the amount of funds for sports has increased significantly. From 2020, this increase will be influenced only by the amount of lottery fees, but it would be appropriate to find a

mechanism that would ensure regular year-to-year growth. One of the possible solutions is to link levies on sports bets, which also regularly grow at an even faster pace than levies on lotteries.

The Act provided an automated redistribution of 92.5 % of the budget chapter of the Ministry of Education for sports in program 026 (national sports development program) from the base after deducting earmarked funds for the government's national sports project (construction, modernization, and reconstruction of sports infrastructure of national importance, support national sport project for all with a focus on youth and the organization of a major competition). Through the formula, 50 % of this NHS base is distributed (from program 026); Before the exclusion of football (17 %) and hockey (13 %), up to 80 % of the funds earmarked for sports (program 026) were divided through the formula from the base after deducting national sports projects. The Ministry of Education has only 7.5 % of all resources left for other tasks. This redistribution is visualized in figure 1 below.

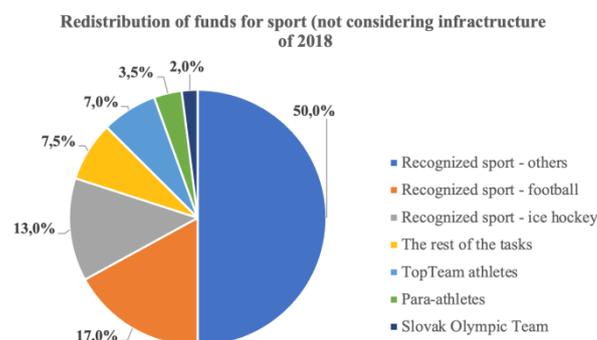


Figure 1: Allocation of funds for sport [1]

2. Methodology

All the content and knowledge presented in this article is a result of authors' practice in the relevant field which could be named as sports macro-management. Moreover, the

analysis of the Slovak law was a prevalent method used to compile the hereby presented knowledge. Therefore, most of the resources cited in the article are of the practical nature (such as articles of official public organs, or the law documents itself). The aim of the article is to provide the reader with practical insight of how the redistribution system works in Slovak Republic. The content should help sport managers to understand the redistribution system, so they are able to adapt their managed subject to the system. Since the system is unique to Slovak Republic, sport managers from other countries might take the article as a use case, from which they can learn and then communicate the knowledge to their respective public organs for the inspiration of new changes to their systems.

3. The redistribution's core mechanism – The Contribution to a recognized sport

The Contribution to a recognized sport (hereinafter referred to as “CRS”) is a financial contribution to the sports activities of the NSA (§ 68), the NSA is entitled to its SR 72 recognized sports). Until 2016, sports associations received an ineligible subsidy for their activities. CRS is directly proportional to the added value of recognized sport for the Slovak Republic and is calculated based on the share of recognized sport according to the formula set out in Annex no. 3 of the Act. The Sports Act has introduced a transparent incentive mechanism into sport, the essence of which is the competition of associations to achieve the best possible parameters in the formula based on which they are financially rewarded by the state for the delivered result. Under this model, the unions were given relative freedom in deciding how to use the funds raised from the recognized sport in exchange for transparency and clear rules for their operation and management. The unions still have a responsibility to the relevant sports movement as well as to the state and its citizens, which is determined by the achievement of sports results (i.e., parameters in the formula), on which the amount of state-guaranteed funding of their sports in the following year depends.

The share of recognized sports depends on three basic parameters and can be expressed as follows: $P = \text{sports success} * \text{interest in sports} + \text{membership base up to 23 years or more}$ precisely by this entry:

$$P = (A * KVVD + A * KVVM) \times (B * ZD + C * ZZ) + (1 - 2 * A) * M23$$

where, P = the proportion of the recognized sport concerned, A = the percentage of the weight of a sporting achievement (40 %), B = a percentage of the weight of domestic interest in sports (70 %), C = the percentage expression of the weight of foreign interest in sports (30 %),

$(1 - 2 * A)$ = a percentage of the weight of the number of young people under 23 (20 %), $KVVD$ = the coefficient of significance of the result in the category of adults, $KVVM$ = a coefficient of significance of the result in the youth category, ZD = a domestic interest in the relevant

recognized sport, ZZ = a foreign interest in the relevant recognized sport, $M23$ = the average number of active athletes in recognized sports under the age of 23.

The value of the weight of achieved sports success A (40 %), the weight of domestic interest in sport B (70 %) and the weight of foreign interest in sport C (30 %), methodology of calculation of the contribution to the recognized sport, maximum possible year-on-year decrease and increase of the contribution to the recognized sport - Annex no. 2 of the Regulation. Compared to previous years (2017 and 2018), the 2019 Regulation has the following changes: [2] increasing the maximum possible year-on-year increase in the contribution to recognized sport from 110 % to 120 %, clarification of the definition for determining the number of opportunities and the weight of sports, increasing the minimum amount of the contribution to recognized sport for the NMS from EUR 5 000 to EUR 15 000.

The formula expresses that the sport is more useful for Slovak society and the representation of the Slovak Republic in the world, the better its results and at the same time the greater its interest, or the more children it attracts to regular sports. At the same time, the formula makes it possible to compare differently recognized sports on the principle of impartiality. The method and parameters of the calculation are determined by a government regulation. The parameters of the formula and the procedure for determining individual variables are determined by Government Regulation no. 245/2018 Coll. on the methodology for calculating the share of recognized sport for 2019 (the "Regulation") [3]. The Regulation provides methodology of determining values and parameters into the formula (Annex No. 1 of the Regulation), i.e. the method of determining the achieved sports success in recognized sports, in individual sports (based on ranking or by number of opportunities and decisive number of results) and in collective sports (gradually in ranking according to the world rankings, ranking in the last World Championships, ranking in the World Cup qualifiers, European ranking, ranking in the last European Championships and ranking in the European Championships).

The formula is complex and is composed of sub-formulas. The individual sub-formulas are given for the category of adults, with the proviso that for the category of youth, in accordance with the second point of Annex no. 3 to the Act as amended by Act no. 335/2017 Coll. taking into account only the two highest age categories in which the World Championships take place (which ultimately takes into account the one that is more favorable for the calculation of the share of youth) and rankings in the youth category. [4]

The maximum possible decrease and increase of CRS (protection limits) are in the amount of min. 90 % (bottom protection against year-on-year decline) and max. 120 % (protection of others from above against year-on-year

growth) of the % share of CRS last year. The protection limits are not linked to the nominal value of the amount of CRS from the previous year, but to the % share of CRS union in the total package for the previous year, which would be the same with the same total amount of funds distributed in both years. However, as the nominal value of the basis for CRS (total allocated amount) increased year-on-year in 2016-2019 by the share of lottery levies (+ 25 % of the share of extra levies each year), a different methodology had to be used to divide the amount.

To ensure a better explanation, let an example be set: if in 2018 the NSA had a share of the allocated amount for CRS of 10 %, in 2019 its share will be in the range of min. 9 % and max. 12 %. If the total allocated amount (2019/2018) increases by 17.5 % in real terms, the CRS of this union for 2019 will be in the range of 105.8 % to 141 % of the absolute amount of CRS for the previous year 2018. In 2019, the protection limit from above applies only when CRS in the previous year 2018 was higher than 1 per mille of the distributed amount in 2018, sports with lower CRS than 1 per mille are not limited by the upper limit of protection (when growing to the level of 1.2 per mille).

The maximum percentage of CRS stipulates that the share of one recognized sport may not exceed 15 % of the total allocated amount. Currently, no sport reaches this limit, in the adjusted calculation for 2017, it only concerned tennis. While football and hockey were included in the formula, this value was set at 25 % of the total allocated amount.

3.1 Not only CRS but also other sources of financing are decisive for the comparison of NSA financing.

When reviewing the financing of individual sports, it is necessary to consider the financing of athletes through TopTeam [5] and departmental sports centers (DSC), which form a significant part of financing, especially in "medal" individual sports with success at the Olympic Games, World Championships and European Championships.

Through TopTeam was in 2017 supported a total of 165 athletes from 30 sports and 3 organizations of disabled athletes in the total amount of 3 563 625 EUR [6] (most canoeing 26 athletes, Slovak Paralympic Committee 17, Slovak Association of Physically Handicapped Athletes 14, shooting 13, karate 11, Deaflympic Committee of Slovakia 8, athletics 7, etc.) and in 2018, a total of 157 athletes from 27 sports and 1 organization of para-athletes were supported in the total amount of EUR 3 916 489 [7] (most canoeing 26 athletes, karate 21, Slovak Association of Physically Handicapped Athletes 14, shooting 11, bodybuilding and fitness 10, athletics 9, kickbox 9, etc.).

The unfinished process of optimizing departmental sports centers [8] is still a considerable reserve for their operation. The legislative process for the project Optimization of the activities of departmental sports centers while ensuring state representation [9] and for the draft government regulation on uniform rules for the

management of departmental sports centers [10] has not been completed since December 2017.

3.2 The percentage limits of the CRS distribution complicated the activities of the unions.

Amendment to the Sports Act no. 354/2016 Coll. with effect from 1.1.2017 introduced in § 69 par. 5 and 6 of the Act without professional analysis or discussion mandatory percentage limits of the distribution of the contribution to recognized sports by national sports federations: for sports clubs by number of teams or individuals, only on the basis of quantity (at least 15 %), for talented youth (at least 20 %), for sports representation (at least 25 %), for the administration and operation of the national sports association (maximum 15 %) and for sports infrastructure (maximum 30 %).

All national sports federations have the same goal - increasing the membership base and achieving better results in youth and adult representation. This goal is destined to compete not only by the very nature of sport but also by setting a formula for calculating CRS. Due to the diversity of individual types of recognized sports, their needs, and priorities, it is not possible to achieve this goal optimally, provided that the law "from above" sets strict limits and criteria for individual groups of expenditures for national sports associations according to the same scheme.

The determination of what funds will be used for and the quantitative and qualitative criteria for their distribution should be the responsibility of each national sports association. The priorities of unions and their respective sports or disciplines cannot be set by the same legal provision as a flat rate for different sports. Each sport has its own specifics, training system, organization of domestic and foreign competitions, the number of active athletes at the top and lower level, care for talented youth, providing sports representation, etc. These characteristics vary considerably from one sport to another, there is a big difference between training in individual and team sports, in technical sports, in sports where there are only a few active clubs, and in Olympic and non-Olympic sports. [11]

At the same time, the introduction of limits is more administratively demanding for all national sports federations, as they must closely monitor internally the use of the recognized sport allowance for individual statutory purposes, which unnecessarily complicates decisions on the redistribution of the recognized sport allowance, its effective use the Ministry of Education, especially in multi-discipline sports. This provision is clearly criticized at meetings of representatives of sports federations at various levels and there are strong voices calling for its amendment, as it runs counter to the needs of the sports movement. If the state is concerned that the funds in the unions will not "overeat", it is appropriate to maintain a % reduction in administrative and operating expenses and to leave the mandatory allocation of funds to clubs (max. up to 15% of CRS), other limits (for talented youth and representation should be abolished).

3.3 Another complication - the decree on the eligible costs of using CRS.

The same amendment to the Act also in § 100 par. 1, letter c) introduced that the Ministry of Education shall establish by generally binding legal regulations the eligible costs of using the allowance for recognized sport. As an example of the missing eligible costs, cannot be used to participate in top junior events (at the European level). Eligible costs would rather be defined as negative meaning all areas of expenditure that cannot be reimbursed from the CRS would be identified and other expenditure would be allowed. Not only the percentage limits of the distribution of CRS, but also the definition of eligible costs of using CRS complicate the activities of individual unions and increase the administrative complexity of their activities. These measures abolished the union's original relative freedom to decide how to use the funds to develop its sport to focus on achieving the parameters in a formula that rewards them for meeting the public interest parameters in sport.

3.4 The lack of infrastructure limits the development of some sports.

The limiting factor for the development of many sports is the lack of infrastructure. In some sports without new infrastructure, it is no longer possible to further increase the membership base and ensure a standard training process and organization of sports events due to capacity reasons (e.g., missing swimming pools, cycling oval, halls for team sports, athletic stadium, canoeing center, shooting range etc.). The financing of sports infrastructure is not systematic and there are no clear criteria for support and funding, it is ad hoc funding without a pre-determined strategy, which would also have a time frame.

4. Conclusions

The original law on sports functions as an automated machine for the redistribution of public budget. It provides the public with transparency of data in the information system of sports, which is to provide a factually correct basis for calculations and decision-making and freedom of associations in dealing with a contribution to recognized sports calculated according to the formula (except 10 % bound for all clubs), while the motivation should be represented by the formula itself and its need to achieve the best possible parameters in the formula. Each union could decide what its priorities were (were) in achieving these parameters.

The amendment to the Sports Act brought the funds of associations from the contribution to recognized sports and the definition of eligible costs. A non-functional IS of sports causes dissatisfaction with the quality of data and the impossibility of their verification. Added to this was a completely unsystematic political intervention consisting in separating football and hockey from the formula.

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References

- [1] § 77 par. 2 of the Sports Act.
- [2] Greguška I., Blažo M., Sepeši P.: The government approved a regulation on the methodology for calculating the share of recognized sports for 2019 or further improvement of the formula. Available online: http://www.ucps.sk/Vlada_schvalila_nprava_o_metodike_na_vypocet_podielu_uznaneho_sportu_na_rok_2019
- [3] Government Regulation no. 245/2018 Coll. on the methodology for calculating the share of recognized sports for the year 2019. Available online: <https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2018/245/20180901>.
- [4] Explanatory memorandum to the government regulation on the methodology for calculating the share of recognized sports for 2019. Available online: <https://www.slov-lex.sk/legislativne-procesy/-/SK/dokumenty/LP-2018-434>.
- [5] Fundamental comments of UčPS applied to the draft amendment to the Sports Act. 8/1/2018 Available online: http://www.ucps.sk/Zasadne_pripomienky_UcPS_uplatnen_e_k_navrhu_zakona_o_sporte.
- [6] <http://www.minedu.sk/financovanie-sportu-v-roku-2017/>
- [7] <http://www.minedu.sk/financovanie-sportu-v-roku-2018/>
- [8] Sepeši, P. Public discussion on the draft government regulation on uniform rules of management of departmental sports centers and on the project of optimizing their activities is very necessary. Available online: http://www.ucps.sk/Verejna_diskusia_k_projektu_optimalizacie_i_nariadeniu_vlady_o_jednotnych_pravidlach_riadenia_stredisk_je_potrebna.
- [9] LP/2017/897 Optimization of the activities of departmental sports centers while ensuring state representation. Available online: <https://www.slov-lex.sk/legislativne-procesy/SK/LP/2017/897>.
- [10] LP/2017/879 Regulation of the Government of the Slovak Republic on uniform rules for the management of departmental sports centers. Available online: <https://www.slov-lex.sk/legislativne-procesy/SK/LP/2017/879>.
- [11] The list of top team athletes is a list of sports representatives in the category of adult and talented athletes compiled based on achieved sports results at a major competition (§3, letter u. Of the Act).

ANALYSIS OF SPORT SUPPORT THROUGH SELF-GOVERNING REGIONS AND LOCAL GOVERNMENTS IN SLOVAKIA

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Abstract: *State and sport. At first glance, two quite different concepts, which share a minimum of common features, and yet have developed hand in hand throughout history. The development of sport has gone through a period of ups and downs. On the one hand, throughout history, sport has represented the achievement and fulfilment of aspirations and has been intended to bring everyone together; on the other, darker side, it has been an instrument of power propaganda, which has treated it as its showcase of achievements. But where is sport in Slovakia realistically today? This paper deals with the importance of answering the previous question through the creation of an analysis of financing for Self-governing Regions and Local Governments. This paper is built on several research methods and techniques which are used mainly in the analytical part of the research paper. Specifically, these are the methods of comparison, synthesis, and analysis. In terms of importance, no single method can be considered superior, because only together they can produce a realistic picture, thanks to which the results of the thesis can be built on a relevant basis. The thesis looks also at the recommendations that can help the Slovak sports community to grow and create a better and healthier environment for sport.*

Keywords: *Sport, Analysis, Financing, Self-governing Regions, Local Governments*

1. Introduction

Nowadays, the phrase 'support for sport' is being bandied about more and more. It is a very sensitive phrase that resonates within society with a diversity of opinions. While many people, not only from the relevant sports associations but also from the lay public, consider the promotion of sport to be a very underfunded area, there are also people who do not see it in such a negative light. Of course, this support needs to be actively perceived and linked to a general concept and not with a focus on a specific sport sector.

Why, in fact, should the promotion of sport, as such, be of interest to people across the whole of society? The answer to this question is not easy to formulate, but it is very well epitomized by Pierre de Coubertin, the founder of the modern Olympic Games, who defines sport as follows: "*Sport is part of the heritage of every man and woman and cannot be replaced by anything else*" [1]. This idea implies that, although we may not realize it, sport itself is part of everyone's life. As a society, we have the opportunity through sport to build imaginary bridges between people and each other, creating an effective and healthy society. Among the most important societal roles within sport are [1]:

- Improving the level of public health through physical activity.
- Joining forces in the fight against doping.
- Strengthening the role of sport in education and training.
- Promoting volunteering and active citizenship through sport.
- Harnessing the potential of sport for social inclusion, integration, and equal opportunities.

- Strengthening the prevention of and fight against racism and violence.
- Promoting our (European Union) values in other parts of the world.
- Promoting sustainable development.

2. Methods

The basis of this research work is its theoretical-analytical level (character). The theoretical character of the thesis is represented within the first chapter in which the thesis attempts to explain the importance of promoting sport. The analytical character represents the more dominant part of the thesis, which is primarily devoted to the analysis of the financing of sport through Self-governing Regions and Local Governments in Slovakia. This analytical part is discussed across the rest of the present research work.

The primary objective of this research work is to create an analysis of the support of sport through higher territorial units and municipalities in Slovakia. The thesis also focuses on several secondary objectives that help to understand the whole issue of sport financing in an effective and correct way. The partial (secondary) objectives of the research work include:

- Determination of the importance of sport within society.
- Analyzing the environment of entities active in sport.
- Creating an analysis of the public funding of sport with an appeal to the funding of sport through Regional Government and Local Authorities.
- Pointing out the gaps in the system of public funding of sport with an appeal for a system for funding sport through the Local Governments and Self-governing Regions.

- Proposing recommendations in the framework of support for sport.
- Evaluating the economic and non-economic aspects of the proposed recommendations.

The research work covers almost the entire spectrum of public funding of sports in the analytical part. The main reason for the involvement of most entities, and not only higher territorial units and municipalities within this funding, is to point out the factors of non-compactness and inefficiency of the system that is currently set up within the Slovak Republic.

3. Research Results

The Slovak Republic does not have the level of support for sport that would be appropriate for a country in the European Union. State support is only 40 EUR per capita by 2020 and it does not seem that anything will change radically in this respect soon [2].

However, the state is not only failing in its role as a supporter of sport, but also in other dimensions that logically have an impact on the sports field. A huge problem can also be seen in society's understanding of sport. Today, most of society sees sport as a very debatable topic that is not important.

In terms of overall public funding for sport, the largest amount of funding has long flowed from municipal budgets. Since 2015, this is also the only budget chapter that has continuously increased the number of financial resources directly allocated to sport and recreation activities. The question in this case may be 2020, which was marked by the coronavirus pandemic and the cancellation of most of the subsidy calls, which certainly affected the total financial resources flowing from the budgets of municipalities, towns and higher territorial units into sport and recreation. In total, municipalities and higher territorial units allocated 573.57 million EUR to sport and recreation activities in the period 2015 - 2019, which represents a percentage of up to 57.75% of all public resources allocated to sport and recreation. The total financing of all involved parties is captured in Table 1.

Table 1 Provision of financial resources for sport in Slovakia, by entity, 2015-2019 (million EUR)

Year	ME	MI	MD	GO	SGR & LG	Total sum
2015	38.50	0.75	5.49	7.30	95.05	147.09
2016	48.41	0.75	4.90	-	99.49	153.55
2017	105.97	0.72	5.48	-	107.57	219.74
2018	68.61	0.76	6.09	9.0	132.28	216.74
2019	99.35	1.02	6.55	10.03	139.18	256.13
Total	360.84	4.00	28.51	26.33	573.57	993.25

where:

ME: Ministry of Education, Science, Research and Sport

MI: Ministry of the Interior

MD: Ministry of Defense

GO: Government Office of the Prime Minister and the use of subsidies from the Prime Minister's reserve

SGR & LG: Self-governing Regions and Local Governments

Overall, public financing of sport can be characterized as continuously progressive, which means that it is constantly increasing. A minor exception is 2018, when total funding decreased by less than 3 million EUR. However, it can be stated that the funding of sport has managed to climb to 256.11 million EUR over five years, which is a shift of almost 110 million EUR compared to 2015 and 147.02 million EUR. Other key findings are as described below:

- The environment of sport is very negatively marked by various social elements. Examples include perceived corruption or the average monthly wage in Slovakia [3,4].
- The economic level of sport is no better off in this respect. The Slovak Republic is at the bottom of most statistics among the countries of the European Union. Particularly striking is the allocation of 218.3 million € to sport and recreation from the state budget, which represents only 0.5%. The main reason why this budget should be larger is the fact that the field of sport in the European Union employs 2.72% of the economically active population and generates a total share of 2.12% of GDP [5].
- On the other hand, the technical aspect, which has undergone significant changes in recent years, is a positive aspect. One example is the sports information system, which has minor quality deficiencies, but on the other hand not such as to prevent the effective management of sport.
- The Ministry of Education, Science, Research and Sport, as the central body for the administration of sport, has not significantly increased its support for sport and thus does not transform sport into an economic creator, but on the contrary puts it in a position where it is only a user of the economy.
- Support for sport through the Self-governing Regions is often chaotic. An example is the Bratislava Self-governing Region, which, instead of looking for alternative solutions for financing cultural and environmental programmes, has cut the budget for sport and moved part of it to these areas. An approximate picture of how it should work in contrast is provided by the Nitra Self-governing Region, which leads by example and participates in the creation of up to 39% of the total funds used for the sport and recreation programme.
- The transformation of a non-functioning subsidy scheme into a functioning one is noted in the case of the Trnava Self-governing Region, which instead of making senseless cuts in the sports budgets, on the contrary, has noticeably increased this programme.
- Local Governments, as representatives of how municipal funding works, show that they have an inconsistently set up system, just like Self-governing Regions.
- Most of the Local Governments do not spend even 2% of their approved budget on the sport programme. For

example, the (non-)intervention of the city of Prešov, which spends only minimal amounts on sport, is negative in this regard. The fall of Tatran Prešov football club or Tatran Prešov handball club can be clearly observed in this regard.

- The regional cities, together with the self-governing regions, do not have relevant data that they could realistically use in the creation of subsidy schemes.
- In connection with the missing data, it can also be stated that there is a lack of communication on the part of local governments, which do not communicate the non-approval of subsidies. Thus, actors often do not know why their applications are not supported in a relevant way.
- The development of concepts for sport is also a huge missing element. Almost no city has a clear idea of how it wants to further develop this area.
- Another serious problem is the lack of city sport officers who can create a valuable position for sport in the city.
- A positive factor is the support of recognized sports that have built a stable base in the Slovak Republic and are able to translate the funds used into results. Examples are football, ice hockey and athletics.

4. Recommendations

The previous analyses in this chapter of the thesis can be used to formulate several recommendations that could be applied to the field of sport. However, the focus in this case reflects the title of the whole thesis and is therefore primarily addressed and targeted at the funding of Self-governing Regions and Local Governments in Slovakia.

An elementary element of all funding is its careful planning. In this respect, it is important that local and regional authorities have developed concepts that reflect their short, medium, and long-term plans for sport and recreation. According to a study by KMPG contribution levels to sports organizations need to be published in advance to reduce the risk of a club failing to manage its funding because it has not found other alternatives for financial support outside of public municipalities in time [7]. It is these developmental concepts that should help to underpin this system.

The fact that the development concept of sport is an absent element in cities is underlined by the findings of the Supreme Audit Office of the Slovak Republic, which carried out an audit in 45 district towns between 2016 and 2018 and found that up to 70% of towns did not have a sports development concept developed or updated to the latest form, in accordance with the Sports Act, despite the fact that this was the most supported area in general [6].

The second follow-up recommendation in this area is the compliance with the rules of financing sports entities from the budgets of local governments and higher territorial units. In cities, but also in self-governing regions, there is often support for activities that cannot be supported based on the Law on Budget Rules of Local Governments, but

also based on the Local Government Code. An example is again given by the Supreme Audit Office of the Slovak Republic, which found misconduct in more than 95% of the audited entities [6].

A potential solution to all the above problems, could be the establishment of more posts of the city's sports officers. Certainly, in the case of this post, one cannot speak of a uniform methodology of proceeding in the case of all municipalities. This post should be represented in each municipality to such an extent that the city is able to supervise the field of sport in a relevant way and to establish logical procedures and conclusions in the implementation of development concepts in the field of sport. However, to establish this post, cities would need to allocate funds, which are hard to find, and that is why the state should help to create this function to some extent from the state budget.

The creation of more city clerk positions, for sports, would also have the advantage of collecting and analyzing real data from local governments that is now absent or present in an irrelevant form.

The final recommendation is again linked to the work of the town clerk, who should communicate and connect all sports clubs in the town. According to the Supreme Audit Office, both the city and the Self-governing Regions should ensure that it transparently informs the consideration of applications based on the decision of the highest representative of the municipality or the municipal region [6]. A similar system can be registered in the case of the Žilina Self-Governing Region, which publishes on its website information on allocated or unallocated subsidies by region, regularly publishes modifications to general binding regulations and actively communicates with sports entities.

4.1 Economic benefits

The evaluation of the recommendations for the promotion of sport can be divided in terms of benefits into economic and non-economic. An important part of this chapter is also an assessment of the potential risks of the recommended proposals.

It is not entirely clear what kind of financial returns can be expected in the short term from the implementation of the recommendations. The most important thing to note in this case is the link to the longer term, which is the following benefits:

- Based on long-term monitoring by the Organization for Economic Co-operation and Development, we can now say that investing one euro in sport can save five euros invested in a person's health care in the long term.
- By developing sport, local and regional authorities can promote sports tourism, which in turn helps local businesses to increase their income.

- By precisely defining the development of sport, within the development concept, the city can be more transparent with its finances.
- Sports clubs can prepare themselves sooner for the eventual search for alternative sources of funding, should the city's development concept in the field of sport not provide for the support of a given sporting activity.
- Compliance with the rules on the financing of sports entities from the budgets of municipalities and higher territorial units can prevent unnecessary costs that may arise when the supreme authorities re-inspect the activities of the highest authorities.
- The creation of new jobs for town clerks in the field of sport can partly reduce unemployment.
- Collecting and analyzing real data helps cities to better understand the functioning of sport. Also, this data can be used retrospectively in communication with the state.

4.2 Non-economic benefits

The main positive points of the recommendations are to build a relationship between municipalities and higher territorial units with sports entities. However, non-economic benefits can also be considered in the following points:

- Building a healthy communication and relationship between the city and the sports community and the public.
- Creating more space for sport and subsequent engagement with the public.
- More space to analyze the work of sport.

4.3 Risks

The main risk, and challenge, of the recommendations, in sport, is that they are tied to the unified elementary functioning of municipalities and higher territorial units. But it is also important that these governance entities also develop their own specificities to include in the elementary model. If this does not happen, it may happen that all public administration entities follow the same path, which may not be successful.

A secondary risk, especially in the case of compliance with funding rules, is the creation of less freedom in the use of the financial resources of the sports entities to which they have been allocated.

5. Conclusion

The support of sport by local governments and self-governing regions in Slovakia is nowadays shipwrecked in several elementary components of functioning. The main reason why this is so the absence of real data that would be capable of drawing certain conclusions. Therefore, the aim of this paper was to create an analysis of the support of sport through higher territorial units and local governments in Slovakia.

The current situation of sport support is reflected by the statistics and the analysis that has been developed, which quite clearly present the support of sport in Slovakia as a significantly undersized area. It turns out that although the situation is slightly improving, Slovak sport still has almost a whole marathon ahead of it and is hampered by elementary mistakes such as the failure to complete the law on sport or the unresolved issue of regional support for sport. The mistakes that reflect this situation are to be found mainly in the overall setting of the state's relationship to sport.

The biggest challenge for the area of support for sport will clearly be the creation of a state concept for the development of sport, which all local governments and self-governing regions will have to implement in their statutes.

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References

- [1] European Communities. (2007). *White Paper on Sport*. Luxembourg: Office for Official Publications of the European Communities. pp. 2-19. ISBN:978-92-79-06943-7
- [2] <https://www.mfsr.sk/sk/financie/verejne-financie/uzemna-samosprava/>
- [3] <https://www.transparency.org/en/cpi/2020>
- [4] <https://tradingeconomics.com/slovakia/wages>
- [5] <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/EDN-20200923-1>
- [6] <https://bit.ly/3KKGYZE>
- [7] <https://www.olympic.sk/sites/default/files/2021-01/KPMG-koncepcia-financovania-sportu-SR-2018.pdf>

PROPOSAL OF METHODOLOGY FOR ANALYSIS OF THE SPORTS SUCCESS OF COUNTRIES IN THE WORLD

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Abstract: *The focus of this work/research is the application of theoretical knowledge and relevant data in regards to ranking the countries in individually recognized sports and also ranking the overall sporting success of countries. The possibility of ranking countries according to the sports success achievement is based on selected indicators. This work aims to define the issue of calculating sports success, provide a theoretical basis, display the selected methodology, and then the methodology to create an expression of sports success of individual sports and overall sports success for authorities involved in creating sports legislation in the Slovak Republic.*

Keywords: *sport, analysis of sport methodology, sports success in the country, absolute sports success, relative sport success*

1. Introduction

The problem of evaluating elite sports success affects each individual state in regards to the redistribution of financial resources from the budget to the field of sports. Sports success of a country in selected sports is determined by the developed methodology of evaluation and subsequent comparison with other countries.[3] Sports success of the country represents the *sum of individual sports successes* in the evaluated recognized sports (sports meeting the conditions of the Sports Act 440/2015 of the Slovak Republic).[4] One of the main reasons why it's important to analyze the success of the country in elite sports is to optimize the redistribution of the country's budget for sports and to improve sports results. There are several ways to evaluate a country's sports success, where *different evaluations may have different outputs*. An essential factor in the expression of sports success is defining the *purpose of analyses*.

The complexity of the analysis increases not only a *large number of data* but also their diversity, where sports are classified as *individual - collective*, categorized by gender *men - women*, divided into *disciplines - weight* categories, and also by the age between *children - adolescents - juniors - adults*. The last division is omitted in this suggestion for developing the methodology, due to an individual criterion in the current formula for calculating the granted contribution for recognized sports in Slovakia.[4]

2. Terminology definition

Sports success in the country has a different definition for practically every country. In general, however, it could be defined as achieving the desired results set by the country's competent authorities at the highest events. (number of medals won at the Olympic Games or other international events). General sports success is used to compare countries with each other, where the success indicators at the highest events are *transparent*.[3] Absolute sports success is a *narrow view* and *static* evaluation of the *achieved success* of athletes or national teams. Relative

sports success, on the other hand, provides a *broad picture*, where in addition to explaining achieved success, it works with determinants (socio-economic, political, and others), based on which the expected sport's success is expressed and compared with the achieved success. Relative expression is an objective way of evaluating countries, as it creates the same starting position for all countries.[2]

3. Available methodologies

Worldsportranking is currently the only methodology that was found during the survey, which *expresses the general sport's success*. The methodology is composed of a point system, which represents an individual *constant*, which is multiplied by the weight coefficient inspired by *Formula 1* from the years 2003 to 2009. The coefficient of universality represents the *number of countries involved*. The popularity coefficient expresses the *public's interest in sports*, measured by the frequency of displaying information about sports in the main sports media of individual countries. The calculation formula also uses relative elements when the expressed popularity of the sport in the country is multiplied by GDP in trillions of dollars in the country.[6]

The Slovak Republic doesn't express sports success on its own, but only as *part of a formula* designed to redistribute the total budget for recognized sports. The formula consists of three parts, which in addition to sports success divided into *youth* (s_y) and *adults* (s_a): interest in sports (*domestic* (i_d) and *foreign* (i_f)) and a membership base of athletes under 23 years (U23). The success of the sport is based on events that have *different weights*. 1st place at the European Championships represents 11th place at the World Championships and 21st at the Olympic Games. The popularity of sports is expressed every two years through a survey.[4]

$$A = (w * s_y + w * s_a) * (ID * i_d + IF * i_f) + (1 - 2 * w) * U23$$

where A - allowance for a recognized sport, w – weight, ID - the coefficient for domestic interest in sports, and IF – the coefficient for foreign interest in sports.[4]

Theoretically, the methodology for individual sports can also be used for expressing the country's general sporting success. The explanation for this statement is *reducing the number of different methodologies* for separate sports will simplify the expression of general sporting success. The individual elements of sports methodologies also serve as a *basis for developing a general methodology*. Examples of methodology for sports as an individual are the ELO system, where the elementary idea is to constantly change the ranking value of individual athletes according to their performance (chess), and other examples is a system of accumulation points, which is based on the results of *matches* or *tournaments*, and the points earned are summing into a table, and then arranged from highest to lowest points. (golf, tennis) [5]

4. Recommended baseline methodology

From the point of view of the Slovak Republic, I see a possible solution to the expression of general sports success as follows. Creating a structure for recording data from major federations through the classification of recognized sports into a collective (football), individual (tennis), disciplines (athletics), and weight (weightlifting). *Data collection* and *adjustment* to the required form of a relational database, where one scheme represents the overall table representing the final result and the other partial parts of the tables represent individual sports. Defining: schedule basis points (subtraction from 1st place) and coefficients:

- disciplines - ascending order by the popularity of discipline, where the least popular has one and each other + 0.2 in the case of sports disciplines less than five each other + 0.4),
- categories - men have the final rating multiplied by two,
- events - results of Olympic Games times 6, World Championships times 3, European Championships 1.5, and other international events 1
- number of participating countries, and
- the popularity of the sport.

Table 1 Constant points for achieved place

Rank	Points	Rank	Points
1.	500	5.-20.	-6
2.	-25	21.-50.	-4
3.	-20	51.-100.	-2
4.	-15	+101.	-1

Coefficients are defined during the development of formulas for determining a country's success in individual sports and the overall sporting success of countries in recognized sports. $W_j = \sum_{i=1}^{93} x_i * (Y_i * z_i)$

Where W_j - overall general sports success of the country j, x_i - sports success of the country in sports i, Y_i - number of participating countries in sports i, and z_i - the popularity of sports i.

The resulting ranking in the table is the points according to W_j , where the highest value represents the country that has achieved the highest absolute sporting success.

5. Relative sports success

However, absolute sporting success is biased when evaluating a budgeting strategy for sport in a country, and can affect the results, especially in larger countries (significant populations and large GDP). Therefore, it is necessary to use socio-economic and political determinants such as population, GDP, climate, history, and others. By adding determinants to the equation, the authorities managing the redistribution of the sports budget in the country will receive an objective indicator of the success of the implemented strategy and policy.

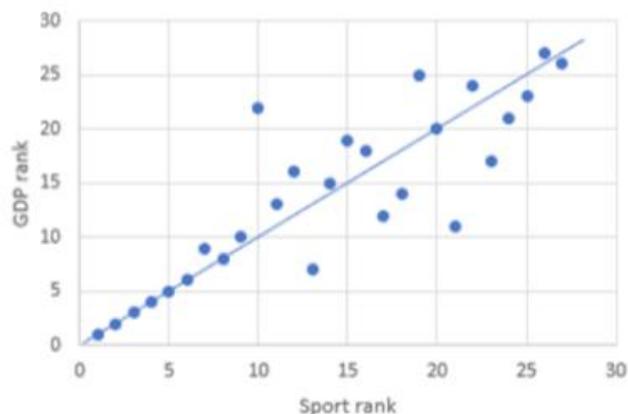


Figure 1: Comparison of European countries

Figure 1 shows us a comparison of the European Union countries according to the amount of GDP in trillions of dollars and sports success evaluated according to the suggested methodology.[1] The points based on the straight line represent countries whose expected sports success equals the achieved. Points above the straight line represent countries that have achieved better sports success than expected and, conversely, points below the straight line have achieved lower success than expected. Based on this information could optimize or stick to their strategy.

6. Conclusions

Expressing a country's sports success is an essential part of setting up an optimal redistribution of the country's sports budget and strategy. The suggested methodology represents only a basic version, which must be specified in more detail, especially according to the need for analysis and country attributes. The creation of this work revealed findings that reduce time and cost, increase the transparency of the expression of sports success and also

provide recommendations for improving the currently-in-use methodology of the Slovak Republic.

The main recommendations are not to use points from individual federations but only ranks for overall placement by sports success. To achieve a transparent result, the methodology of evaluation must be the same for all sports. Simplification of the calculation of the discipline's coefficient. Disciplines are a part of sports. In the case of a large number of disciplines defining sport, it is difficult to express sports success and popularity. Therefore, reducing the detail of the calculation will reduce costs and save time. The application of this recommendation has resulted in a decreasing place accuracy, specifically in countries that have finished worse than 100th. However, the point differences are negligible and therefore, if the analysis doesn't require as accurate as possible solution, this recommendation is an excellent way to reduce cost and save time. Evaluation of sports categories separately. The popularity of each sport is different for men and women. Also, countries have a different levels of success by category. By evaluating sports success individually by category, authorities gain a better overview of placement and could apply optimization of their strategies. Use for individual sports with more than 10,000 athletes the ELO system methodology. The methodology provides an objective indicator of the athlete's current success and thus creates a more objective order of countries according to the nationality of the athletes.

The challenge that emerged from this work is to create a methodology for expressing the popularity of sports. The current solution in Slovakia is to create a foreign and domestic survey every two years. Worldsportranking uses an annual survey, which is time-consuming and costly. Establishing a methodology that shows the most objective view of popularity but at the same time is within acceptable time and financial demands is the key to the optimal expression of general sports success, from an absolute point of view.

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References

- [1] DATA WORLDBANK, *GDP per capita 2021*, available on the: <https://data.worldbank.org/indicator/NY.GDP.PCAP.CD>, 2021
- [2] DE BOSSCHER Veerle, HEYNDELS Bruno, DE KNOP Paul, *The paradox of measuring success of nations in elite sports*, ISSN: 13772368, 2008
- [3] ELLING Agnes, VAN HILVOORDE Ivo, VAN DEN DOOL Remko, *Creating or awakening national pride through sporting success*. ISSN: 10126902, 2012
- [4] Law n. 440/2015 Z.z about sport Collections of laws SR, 2015, available on the: <https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2015/440/20160101>
- [5] SORENSEN Soren P., *An overview of some methods for ranking sports teams*, available on the: <http://www.phys.utk.edu/sorensen/Ranking/Documentation/rankingofsportsteamsv01.html>, 2018

ys.utk.edu/sorensen/Ranking/Documentation/rankingofsportsteamsv01.html, 2018

[6] WORLD RANKING OF COUNTRIES IN ELITE SPORT, available on the: https://www.worldsportranking.info/_files/ugd/93be31_c4d21db256764a8286af93d814c26d4f.pdf, 2021

WELL-BEING OF OLDER PEOPLE IN THE EUROPEAN UNION

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Abstract: *The phenomenon of an aging population in Europe has led to an increase in the group of older people, which affects various areas of society. The concept of active aging monitors the processes in the lives of older people, which includes areas such as employment and independent living. From the point of view of human resources management the concept of active aging is important in terms of examining the employment of older people and thus the use of their employment potential in the labor market. The motives for using employment potential in the labor market of older people 65+ are diverse and well-being plays an important role. Well-being is one of the categories focused by the concept of active aging, which we follow up on the data in our article. It is focused on the development and comparison of well-being in the European Union (EU) during 2008-2018 through the well-being index. It was found that in the period under review the development of the index curve compared to the base year 2008 had a predominantly increasing trend. In some countries, the well-being index rose significantly higher. According to the six survey groups the maximum reached: Slovakia 8.1%, Bulgaria 23.2%, United Kingdom 8.0%, Latvia 32.4%, Austria 6.0%, Cyprus 19.8%, so far which was the EU 28 average at most 6.0%. We expect decline of the well-being of older people in the EU according to the index in 2018 and the latest developments due to the pandemic, war in Ukraine and recession.*

Keywords: *ageing, European Union, employment potential, older people, well-being*

1. Introduction

The expanding phenomenon of aging populations throughout Europe [1, 2, 3, 4, 5, 6] is caused not only by low birth rates but also by an increase in life expectancy [7, 8, 9] and thus by an increase in the cohort of older people 65+ in the population. The aging of the population and, above all, the growing group of older people in the population affect various areas of society and their daily lives. Probably the most common multifactor concept dealing with population aging and the older people is the concept of active aging [10, 11, 12]. From the point of view of human resources management and personnel management, the concept of active aging is important in terms of examining the employment of older people and thus actively using their employment potential in the labor market, which benefits the appreciation of human capital and increase the competitiveness of EU economies. The motives for using their employment potential in the labor market at the age of 65+ [7] are diverse and well-being plays an important role in it [13]. The well-being of older people reduces the amount of financial resources in retirement age [14, 15, 16, 17], housing affordability [18, 19, 20] or the level of food quality [21, 22, 23], and therefore it is important to monitor development of the well-being level of older people. Well-being is one of the categories focused by the concept of active aging [10, 11, 12], which we follow up on the data in our article, where we focus on the development and comparison of well-being in the EU during the years 2008-2018. The data are collected from the UNECE [12] Active Aging Index (AAI) database. As a tool for monitoring the development of well-being, we chose the well-being index [24], which contains the three examined categories of relative median income, no poverty risk and no severe material

deprivation. The article continues with a chapter on methodology, results and conclusions.

2. Methodology

To achieve the set goal of comparing the well-being of EU countries, we used the following methods: literature analysis, comparison, induction, deduction. To analyze the development of well-being, we used the well-being index, which contains three categories: relative median income, no poverty risk and no severe material deprivation according to UNECE [12].

The well-being index is formulated by the author [24] and according to [25] :

$$I_n = \frac{x_n + y_n + z_n}{q} * 1$$

where, I = well-being index, x = relative median income, y = no poverty risk, z = no severe material deprivation, q = value for the base year 2008, n = year.

3. Results

We divided the results of the index calculations for individual EU countries into six groups, mainly according to geographical proximity, and we added data on the EU average index in each figure. We monitored the development of the index in 2010, 2012, 2014, 2016 and 2018 considering to the base year 2008.

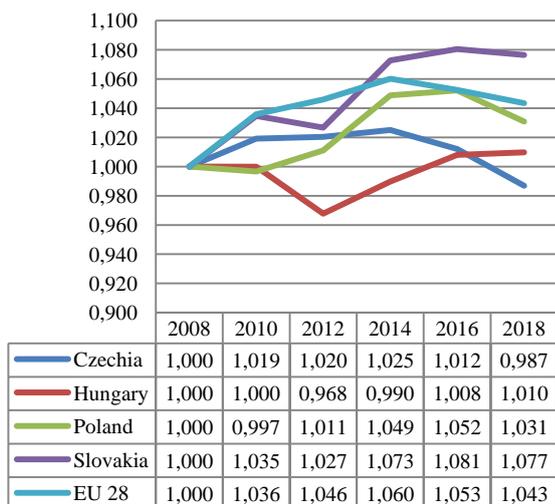


Figure 1: Well-being index of people aged 65 and over, Czechia, Hungary, Poland, Slovakia, EU 28
Source: [24]

Figure 1 represents the well-being index of the Visegrad group countries and the EU 28. The index curve in the Czech Republic grew until 2014 and then decreased, in 2018 it was below the base year level. In Hungary, the index had the largest drop in 2012, then rose. In Poland and Slovakia, the index grew mostly. In comparison, the EU-28 average outperformed only the development of the index in Slovakia in this group.

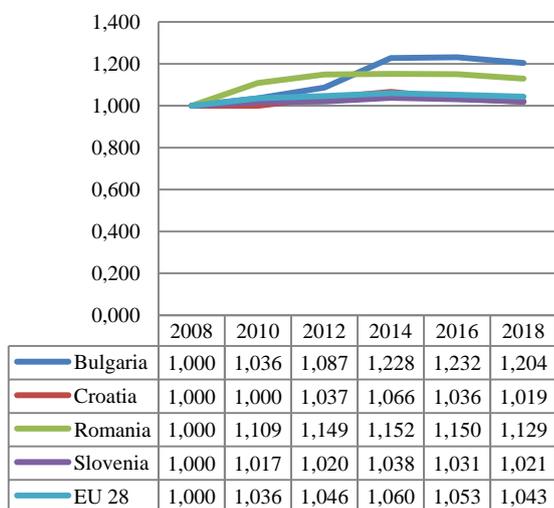


Figure 2: Well-being index of people aged 65 and over, Bulgaria, Croatia, Romania, Slovenia, EU 28
Source: Own calculations based on data from UNECE [12]

Figure 2 presents the development of the well-being index of the group of southeast countries and the EU 28. The most significant growth of the index was recorded in Bulgaria. There was also significant growth in Romania. Croatia and Slovenia grew slightly. Romania and Bulgaria were above the EU 28 average, while Croatia and Slovenia almost copied the EU 28 index.

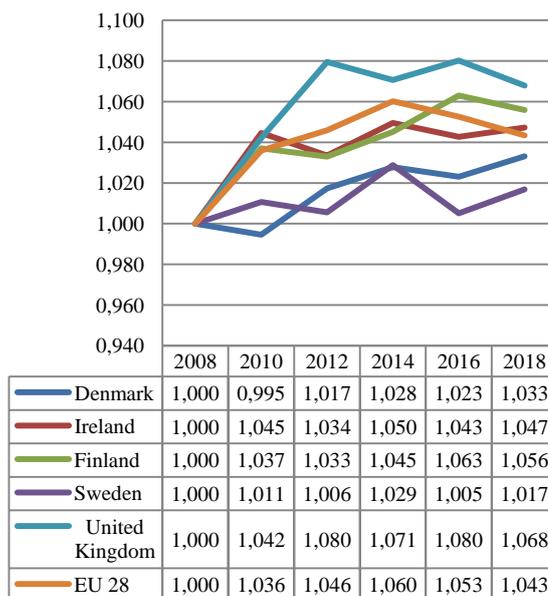


Figure 3: Well-being index of people aged 65 and over, Denmark, Ireland, Finland, Sweden, United Kingdom, EU 28
Source: Own calculations based on data from UNECE [12]

Figure 3 represents the development of the index in the group of countries that are predominantly geographically in northern Europe and the EU 28. In all countries, the development of the index had an oscillating and slightly increasing trend around the EU 28 average. The strongest growth was in the United Kingdom and the lowest in Sweden.

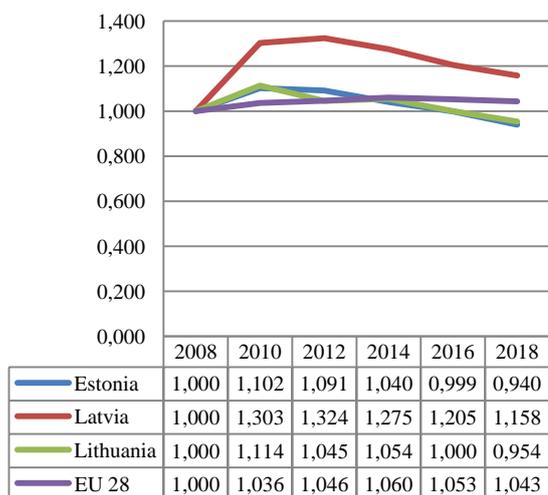


Figure 4: Well-being index of people aged 65 and over, Estonia, Latvia, Lithuania, EU 28
Source: Own calculations based on data from UNECE [12]

Figure 4 presents the development of the index in the Baltic states and the EU 28. The Latvia's well-being index recorded the highest growth not only within this group but

also in the EU 28. Lithuania and Estonia initially grew, but fell below the EU 28 average in 2014 and below base year.

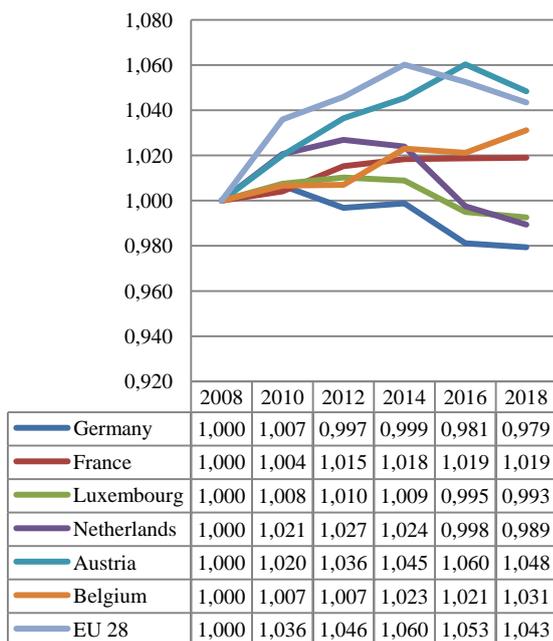


Figure 5: Well-being index of people aged 65 and over, Germany, France, Luxembourg, Netherlands, Austria, Belgium, EU 28

Source: Own calculations based on data from UNECE [12]

Figure 5 represents the group of continental European countries of the old EU Member States and EU 28. The development of the well-being index of all countries was below the EU 28 average throughout the period under review, except for Austria, which grew in 2016.

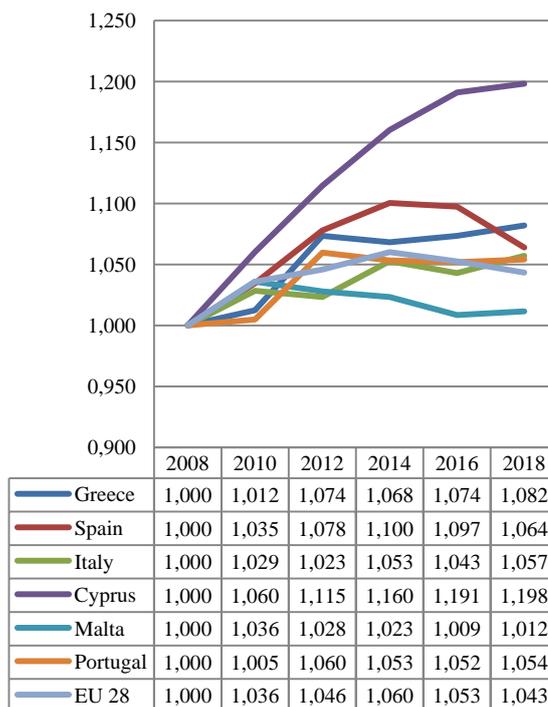


Figure 6: Well-being index of people aged 65 and over, Greece, Spain, Italy, Cyprus, Malta, Portugal, EU 28

Source: Own calculations based on data from UNECE [12]

Figure 6 presents the development of the well-being index in the group of Mediterranean countries and the EU 28. In all countries in the period under review, the index increased compared to the base year 2008. The highest growth in this group was recorded in Cyprus, which was also significantly higher than the EU 28 average. Malta had the lowest growth.

4. Conclusions

We consider the well-being of older people 65+ to be a key indicator in terms of examining the motivation for using their employment potential in the labor market, prolonging working life or active aging. We also consider knowledge about the level of well-being of older people to be important from the point of view of human resources management and personnel management, because it is essential to know the motives of older people in the labor market if we consider exploiting their employment potential, multiply human capital or increasing the competitiveness of economies. Does the level of their well-being motivate older people to use their employment potential in the labor market or to increase their human capital? We cannot answer this question yet and it would need further research. However, what we can say based on the monitoring of the development and comparison of the well-being index of older people 65+ in the EU countries is that in the observed period 2008-2018, the development of the index curve compared to the base year 2008 had a predominantly increasing trend. In some countries, the well-being index rose significantly higher than in 2008. According to the six survey groups, created by geographical segmentation, they reached the maximum:

Slovakia 8.1%, Bulgaria 23.2%, United Kingdom 8.0%, Latvia 32.4%, Austria 6.0%, Cyprus 19.8%, so far which was the EU 28 average at most 6.0%. On the positive side, the well-being index of older people in the EU 28 rose. In some countries very significantly, in others the development was more stable. We expect decline of the well-being of older people in the EU according to the index in 2018 and the latest developments due to the pandemic, war and economic recession.

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References

- [1] Dudel, C. and Myrskylä, M., *Demography*, Vol. 1, No. 54, pp. 2101-2123, 2017
- [2] Horváthová, A. and J. Ěhn, *Social and Economic Revue*, Vol. 1. No. 1, pp. 40-50, 2020
- [3] Jeníček, V. and Foltýn, J., *Globální problémy a světová ekonomika* [Global Problems and World Economy], Praha, C. H. Beck, 2003, p. 269.
- [4] Neary, J., Katikireddi, S. V., Brown, J., Macdonald, E. B. and Thomson, H., *BMC Public Health*, No. 19, pp. 1-10, 2019
- [5] Vaňo, B., *Slovak Statistics and Demography*, Vol. 30 No. 4, pp. 3-12, 2020
- [6] Ćwirlej-Sozańska, A. Wiśniowska-Szurlej, A. Wilmowska-Pietruszyńska, A. Sozański, B. and Woloszyn, N., *Medycyna Pracy*, Vol. 69, No. 4, pp. 375-381, 2018
- [7] <https://ec.europa.eu/eurostat/documents/3217494/11478057/KS-02-20-655-EN-N.pdf/9b09606c-d4e8-4c33-63d2-3b20d5c19c91?t=1604055531000>
- [8] Bartek, J., *Employment and Life Expectancy of Older People in Slovakia and European Union*, Proceedings Of The 3rd International Conference Contemporary Issues In Theory And Practice Of Management CITPM 2020, pp. 40-47, Czestochowa, 2020
- [9] van der Mark-Reeuwijk, K. G., Weggemans, R. M., Bultmann, U., Burdorf, A., Deeg, D. J. H., Geuskens, G. A., Henkens, K. C. J. I. M., Kant, I., de Lange, A., Lindeboom, M., van Rhenen, W. and van der Beek, A. J., *Scandinavian Journal of Work Environment & Health*, Vol. 45, No. 5, pp. 514-519, 2019
- [10] <https://ied.eu/project-updates/the-concept-of-active-aging/>
- [11] Bútorová, Z., Filadelfiová, J., Bodnárová, B., Guráň, P., and Šumšalová, S., *Štvrtý rozmer tretieho veku: Desať kapitol o aktívnom starnutí* [The Fourth Dimension of the Third Age: Ten Chapters on Active Aging], Bratislava, Inštitút pre verejné otázky, 2013, p. 366.
- [12] <https://statswiki.unece.org/pages/viewpage.action?pageId=76287845>
- [13] Lakomy, M., *Social Science Research*, Vol. 82, pp. 33-44, 2019
- [14] Swain, J., Carpentieri, J. D., Parsons, S. and Goodman, A., *Journal of Population Ageing*, 2020
- [15] Lu, P., Shelley, M. and Liu, Y.-L., *International Journal of Social Welfare*, Vol. 30, No. 2, pp. 140-151, 2021
- [16] Fonseca, R., Kapteyn, A., Lee, J., Zamarro, G. and Feeney, K., *Journal of Population Ageing*, Vol. 7, No. 1, pp. 21-41, 2014
- [17] Pienkowska-Kamieniecka, S., *The Issue of Responsibility for Financial Security in Old Age and Additional Retirement Saving*, European Financial Systems 2018: Proceedings of the 15th International Scientific Conference, pp. 518-524, Brno, Czech Republic, 2018
- [18] Riedy, C., Wynne, L., McKenna, K. and Daly, M., *Urban Policy and Research*, Vol. 37, No. 2, pp. 227-242, 2019
- [19] Alidoust, S. and Khalaj, F., *Australian Geographer*, Vol. 52, No. 4, pp. 391-406, 2021
- [20] Costa-Font, J. *Urban Studies*, Vol. 50, No. 4, pp. 657-673, 2013
- [21] Gajda, R. and Jezewska-Zychowicz, M., *Food Security*, Vol. 13, No. 3, pp. 717-727, 2021
- [22] Knight, L., Schatz, E., Lewis, K. R. and Mukumbang, F. C., *Global Public Health*, Vol. 15, No. 1, pp. 97-110, 2020
- [23] Radermacher, H., Feldman, S. and Bird, S., *Journal of Nutrition Education And Behavior*, Vol. 5, No. 42, pp. 328-336, 2010
- [24] Bartek, J., *Well-being and Employment of Older People in the Countries of the Visegrad Group and the European Union*, unpublished
- [25] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Beginners:Statistical_concept_-_Index_and_base_year/sk

Session: Economy, Financing, Public Administration

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DIAGNOSTICS OF THE INFLUENCE OF INFORMATION ASYMMETRY ON DECISION-MAKING IN THE INSURANCE MARKET

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Abstract: *Insurance is a type of economic activity focused on insurance protection, in which risk is transferred between insurance market participants through insurance. The aim of the paper is to define the assumptions of determining the level of influence of information asymmetry on the decision-making of actors in the process of risk assessment and management in the company's activities, with the possibility of eliminating risk in the future. The paper is current from the client's point of view on risk perception, its identification, prevention, the possibility of its elimination by insurance, with regard to the asymmetry of information of individual actors (insurance company - reinsurance company - broker - client, hereinafter I-B-C). The company is currently facing a new problem, which is liability without transferring risk to a third party, i.e. state involvement. The defined assumptions in the paper will allow to propose some new solutions and new processes between IBC, which can significantly help in risk assessment and elimination under acceptable market conditions, especially in the area of unmanaged and modern risks, resulting from dynamic market environment, changing legal standards and social change.*

Keywords: *information asymmetry, insurance market, insurance company, reinsurance company, broker, client, risk management*

1. Introduction

As society evolved, mainly due to the Industrial Revolution, which restarted economic growth in agrarian society, the risks evolved as well. It developed not only with a changing economy, innovation and division of labor, but also in the context of social change in industrial society. [18] Is it possible to prepare for risk? Is it possible to plan it? Is it possible to predict it? These and other issues have been addressed in these societies and are still required in the current post-industrial era. [9] Since the beginning of the 21st century, the term "emerging risks" has become increasingly relevant, which can be translated as "newly emerging risks". Emerging risks are "new risks or known risks that become apparent in new or unknown conditions". [7]

The expected content of the solution is to determine how the individual actors perceive the risk management process, how they relate to it and what are their possible partial starting points for the risk management process. There are a number of factors that can influence the decision-making process. The asymmetry of information has a major influence. The aim of the paper is to examine which of the actors in this specific market influence its prevention, predictability, origin and eventual elimination. The actors at the level of the company's risk management are mainly: Insurance Company - Broker - Client (I-B-C). Solutions will be applied that can change decision-making process of the actors in these dynamic times so that there is a process that is most effective for all participants.

The paper mentions some events that fundamentally affected the development of the economy and society. Some phenomena that have occurred in the financial and

insurance markets will be analyzed and explained, and we will try to draw conclusions and learn from these events. It will be described how the risk was perceived in the past and what the current view is, and questions about how to perceive newly emerging risks will be asked. The conclusions of the envisaged research should make it possible to propose some new solutions and new processes between IBCs, which can significantly help in assessing and eliminating risk under acceptable market conditions, especially in the area of "unmanaged" and modern risks, resulting from the dynamic market environment, changing legal norms and societal changes.

2. Risk and its perception

There are many definitions of risk. The paper will deal with risk as a term that indicates an uncertain outcome with a possible unpredictable, undesirable condition. Accidents can cause loss of life, health and property. In this text we will deal mainly with a qualitative (philosophical) view of risk. [5]

Perceptions of risk and danger have been completely different in the past, with different tools and information available. Due to technological changes and the advent of information technology, this attitude has changed over time. This can be demonstrated on the example of fire risk, which, together with marine risk (shipwreck), stood at the birth of insurance. Phenomena arising from the history of economic thought also determine the development of risk perception, the possibilities of its elimination and the development of individual insurance products as protection tools that made it possible to hedge individual risks in the past. With the societal changes of 1989, there was also an economic transformation that fundamentally changed the

financial sector and thus the catalog of risks and approach to them.

Thus, the methods of risk assessment and its perception, as well as its insurability, are related to history, it had its logical development, just as the capitalism had its logical, unplanned development. In practice, this means that there is a need to learn from history and to avoid repeating already known mistakes. By learning from different models and situations, accepting mathematical models in combination with common sense and one's own intuition, risks can be eliminated to some extent. The European and Asian populations are afraid of risk, and even consider failures stemming from them to be socially unacceptable. This is not the case, for example, in the United States, where risk and failure are seen as part of life leading to further challenges. Such environment is healthier and more appropriate to modern economics and its capture of risk within the so-called behavioral economics. However, this requires above all the personal responsibility of each of us. [10]

Theoretical knowledge of risk perception from the perspective of psychology has an irreplaceable role in the whole process and is an integral part of it. [10] Hard to predict risk - the risks that are difficult to imagine are so called "Black Swans". This theory describes important unexpected events that have a significant impact on society. These events deviate from what is common and therefore they are difficult to be predicted. [20] The client tends to insure known, smaller-scale risks and not insure difficult-to-predict, larger-scale risks. In order to be able to work with risk, it is necessary to categorize it. [2] From a macroeconomic point of view, risk management is a very important part of the market process and the possible realization of risk can have an impact on entire sectors of the economy. [15] The definition of insurance risk means the degree of probability of the occurrence of an insured event caused by an insurance risk.

In insurance practice, the term risk is used in three senses:

- a) an object endangered by accidental danger (building, machine, etc.),
- b) an event causing damage, i.e. a source of risk (fire, accident, injury, etc.),
- c) the likelihood of an accident occurring with adverse effects. [6]

3. Institutional interaction of the insurance market

The state arises as a form of organization of society. Society is usually organized through institutions. This creates both extractive and inclusive institutions. Institutions should have an impact on the development of the financial sector and thus on risk perception. [1] The transformation of society from feudalism to various types of parliamentary, democratic organization is also associated with the socio-economic stratification of society, and the financial sector is also changing. [17] People are part of society and people act. Human behavior

[22] fundamentally influences the above-mentioned interactions of all. There must be trust in every society. This also applies to economic activity. It is a complicated model - a process that cannot be planned. [8]

The understanding of past phenomena, as well as current events, is also mediated by the media, which influences their perception and can play a positive and negative role in the whole issue. [23] The media provide information that actors work with. None of them, especially the state planner, have perfect information. They are often asymmetric. The analysis of information asymmetry brings a new perspective on the interactions of actors who are participants in the insurance market. [4] We will evaluate what information individual insurance market participants (I-B-C) can have and which of them pulls the shorter end of the rope.

Due to the high level of risk, stemming mainly from unpredictability and possible social impacts, an adequate degree of regulation is also necessary. [3] The basis is a quality legal environment. This often changes as a response to market fluctuations and, together with regulations, often ceases to be an effective tool. Excessive regulation greatly undermines these basic market principles. Insurance subsidies, tendencies / tendencies towards oligopolisation, price regulation can upset the balance and social relations in society. Even people are able to agree and find effective solutions without significant state intervention. These are classical phenomena that do not fit into the dichotomous world of "economic and social systems", i.e. the market and / versus the state. [16]

In the past, even in the current conception of economic thinking, there were regulations and state intervention in the insurance process. This is still a topical issue today with Basel 3 (increased bank regulation) and Solvency II applications. Process participants often have less space and ability to respond to market needs. At present, it is necessary to proceed from Act No. 277/2009 Coll., On Insurance, as amended, which implemented Directive 2009/138 / EC Solvency II. On the basis of this Act, Decree No. 306/2016 Coll. Was issued, which stipulates, for example, the calculation of the Solvency Capital Requirement. The decision on whether or not to insure seems to be influenced by other factors, among others. The position of financial institutions (insurance companies) in the market is also influenced by marketing strategies and media. They positively or negatively motivate to use this instrument in their complexity. The level of perception and management of emerging - modern risks presents new challenges and a fundamental change in approach to them.

4. Insurance and Insurance Market Entities (I-B-C)

Insurance is a type of economic activity focused on insurance protection, in which risk is transferred between insurance market participants by insurance. Leaving aside some signs of insurance stemming from the archaeological finds of Egyptian stonemasons, pyramid builders from

around 2500 BC, which bore signs of mutual solidarity, we date the first treaty in the middle of the 14th century in Italy (April 13, 1379 in Pisa), which concerned insurance agreements arising from maritime contracts. With the development of the industrial revolution, modern insurance was born, especially in the coastal states. In 1827, the first insurance company "Imperial-Royal, Privileged, Czech, Common, Damage Damaged by an Insurance Institute" was established in the Czech lands. [12] At the beginning of the insurance, it was mainly about fire risks, a significant moment was the fire of the National Theater (1881) and the payment of insurance compensation in the amount of 297,869 gold by the First Czech Mutual Insurance Company. [12] Gradually, other insurance companies were established. With the insurance of ships and their costs, great risks have been defined, which arise, for example, in connection with land transport, where the carrier's liability insurance has been taken out. During the 19th century, there was a growing interest in the possibility of insuring other risks - property, accident, credit, glass insurance and insurance against the consequences of increasingly frequent strikes. In the 17th and 18th centuries, we also see the first beginnings of life and pension insurance, on the scientific basis of probable life expectancy. The Society of Assurance from Windows and Orphans is established in London. With the development, the first problems also appear - deviations from the normal and thus a security is created. [13]

Economic development and the recent period since the 1990s have significantly affected the process of globalization and major political and economic changes in Central Europe. The company was faced with a new problem - responsibility without transferring risk to a third party - state involvement. It was necessary to define a new risk catalog and reconsider the view of it. A new element, unlike the Marxist, state-regulated economy, is the company's risk management. New insurance companies are formed and the state insurance company loses its monopoly. Following this, another entity enters the market, resp. intermediary - broker. The direct relationship Insurance Company-Enterprise is changing. The partial tasks of the process of building the Insurance Company - Client relationship have thus changed significantly. In the environment of the Czech Republic, the broker was involved in the whole process after 1989, similarly to traditional standard functioning market economies. This intermediate link can in some cases have a significant effect on insurance pricing and has become an important part of the process. The main task in the process is to design tools suitable for risk management in cooperation with the client. The client decides between the insurance, i.e. the transfer of risk and the creation of reserves for possible future losses. A combination of both is also possible. If it is concluded that the risk is real and its eventual implementation has an impact on the smooth operation of the company.

The insurance market has similar features to any other market. He has his participants, there is an exchange

between them. [21] From the three mentioned participants in the process: insurance company - reinsurance company-broker - broker - client (hereinafter referred to as IBC), we assume that most information will be on the broker's side, if the company has one. He is able to find the optimal, interconnected solution, pass on relevant information to both parties, the insurance company and the client, which has a positive impact on the client both in terms of costs and in choosing the insurer who will provide the required protection. However, the key issue is the responsibility of each of the participants in the process.

An insurance company is a financial institution that assumes predefined risks for a client on behalf of the client. We can meet universal, non-life, life and specialized insurance companies in the insurance market. Reinsurance is insurance of insurance companies. This is a vertical division of risk. The economic impacts in this model are not more bearable for the primary insurer.

The broker is an intermediary between the insurance company and the client. The broker, in cooperation with the client, compiles the insurance program so that it meets its goals of protecting the company and eliminating risks. This gives rise to the assignment or structure and content of the insurance contract. With this assignment, he addresses insurance companies on the market and thus looks for a suitable partner - an insurance company that, under acceptable conditions, excluding prices, can best satisfy the client's needs. The whole process is managed by a broker, who gives recommendations and draws attention to any individual specifics and obligations arising from a possible future insurance contract. The client thus understands the basic principles of insurance protection, the price of the service and can opt for adequate insurance protection. The result is a contractual relationship under the professional supervision of a specialist (broker), who monitors the process throughout the duration of the contract, updating the data, which is called the administration of the insurance contract. This process is an integral part of risk management and thus provides the client with greater certainty that if the risk is realized, the insurance company will compensate for the resulting loss. Density and insurance coverage are two key macroeconomic indicators of the willingness of actors to enter into a contract. Another motive for eliminating risk is risk management and risk transfer. [14]

5. Risk underestimation and critique of current risk perception

Under the influence of the current mainstream, the state is becoming more and more involved in market processes, and its own responsibility is underestimated. Under the influence of regulators who indirectly influence risk assessment and management, companies still rely on state assistance as "insurers of last resort". Even thanks to the institutional set-up for the management of common resources and public goods at EU level, there is often moral hazard, with all market players taking the risk of this "certainty", but most of all clients who either stop

perceiving or underestimate some risks. Thus, there is an undesirable transfer of risk outside market processes. However, a greater degree of responsibility of all actors towards goods in a free market environment logically leads to much greater prudence.

Surprisingly, risks are often underestimated by corporate clients. This can in many cases be due to the increasingly prevalent subsidy of the economy that was typical of the Marxist economy. At the same time, one of the goals and an important element of the economic transformation after the political changes in Central Europe was desubsidization. Bankruptcies in banks, investment funds and pension funds have led regulators to intervene, which even proponents of Smith's invisible hand of the market understand. Due to the asymmetry of information, when the position is unfavorable on the part of the consumer, his "Keynesian" protection occurs. Spontaneous market clean-up is not desirable in many cases, especially in the financial sector, as one of the provider-consumers has generally not committed any market failure.

Adequate regulation is certainly in order, but competition must not ultimately be eliminated. Disproportionate interventions not only run counter to common sense, but limit innovative processes, prices and balance. An example is the current issues of Pojišťovna VZP in the field of insurance for foreigners, which is in conflict with the Solvency II Directive and the TFEU. A person makes a decision based on instinct, the decision is based on an inner feeling, and usually he is not able to explain why he decided in a given way. Among other things, the issue of risk aversion is connected with the issue of individual decision-making. The literature mentions the terms: "Risk aversion" or "Loss aversion", i.e. resistance to risk or loss, which is a crucial term when we talk about risk, respectively about decision making in uncertainty. [11]

From the point of view of the current risk perception, the current protection instruments cannot be considered sufficient. In addition, the policy of states and economic trends, especially of the EU economic area, unfortunately has a demotivating effect on both the objects of risk themselves and the subjects of its elimination. It can be said with certainty that the current insurance products do not meet the protection needs of business and private entities. On the other hand, the environment of so-called "security" within the framework of social justice and modern egalitarianism exposes individual subjects to threats, primarily through financial losses resulting from actions, business and everyday life. The importance of compensation in the form of claims against liable entities is growing to previously difficult to imagine and the absence of any regulation of requirements in terms of its amount and limitation periods contrasts sharply with insurance market regulation, especially in the area of solvency and financial stability. This often makes it impossible to develop new products and, as a result, affects the company, which seeks resources not on its own responsibility, but above all in help from the state and

from civic or non-profit organizations. The harmonization of business and social relations under a single structure of European Union directives often introduces into the market environment controversial provisions in business and social contracts, which are very difficult to fulfill without the necessary insurance instruments. However, I believe that there are areas of human activity, such as the seemingly 'risk-free' profession, where an adequate degree of regulation in the form of compulsory insurance is, on the contrary, desirable.

6. Risk underestimation and critique of current risk perception

The solution of the topic is based on the following basic theses:

- "Human society today has to come to terms with the fact that unpleasant axioms still apply to man, and that the external world is unpredictable, the future cannot be the subject of scientific research because it does not yet exist as a subject." [4]
- Risk is defined in two ways: "risk as feelings that relate to our instinctive and intuitive reactions" and "risk as analyzes that bring logic, reason and scientific reasoning based on risk assessment and decision-making". [19]

The risk manager (business risk owner) should manage the risks, monitor, evaluate, evaluate and take the right measures against them. He should also be able to analyze the risk, prevent it, and prepare for it better, including the choice of tools that are currently available. The company's risk management provides a systematic view of the division of risks in terms of various criteria (probability, size, manageability, relationship to the organization, impacts on the organization, etc.), also deals with decision-making, risk relationship and risk appetite according to psychological and social influences and experience. Businesses with advanced risk management are more resilient, stable and more competitive due to the uncertainties arising from the future.

Critical assumptions of the current state of insurance in business practice:

- each of the corporate clients perceives the risk differently,
- there is no consistent communication between the underwriter (trader) and the risk manager in insurance companies,
- most clients deal with the risk by its transfer (insurance), rather than by creating a reserve,
- companies present risks for which they have a high risk aversion but do not insure them (credit risks, currency risks / FX risks /, health risks),
- companies usually do not have their own risk managers,
- companies usually do not pay attention to environmental risk or technological risk (development of artificial intelligence),

- the urgency of certain risks (e.g. terrorist attack) disappears after the media coverage of the problem subsides,
- corporate distrust of the government's ability to deal with crises (pensions, health care, etc.),
- when choosing an insurance company, corporate clients care about its financial strength (creditworthiness).

The respondents (respondents) will be a specific group of managers at the company level from all areas of business activity. Managers at the level of statutory bodies or directors or the owners themselves will be selected, i.e. persons who are directly responsible for the operation of the companies. Enterprises will be categorized according to the turnover of companies that are in the order of CZK 100 million - CZK 5 billion. The aim will be to obtain information on the attitude to different types of risks, not only specific to their company. The number of respondents will be 55. The tool will be a questionnaire, in the form of an interview - discussion, none of the respondents will fill it in independently without the presence of the interviewer.

The questionnaire survey and discussion with respondents will offer results on how clients perceive risks in practice, how they would make decisions based on already available information, and how they relate to future risks. All known factors that are known and available in the risk decision-making process and perception will be analyzed. The questions will be supplemented by statistical data related to the issue. These will be supplemented by the experience and opinions of risk managers and insurance workers. The resulting data will be compared.

Basic questions of the questionnaire survey:

1. Was the risk (past, already known) predictable, was it possible to prepare for its future elimination? (The course, consequences and other possible future risks arising from the situation. Possible impacts and sanctions. Finding a way to answer other questions).
2. How do you perceive and evaluate current risks, how do you relate to them and how can you prevent them? (A set of questions arising from the sub-objectives)
3. How do you perceive the risks arising from the expected future development of society and the economy? How do you perceive current regulations?
4. According to what criteria do you choose an insurance company? Is a broker important to you?

7. Structure of design goals, hypotheses and solution methods

The aim of the research is to determine the level of influence of information asymmetry on the decision-making of actors in the process of risk assessment and management in the company's activities with the possibility of eliminating risk in the future. It can be assumed that own responsibility for the risk assessment and management process and the threat of moral hazard are currently underestimated under the influence of

regulators affecting the stability and transparency of the insurance sector.

Objective 1: To make a historical and economic overview of the development of risk perception and management, including the tools for its elimination that were available. It can be assumed that the approach to perception and risk management corresponded to the development of economic thinking.

Objective 1 solution method - defining the types of risks, their impact on the activities of the "company", methods of risk assessment, following the "history of economic thinking" (how the risk was analyzed, how the risk was prevented or prepared, including tools that were available). Research questions based on examples of known claims that have occurred in the past will be identified. For each event, the cause, extent and consequences are known, and it is therefore possible to analyze how the risk was prevented. The questions will also be an excursion into an overview of development, perception and risk management, including the tools that were available.

Objective 2: Defining current risk protection instruments and the effects of regulations affecting the stability and transparency of the insurance sector. It can be assumed that the level of risk perception and management corresponds to the size of the company and the influence of information asymmetry on decision-making in the risk assessment and management process.

Objective 2 solution method - analysis of the position, role of the insurance company and insurance broker and information asymmetry. Thematic areas: impact assessment, risk aversion, risk transfer, reassessment of the risk catalog, the role of the insurance broker, criteria for selecting an insurance company, the role of the insurance broker, the influence of marketing tools in decision-making, confidence in public intervention economic sphere. In the areas set out above, it will be verified whether the beneficiaries seek security, i.e. they choose the minimum probability of loss rather than the high probability of profit. So will they be insured against all possible risks, even if the probability that they will be realized is minimal? We will verify that "all possible risks" do not represent "all conceivable risks".

Objective 3: To determine the current perception of risk in business practice, how business entities would make decisions based on available information and how they relate to risk. It can be assumed that the level of risk perception and management corresponds to the size of the company and the asymmetry of information (about risk) influencing decision-making in the risk assessment and management process.

Objective 3 solution method - questionnaire survey of the corporate level of risk perception in the scale of small / medium / large enterprise in relation to predefined levels of information asymmetry with the evaluation of the

influence on decision-making in the risk assessment and management process. The method used will be a questionnaire survey and analysis of the perception of modern and difficult to predict risks. As already mentioned, the catalog of possible risks changes with technological progress and way of life. Political decisions at the state or "superstate" level can also change approaches to risk and entire segments of the economy. It will be verified whether the respondents are willing to perceive and quantify the new risks. The task resulting from the results of this survey will be to propose a specific solution at the level of risk management in cooperation with a broker.

8. Conclusions

Not all risks can be insured with a sophisticated product. By learning from different models and situations, accepting mathematical models in combination with common sense and one's own intuition, risks can be eliminated to some extent.

Recapitulation of goal processing methods:

- 1) The method - Literary research - commentary on the set of published sources, statistics and methodological materials on the given issue, own practice will be used for the elaboration of the first goal.
- 2) The method - Description and distribution of risks, market participants, process participants and other factors influencing risk decision-making will be used to process the second objective.
- 3) The method - Collection of data from the questionnaire survey, comparison with available data and statistics will be used to process the third goal.

Statistical data and graphs from publicly available sources (ranking of economic freedoms, bureaucracy index, insurance coverage, density, written premiums in sectors, attitudes to risk, etc.) will complete the answers to the questionnaire survey. The elaboration of the first goal will offer a view of known, previously realized insurance events and determine how the client would decide in a situation if he worked with unpredictability, including the respondents' view of economic thinking, the current economic situation and willingness to accept state intervention in the market. The elaboration of the second goal evaluates the view of risk from several aspects and the role of the broker in the risk management of the company. The elaboration of the third goal will correspond to the degree of aversion to modern risks, the influence of the media, marketing and the reasons leading to the decision to transfer risk or choose another method of elimination. The results of the questionnaire survey and the resulting information will show whether each client requires more individual solutions. Here, due to the asymmetry of information, the role of the broker increases.

The starting points for the conclusions will be the results of a questionnaire survey and personal interviews, supplemented by statistical data. The finding will focus on

whether there is a relationship between the requirements of the client and the insurance company with regard to insurability, i.e. the requirement versus the real possibilities of insurance products and insurance companies. Obviously, there are many risks that the client would like to have covered, but there is no possibility to insure them - (un) insurability, due to the fact that they do not meet criteria such as randomness, reasonable price for risk or extreme risk. The result will show whether the insurance companies have sufficient information about the riskiness of the clients and whether this is an asymmetry of information on the part of the insurance company or the client. It will be verified whether there is a breakthrough in the perception of risk between the risk management of the insurance company, the underwriter, the trader, the broker and the client. The results will be clearly demonstrated on the squaring of the parabola, i.e. the method of exhaustion.

References

- [1] ACEMOGLU, Daron a James A. ROBINSON. *Proč státy selhávají: kořeny moci, prosperity a chudoby*. Praha: Argo, 2015. Zip (Argo: Dokořán). ISBN 9788025713051.
- [2] BANNISTER, J.E. a Paul BAWCUTT. *Practical Risk Management*. London: Hyperion Books, 1981. ISBN 0900886226.
- [3] CIPRA, Tomáš. *Riziko ve financích a pojišťovnictví: Basel III a Solvency II*. Vydání I. Praha: Ekopress, 2015. ISBN 978-80-87865-24-8.
- [4] DAŇHEL, Jaroslav. *Kapitoly z pojistné teorie*. Praha: Oeconomica, 2002. ISBN 80-245-0306-9.
- [5] DAŇHEL, Jaroslav. *Pojistná teorie*. 2. vyd. [Praha]: Professional Publishing, 2006. ISBN 80-86946-00-2.
- [6] DUCHÁČKOVÁ, Eva. *Principy pojištění a pojišťovnictví*. 2., aktualiz. vyd. Praha: Ekopress, 2005. ISBN 80-86119-92-0.
- [7] HALL, Harry. *Jak identifikovat a řídit vznikající rizika*. [on-line] Copyright 2021 Harry Hall, LLC [2022-1-10]. Dostupné z: <https://projectriskcoach.com/emerging-risks/>
- [8] HAYEK, Friedrich A. von. *Kontrarevoluce vědy*. Přeložil Danica SLOUKOVÁ, přeložil Ján PAVLÍK. Praha: Liberální institut, 1995. ISBN 80-85787-87-3.
- [9] HAYWOOD, John, Brian CATCHPOLE, Simon HALL a Edward BARRATT. *Historie světa: atlas světových dějin*. Přeložil Věra KOTÁBOVÁ, přeložil Lubomír KOTAČKA, přeložil Kateřina PEKÁRKOVÁ. V Praze: Columbus, 1998. Encyklopedie. ISBN 80-85928-81-7.
- [10] KAHNEMAN, Daniel. *Myšlení: rychlé a pomalé*. V Brně: Jan Melvil, 2012. Pod povrchem. ISBN 978-80-87270-42-4.
- [11] KAHNEMAN, Daniel and Amos, TVERSKY. Prospect Theory: An Analysis of Decision under Risk. In: *Econometrica*, 1979. Vol. 47, No. 2. [online] [2022-1-29] (Mar., 1979), pp. 263-292. Available: <https://www.jstor.org/stable/1914185>
- [12] MARVAN, Miroslav. *Dějiny pojišťovnictví v Československu*. Díl 1: Dějiny pojišťovnictví v Československu do roku 1918. Praha: Novinář, 1989, 360 pages.

- [13] MARTINOVIČOVÁ, Dana. *Pojišťovnictví*. 1. vyd. Akademické nakladatelství Cerm, s.r.o. 2006. ISBN 978-80-214-3963-4.
- [14] MERNA, Tony a Faisal F. AL-THANI. *Risk management: řízení rizika ve firmě*. Přeložil Jiří PENC. Praha: Computer Press, 2007. ISBN 978-80-251-1547-3.
- [15] ONDER, Štěpán. *Architektura Solvency II*. [online]. KPMG 2006 [2022-1-29]. Available: <http://nb.vse.cz/kbp/TEXT/IIR%20SolvencyII.ppt>
- [16] OSTROM, Elinor. Institutional rational choice: An assessment of the Institutional Analysis and Development Framework. In: *Theories of the Policy Process*, 2nd ed., Paul A. Sabatier (ed.). [online] Copyright © 2007 by Westview Press [2022-1-12], pp. 21-64. Available: <http://edwardwimberley.com/courses/EnviroPol/theorypol/process.pdf#page=27>
- [17] SCHROEDER, Ralph. *Max Weber and the sociology of culture*. London, Sage Publications, 1992, 177 pages. ISBN 9780803985490.
- [18] SIRŮČEK, Pavel. *Hospodářské dějiny a ekonomické teorie: (vývoj, současnost, výhledy)*. Slaný: Melandrium, 2007. ISBN 978-80-86175-53-9.
- [19] SLOVIC, Paul and Ellen PETERS. *Risk Perception and Affect*. [on-line] © 2006 Association for Psychological Science [2022-1-14]. Ročník: 15 číslo: 6, strana(y): 322-325. 1. prosince 2006. Available: <https://journals.sagepub.com/doi/10.1111/j.1467-8721.2006.00461.x>
- [20] TALEB, Nassim. *Černá labuť: následky vysoce nepravděpodobných událostí*. Praha: Paseka, 2011. ISBN 978-80-7432-128-3.
- [21] TRÍSKA, Dušan. *Ekonomie jako osud*. Praha: Institut Václava Klause, 2016. Publikace (Institut Václava Klause). ISBN 9788075420176.
- [22] VON MISES, Ludwig. *Lidské jednání: pojednání o ekonomii*. Druhé vydání. Přeložil Josef ŠÍMA. Praha: Liberální institut, 2018. ISBN 978-80-86389-61-5.
- [23] ŽANTOVSKÝ, Petr. *Česká politika a média po roce 1989*. Praha: Institut Václava Klause, 2013. Publikace (Institut Václava Klause). ISBN 978-80-878-0602-9.

COMPARISON OF SMART CITY STRATEGIES IN SELECTED CITIES – BRATISLAVA AND VIENNA

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Abstract: *The concept of smart cities is becoming more popular. What elements should a smart city have. What goals did the surveyed cities choose and in which areas did they divide them. There are some barriers to implementing smart cities.*

Keywords: *Smart City Concept, Smart City Strategy, Challenges of Smart City, Threats of Smart City*

1. Introduction

This paper focuses on the comparison of the Smart City concept in two selected European capitals - Bratislava and Vienna.

To begin with, is it necessary to determine what the Smart City concept represents and contains?

According to Winkowska, Szpilko and Pejić (2019) in Smart city concept in the light of the literature review [1], Smart City is a holistic interdisciplinary element that includes smart governance, smart environment, smart economy, smart mobility, smart living and smart people. A city that uses technology can only be called a smart city, as any agenda is solved using information and communication technologies, but these are separate actions in an unconnected system / systems.

Author Wadhwa (2015) in Understanding the Impact of Smart Cities and the Need for Smart Regulations [2] has a similar opinion, who describes that only if all the elements work: smart governance, smart infrastructure and innovation economy can we talk about smart city, if these requirements are met, the city is more life-friendly and can respond more quickly to demands and challenges.

We also present publications that deal in detail with smart cities and the elements they contain, which can contribute to a better quality of life in urban agglomerations.

In order to evaluate appropriate measures, we must first know the data on the plans for the implementation of smart cities in selected research cities - there are several perspectives where the situation can be assessed individually or as a whole for a greater effect.

2. Current state of the issue in the literature

Caraglio, Del Bo and Nijkamp [3] describe that the city's performance now depends not only on equipping the city with physical capital, but increasingly on human and social capital - the latter form of capital is crucial for the competitiveness of cities. In this context, the concept of a "smart city" has been introduced as a strategic tool combining modern urban factors into a common goal to emphasize the importance of information and

communication technologies (ICT) in any city today. They found that the development of the city and its wealth is directly linked to the quality of the urban environment and the presence of the creative class, and they also focus on the level of education and accessibility and peace, and the use of ICT in public administration, and in this connection it correlates positively. This result encourages the formulation of a new strategic agenda for European cities of various sizes, which will enable them to achieve modern and sustainable urban development and a better urban landscape.

3 Condition assessment

In the following subchapters, we will focus on a detailed view of the two cities surveyed - what their plans are and what goals they have set for themselves in the area of smart cities.

The names of the areas are based exactly on the strategic documents.

3.1 Condition assessment - Bratislava

Bratislava has adopted in 2018 a strategic document called BRATISLAVA Reasonable City 2030 [4], which compressively presents what goals the city plans to meet in a given time horizon, as well as what steps need to be taken to meet them.

The following table will clearly show the name of the area and its associated objectives that Bratislava plans to meet.

Table 1 Focus groups and related goals in Smart City – Bratislava

<i>Area of intent</i>	<i>Specified targets</i>
Social Inclusion	- Improving the quality of life of socially disadvantaged and disadvantaged groups, - alleviating social exclusion and crisis situations, - increasing intergenerational understanding in society.
Environment and Circular Economy	- More efficient use of natural potential, - reducing the adverse effects of urbanization, - implementation of comprehensive measures for the adaptation of the city to climate change, - comprehensive water management with the aim of their sustainable use (water quality and quantity),

	<ul style="list-style-type: none"> - efficient water management - reducing water leakage from water supply systems, reducing water consumption by the population (including environmental education), - systematic collection and sorting of waste within the city self-government (city and city organizations), - building collection yards for citizens, - optimization of waste collection in the city as a prevention of waste degradation (preventing its recycling), - separation of bio-waste and its further use by composting, - reasonable use of the potential of unused areas (so-called brownfields) within the development of the city.
Education	<ul style="list-style-type: none"> - Greater involvement of children and young people in the life of the city, - cooperation of schools, scientific-research sector or business sector in the field of innovative projects and the introduction of modern technologies into practice (involvement of primary art schools, leisure centers, primary, secondary and tertiary schools in creative solutions and challenges in various areas of city life), - support for educational and awareness-raising activities of the socially weaker population.
Mobility	<ul style="list-style-type: none"> - Sustainable transport safety based on effective separation, integration of motorized and non-motorized transport and development of rail transport, - intelligent parking policy, Park and Ride system, - support of electromobility, - building of technical infrastructure in the city, introduction of electric energy technology in the public transport system, sharing of electric vehicles (e-carsharing), - reduce air pollutants and reduce noise.
Power Industry	<ul style="list-style-type: none"> - Support for investment in the construction of less energy-intensive buildings as part of urban development, - support for the modernization, reconstruction and construction of technical infrastructure in order to reduce energy losses, energy intensity and energy savings, - use of renewable energy sources, - efficient energy recovery of waste in the production of electricity and heat.
Public Space	<ul style="list-style-type: none"> - Protection of the cultural natural heritage and natural resources as one of the pillars of the city's identity, - intelligent networking of green spaces, interconnection of alleys, parks, public gardens, public spaces, interconnection of squares, street lanes and passages, accessibility of public buildings from public spaces, - taking into account the specific requirements of public space security for all groups of the population, - renovation, completion and development of public spaces.

Each city has a smart city implementation plan document developed into a different number and type of chapters. In addition to those mentioned above in the table, Bratislava also has the following: City Administration, Business, Culture, Tourism and Sports.

3.2 Condition assessment - Vienna

Another research object - Vienna adopted a revised strategy from 2014 in an updated version in 2019 with a name Smart City Wien Framework Strategy 2019-2050 [5] containing new approaches, perspectives and reflecting the

reality and progress that occurred during the 5-year horizon.

The table shows related / identical areas in Vienna in order to make a comparison.

Table 2 Focus groups and related goals in Smart City – Vienna

<i>Area of intent</i>	<i>Specified targets</i>
Population	<ul style="list-style-type: none"> - Improving the quality of life in each neighborhood, - improve housing conditions, - modernization of buildings and adaptation of urban infrastructure to current standards - the so-called project The neighborhood has to meet the demands of citizens such as dinner on the street, summer festival with minigolf, baking bread on the grass, etc.
Ecology	<ul style="list-style-type: none"> - Ecological renovation of buildings, - clean energy production and efficient cooling systems, - weather and environmental sensors, - creation and maintenance of a self-sufficient wastewater treatment plant, - creation and installation of facilities for the extraction and use of biogas, - the introduction of dual rainwater infiltration, in which chloride-contaminated water flows into the sewers, while cleaner drains naturally seep into the soil through infiltration tanks, - the introduction of modern snow and ice standards, which serve as a flood protection measure, by relieving sewerage during heavy rains.
Digital Education	<ul style="list-style-type: none"> - Developing the digital school project to acquire digital skills and increase digital literacy, - the introduction of high-speed Wi-Fi in all primary and secondary schools, - development of digital learning tools, - setting new learning standards with individual work email addresses for teachers and Office 365 licenses for all schools.
Transport and Mobility	<ul style="list-style-type: none"> - Reducing greenhouse gas emissions, - construction of the Wiener Linien center for hydrogen buses, - replacement of conventional buses with electric and hydrogen buses, - intelligent traffic lights: this system uses camera detectors mounted four meters above the ground to detect pedestrians approaching within eight meters of traffic lights. Based on their direction of movement, the software algorithm predicts whether they wish to go to the other side of the road and this data is transmitted to the traffic light control system, - ensuring traffic flow through intelligent traffic lights (eg. more efficient road works), - weather and environmental sensors.
Power Industry	<ul style="list-style-type: none"> - Introduce blockchain technologies to simplify the processing of energy transactions, - acquiring partners in the product development process, e.g. testing innovative energy tariffs or acquiring new business models based on solar energy e.g. blockchain - achieve harmonization of services in all spheres, e.g. photovoltaic systems, electromobility and storage.
Public Space	<ul style="list-style-type: none"> - Extension of the BeRTA green façade module, which consists of a 300-liter flower pot, a grid, a soil substrate and two climbing plants, which together cover approximately 8 m2 of facade.

4. Suggestions for possible solutions

Both cities have developed a strategy with set goals - it is positive that the agenda is divided into thematic units and in each such part there are several goals and sub-goals that [6], if met, will have a positive impact on each resident or visitor to the cities. It is important to revise the goals regularly, as the requirements are very dynamic at a rapidly changing time.

These goals and sub-goals need to be analyzed regularly to keep them up-to-date. At the same time, it is necessary to take continuous steps for improvement in each of the defined areas [7], because the elements are interrelated and influential, and of course, each inhabitant has different needs and priorities - as a result, as many people as possible need to be influenced.

5. Conclusions

The goals set are interesting and admirable, but cities still have a challenging way to achieve them [8], either partially or completely. The biggest obstacles may be [9]: lack of human resources to create cities in the 21st century, underfunding of individual smart projects and currently much more and constantly changing environment - inflation, cybersecurity, anti-pandemic measures.

Given all the above-mentioned aspects, elements and goals that are set, it can be expected that in modern times it will be possible to meet the set goals for the most part [10] and the cities will be much more life-friendly than before the introduction of the smart city concept elements.

It will be a great challenge for citizens and elected representatives to meet a number of set priorities at the same time.

References

- [1] WINKOWSKA Justyna, SZPILKO Danuta, PEJIĆ Sonja, *Smart city concept in the light of the literature review*, Engineering Management in Production and Services, Bialystok, Bialystok University of Technology, 2019, pp. 70-86
- [2] WADHWA Manick, *Understanding the Impact of Smart Cities and the Need for Smart Regulations*, SSRN Electronic Journal, Rochester, SSRN, 2015, pp. 32-43
- [3] CARAGLIU, Andrea, DEL BO, Chiara a NIJKAMP, Peter, *Smart Cities in Europe*, Journal of Urban Technology, London, Informa UK Limited, 2011, pp. 65-82
- [4] <https://bratislava.blob.core.windows.net/media/Default/Dokumenty/smartcity%20rozumna%20bratislava2030.pdf>
- [5] <https://www.wien.gv.at/stadtentwicklung/studien/pdf/b008552.pdf>
- [6] ALDEGHEISHEM Abdulaziz, *Success Factors of Smart Cities: A Systematic Review of Literature from 2000-2018*, TeMA - Journal of Land Use, Mobility and Environment, Naples, Laboratory of Land Use Mobility and Environment, 2019, pp. 53-64
- [7] FERNANDEZ-ANEZ Victoria, FERÁNDEZ-GUELL José Miguel, GIFFINGER Rudolf,

Smart City implementation and discourses: An integrated conceptual model. The case of Vienna, Cities, Amsterdam, Elsevier, 2018, pp. 4-16

[8] HASBINI Mohamad Amin, ELDABI Tillal, ALDALLAL Ammar, *Investigating the information security management role in smart city organisations*, World Journal of Entrepreneurship, Bingley, Emerald Group Publishing, 2018, pp. 86-98

[9] https://www.researchgate.net/profile/Georgi-Georgiev-28/publication/343615678_Smart_City_Guidance_Package/links/5f3476b7a6fdcccc43c59db6/Smart-City-Guidance-Package.pdf

[10] DAMERI Renata Paola, *Urban Smart Dashboard. Measuring Smart City Performance*, Smart City Implementation, Basel, MDPI, 2017, pp. 67-84

PROCESSING OF PERSONAL DATA IN INFORMATION SYSTEMS

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Abstract: *The paper deals with the principles that can be identified in the processing of personal data in public administration information systems. The paper points to the invasion of privacy in the processing of personal data, which is associated with increased responsibility of the public authorities for the security and protection of personal data processed in information systems.*

Keywords: *privacy, personal data, information systems, principles*

1. Introduction

Data has been collected, stored and processed since the beginning of mankind. People have always needed to observe and interpret things that are happening around them so that they have enough information as a basis for their decisions. However, the situation has changed radically with the advent of computers and information technology. It is estimated that around 44 zettabytes (44 trillion GB) of data were generated by 2020. By 2025, the volume of data was to increase to 175 zettabytes. This huge increase in data is mainly related to the increase in the number of devices that produce data, as well as the number of devices with sensors. Around 80 billion devices are expected to be connected to the Internet in 2025. A huge number of devices collecting data and connected to other devices via the Internet are referred to as the so-called Internet of Things – in Slovak Internet vecí. Data and information that is collected through devices or other means, such as from Internet users themselves (and specifically social networks), are further stored, processed and evaluated. The ability to create tools to process such data and turn them into value, to extract some knowledge, is a cornerstone of decision-making processes not only for states, but nowadays it is already an integral part of the practice of private entities.

States and their authorities collect, process and store information on personal data in information systems. At the same time, they must protect privacy and personal data collected. The right to privacy and the protection of personal data is a factor which makes it even impossible to make information available on request and therefore needs special attention.

In this paper, we focus on the legal principles of protection and processing of personal data in public administration information systems. In doing so, we will primarily proceed from the right to privacy, which also includes personal data. The level of processing of personal data in information systems thus represents an intrusion into the privacy and private life of the data subject, which increases the responsibility of the information system operator for the protection of processed personal data.

2. The right to privacy

The right to privacy is guaranteed according to Art. 17 par. 1 of the International Covenant on Civil and Political Rights, as well as under Art. 8 par. 1 of the Convention for the Protection of Human Rights and Fundamental Freedoms (hereinafter "the Convention"). In decisions applying Art. 8 of the Convention reiterates that the purpose of the right to private and family life is to protect the individual against arbitrary interference by public authorities.

The purpose of the right to privacy is not only to provide protection for privacy, but also to prevent state and local authorities from interfering in an individual's behaviour beyond what is necessary and over-managing his or her private life.

The right to privacy lies in the right of an individual to decide at his own discretion whether and to what extent facts from his or her private life should be made available to others. The object of protection is the inner, intimate sphere of life of a natural person, which is shaped by the realities of his or her private life. With privacy in the broadest sense, that is, with privacy that includes a person's social relationships, which he naturally creates during his life, it is assumed that many facts from his private or family life will be made available, many without his own influence or proceedings. This in itself does not have to be sensitive or unwanted. However, the human intimate sphere, one's own privacy and one's immediate family life should be protected from such interference and disclosure of various information. In accordance with the purpose of the right to privacy, public authorities, natural and legal persons may interfere in the private and family life of others if their interference can be assessed as justified.

At present, however, the need to protect privacy and private life in horizontal relations may be even more pronounced than in vertical relations. The right to respect for private and family life according to Art. 8 of the Convention comes to the fore.

In terms of examining the right to disappear from the Internet, in relation to Art. 8 of the Convention, especially its paragraph 2, it is important that this paragraph deals explicitly with vertical relations and in the field of public power provides protection of private and family life from state authorities and interventions by them. Thus, paragraph 2 constitutes, in a way, a narrowing of paragraph 1, which grants the right to respect for private and family life to each *erga omnes*. The understanding of the primary protection of privacy and private life in vertical relations corresponded to the time when the Convention was adopted and to the needs pursued by such an arrangement.

In the case of *Marckx v. Belgium* in 1979, the European Court of Human Rights criticized the Belgian legal system for allowing unequal treatment of married and single mothers. In the later judicature of the European Court of Human Rights, the positive commitment of the state only by the obligation to create an adequate legal order. In the light of that case-law, the right to privacy may also be infringed by the failure of public authorities which have not prevented the infringement of the right to privacy in a particular case. Based on a positive commitment, the European Court of Human Rights has gradually shifted the application of the right to privacy from vertical relations of public law to horizontal relations of private law.

The right to privacy contains, in accordance with the Convention and the judicial precedents of the European Court of Human Rights derived from it

- a ban on the collection and storage of personal data, which may involve monitoring the actions of an individual (e.g. camera system) in public or more precisely at a police station, collecting personal data in terms of state security, crime prevention, medical records, while the content of this right (defined in in the form of a ban) is also the right of an individual to have access to his or her personal data,
- rights associated with minority sexual orientation, both homosexuals, where it is mainly a matter of criminalizing homosexuals, preventing homosexuals from accessing certain professions, as well as transsexuals, where it was mainly a matter of bringing biological status into line with legal status (gender reassignment not only factual, but also marked in the register office),
- the right to the protection of good name and honour, which is a kind of counterpart to the right to freedom of expression and its violation occurs precisely when exercising (abuse) freedom of expression, which in national law usually corresponds to constitutional, but in particular the legal protection of the person's personality with priority protection through the general courts. The European Court of Human Rights has also developed the protection of the name and surname of a person, as well as the basic principles of deprivation (restriction) of legal capacity,

- the right to protection of the home and freedom of home, which stipulates in particular strict criteria for conducting house searches, with special attention being paid to computers and securing their contents, in which case third parties may also be harmed,
- protection of correspondence and secrecy of transported messages, while telephone calls (eavesdropping) are most often the subject of intervention by public authorities and correspondence of prisoners, distinguishing between correspondence with a lawyer, which is more strictly protected, and other correspondence [1].

Protection of the rights guaranteed in Art. 8 of the Convention thus concerns vertical relations, which are likely to remain in the first place, but also horizontal relations. Privacy and the right to privacy can also be invaded by private persons, and the protection of privacy in such interventions must be as intensive as the protection of privacy against public intervention. In connection with modern information technologies, which are private and not owned and managed by public authorities, it is the protection of privacy from private interventions on a horizontal level that is becoming more and more important.

At the level of the European Union and its human rights catalogue, the right to privacy and in particular the right to protection of personal data is based on Art. 7 and Art. 8 of the EU Charter of Fundamental Rights (hereinafter referred to as the "Charter").

Art. 7 of the Charter guarantees the right to respect for private life, while Art. 8 of the Charter expressly regulates the right to personal data protection. Paragraphs 2 and 3 of this article of the Charter specify that such data must be properly processed for specified purposes with the consent of the person concerned or on another legitimate basis laid down by law. They also specify that everyone has the right to access and rectify the data collected concerning them and that compliance with these rules is subject to the control of an independent body.

However, one of the main objectives of data protection is the protection of privacy, which is also clear from the judicature of the Court of Justice of the European Union and the European Court of Human Rights. Generally speaking, the right to privacy is a broader concept. The right to the protection of personal data concerns the restrictions and conditions for the processing of data in relation to identifiable individuals, while the right to privacy concerns the whole "personal space" of individuals, various areas of their private life and their inner world, its essence.

Regulation of personal data protection in Art. 8 par. 2 of the Charter also brought a shift compared to the regulation of personal data protection in the Constitution, to the extent that it explicitly guarantees the data subject the right to correct the collected data. This correction, resp. the right

to rectification could also mean the deletion or other deletion of collected personal data, e.g. from social networks or from the Internet as such.

In Art. 16 par. 1 of the Treaty on the Functioning of the European Union is provided, that everyone has the right to the protection of personal data concerning him or her.

3. Processing of personal data in information systems

The Member States of the European Union are obliged by their legislation to harmonize the right to personal data under Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of individuals with regard to the processing of personal data and on the free movement of such data and repealing Directive 95/46 / EC (General Data Protection Regulation) with the right to freedom of expression and the right to information, including processing for journalistic and academic, artistic or literary purposes.

In Art. 85 is addressed primarily the relationship between two constitutional rights, namely freedom of expression and the right to information on the one hand and on the other hand the protection of personal data for the purposes of journalism and for the purposes of academic, artistic or literary production. As there is a potential conflict of these rights in this case, the resolution of such a situation is based on a proportionality test of the interference with the rights and freedoms of the data subject and also proportionately assessing and evaluating whether for disclosure exceeds the right to information beyond the interest of the data subject in the protection of his or her personal data.

The proportionality test consists of several parts. It is primarily a question of assessing suitability, i.e. whether the restriction of the right to protection of personal data can be achieved by a defined objective, i.e. the right to information. Furthermore, it is the definition of necessity, i.e. whether the goal - the right to information - can be achieved in relation to personal data by a less invasive method, and finally it is its own, more precisely a narrower proportionality test, where the two rights in question are compared.

The subject of the assessment should be whether the exercise of the right to information by providing the required information can be ensured only by providing personal data about the person concerned and whether this provision, more precisely provision to a certain extent is proportionate to the protection of rights and at the same time to the protection of personal data to be disclosed. It is also necessary to assess whether or not the consent of the data subject is required for the disclosure of personal data.

The criterion of proportionality of the intervention means maintaining a balance between the individual's right to privacy and the choice of the means available to the State to pursue a legitimate aim. Their choice is limited in that the interference with the right to privacy is possible only

when necessary and can only be done in the spirit of the demands placed on a democratic society. In its decision-making process, the ECHR emphasized that in interfering with the right to privacy in accordance with the Convention, the State cannot rely solely on any "general necessity". The term "necessary" is not, in the view of the ECHR, flexible enough to be interpreted as "useful", "appropriate" or "desirable", but must be linked to the existence of an "urgent social need" to carry out the intervention.

Freedom of expression and the right to information are limited by privacy, personal data protection, but also e.g. protection of human dignity, if it should be, for example, the disclosure of personal data concerning health, intimate life, etc.

In Art. 86 Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of individuals with regard to the processing of personal data and on the free movement of such data, repealing Directive 95/46 / EC (General Data Protection Regulation) explicitly addresses personal data in official documents. Personal data in official documents held by a public authority or a public or private body for the performance of a task carried out in the public interest may be provided by that authority or body in accordance with European Union law or the law of the Member State to which the public authority or a public body belongs, in order to harmonize public access to official documents with the right to personal data protection.

The information system is a functional unit providing purposeful and systematic information activities through technical means and software. The public administration information system is an information system within the competence of the administrator supporting public administration services, services in the public interest or public services.

The processing and use of personal data in public administration information systems, including their possible disclosure as information on request, must be lawful, while the law must respect certain principles laid down in its judicature by the Court of Justice of the European Union. The principles are:

- a) subsidiarity of the use of the data obtained,
- b) clear definition of the purpose of the use of the data,
- c) quality supervision by a court or other independent institution,
- d) ensuring an exceptionally high level of protection and security,
- e) time-limited data destruction,
- f) notification of the persons concerned.

3.1 Subsidiarity of the use of the data obtained

Subsidiarity of the use of the data obtained means that data should be obtained from more sensitive sources only if they cannot be obtained from less sensitive sources.

Subsidiarity is also fully compatible with the sanctioning role of public authorities.

Interference with privacy and the provision of personal data should be exceptional and, in accordance with the principle of subsidiarity, only if this is necessary to fulfil a public interest which cannot be achieved otherwise.

The subsidiarity of the processing of personal data and their use and possible disclosure upon request is also linked to the requirement to minimize the processing of personal data. Minimizing the processing of personal data means the obligation to thoroughly assess and consider the extent of personal data that need to be processed for the purpose stipulated by law.

The minimization of personal data processing will be fulfilled on two levels –

- a) assessment of the necessity of personal data processed in relation to the purpose of processing and consideration of each processing operation in relation to the intended purpose of personal data processing and possible interference with the rights and freedoms of persons,
- b) introduction of appropriate technical and organizational measures that will lead to data minimization [2].

3.2 Clear definition of the purpose of the use of the data

A clear definition of the purpose of the use of the data means that the data must be used for a predetermined purpose, which must be defined in law. A clear definition of the purpose also allows the Constitutional Court to properly examine the adequacy of the legislation. Legislation must set out the substantive and procedural conditions for access by competent authorities to retained data in justified cases. The purpose of access to data must also take into the account the criterion of necessity.

The purpose of personal data processing is determined by the controller itself or the purpose follows directly from the law. Personal data may only be collected and processed for a specifically specified, explicit and legitimate purpose and may not be further processed and provided in a way that is incompatible with the purpose of their processing. The purpose must be defined clearly and intelligibly enough to make it clear what processing operations will take place on it, more precisely what processing operations the data subject can expect with the data.

Clear definition of the purpose of the processing of personal data and their use prevents the use of personal data for any processing operations. However, data which has already been lawfully processed for some purpose may also be useful for another lawful purpose for which it was not originally processed. New further use of personal data is possible provided that –

- a) personal data are processed on the so-called privileged purposes - personal data processed on the so-called

privileged purposes are the processing of personal data for the purposes of archiving in the public interest, scientific or historical research and for statistical purposes and in relation to adequate safeguards for the rights of the data subject. These guarantees shall include the establishment of adequate and effective technical and organizational measures, in particular to ensure compliance with the principle of data minimization, pseudonymisation, where such measures can achieve those purposes,

- b) positive result of the compatibility test was achieved – i.e. processing of personal data obtained for a purpose other than the one originally defined is possible if this other purpose is related to and compatible with the original purpose of the processing [3].

3.3 Quality supervision by a court or other independent institution

The legislation must include sufficient safeguards against data misuse. This includes clear data disposal legislation, including the definition of a precise procedure and control. Legislation must provide for specific supervision of access to data, the possibility of public scrutiny, the provision of data security guarantees or the possibility for data subjects to defend themselves.

The deeper the legislator restricts the rights of the individual, the stronger the guarantees he must provide in protecting the rights against possible abuse. Therefore, even when formulating safeguards in the event of a particularly serious invasion of the right to privacy and the right to the protection of personal data, it is necessary to require that the strictest criteria be met.

Good independent supervision means that there must be an independent institution that can pre-filter or subsequently correct any non-compliance with the scope and purpose of the legal norm. As a rule, this institution is a court or an independent administrative body. Good independent supervision cannot be performed without sufficient authorization and control tools. There is also a need for transparency with independent supervision, which allows for public control over the handling of personal data.

Regulation (EU) 2016/679 of the European Parliament and of the Council requires each Member State to designate one or more independent public authorities to monitor the application of this Regulation in order to protect the fundamental rights and freedoms of individuals with regard to processing and facilitate the free flow of personal data within the European Union. Such a supervisory body shall act with complete independence in the performance of its tasks and in the exercise of its powers.

The independence of the supervisory authority shall be achieved by not exercising any external influence, whether direct or indirect, in the performance of their duties and in exercising their powers, nor by seeking or taking instructions from any person.

The members of the supervisory organ shall refrain from any action incompatible with their duties and shall not, during their term of office, engage in any other occupation, whether gainful or not, which is incompatible with that office.

The supervisory authority shall be equipped and shall have at its disposal the human, technical and financial resources, premises and infrastructure necessary for the effective performance of its tasks and the exercise of its powers, including those to be performed and exercised in relation to mutual assistance and cooperation. An essential part of the independent supervisory body is also its own staff, which is subordinated exclusively to the members of the supervisory body.

The supervisory authority is subject to financial control that does not affect its independence and that it has a separate public annual budget, which may be part of the overall state or national budget.

3.4 Ensuring an exceptionally high level of protection and security

Ensuring an exceptionally high level of protection and security through technological and organizational measures means that the more sensitive the data, the more necessary it is to insist on better ways to protect data against misuse (e.g. asymmetric encryption, implementing security certification, restricting access to data or training of responsible persons). At the same time, safety guarantees must be adjusted separately and comply with the latest high standards used in professional circles.

The requirement of an exceptionally high level of protection and security means the creation and maintenance of technical, organizational and personnel measures for the protection of personal data processed. Their settings shall take into account the risks posed by the processing of personal data, in particular those which may arise as a result of accidental or unlawful destruction, loss, alteration, unauthorized disclosure of personal data or unauthorized access to such data.

These must be security measures of varying importance to the rights and freedoms of individuals. This means the need to assess the threat and vulnerability of the personal data processed. When processing personal data, it is necessary to take security measures that correspond to the identified security risks. Measures should include –

- a) pseudonymization and encryption of personal data - the need for the application of such measures should be subject to professional assessment and the real need for their application. Pseudonymization may not always be an effective privacy solution. If there is a real possibility of ordering access rights to the data according to the authorizations, pseudonymization will probably not be necessary. Likewise, encryption should be applied in a targeted manner where its use is justified. E.g. when storing sensitive data on local disks

of workstations (notebook), which are used by employees outside the secure work environment. Encryption at least at the disk level should be the standard in such cases. The application of pseudonymization and encryption should realistically lead to a reduction in the level of risk to the rights and freedoms of the persons concerned,

- b) ensuring the continued trust, integrity, availability and resilience of processing systems and services. Confidentiality in this case means that personal data are accessible only to authorized persons who, on behalf of the controller or intermediary, may have access to the personal data processed. Access should be granted on the basis of appropriate authentication and identification tools. Integrity means preventing unobserved data modification, eliminating any unauthorized interference with data during data processing. Availability is access to personal data when needed, e.g. in the form of backup sources, which will ensure the availability of processed personal data in the event of a system failure. The resilience of processing systems and services means securing systems against threats that could lead to breaches of the confidentiality, integrity and availability of personal data. The ability of the system to withstand attacks and keep processed personal data in a correct state, thus ensuring the functionality of the system and data sessions as a whole,
- c) restoring data availability and access in the event of a physical or technical incident. The operator or intermediary shall ensure the backup of data in case of system failures and their availability so as not to harm the persons concerned. Restoration of data availability can be achieved e.g. creating regular backups, testing the functionality of systems and rules, creating continuity plans in case of outages or failures, etc.,
- d) the process of regularly testing, assessing and evaluating the effectiveness of security measures. All security measures taken to reduce the risk to the rights and freedoms of data subjects, as well as to ensure the integrity, confidentiality and availability of data, must be regularly tested, assessed for effectiveness and evaluated. When processing personal data, it is necessary to create mechanisms and rules for regular assessment and monitoring, evaluation of changes in processing conditions that could affect processing operations and, consequently, the degree of their risk. Monitoring must focus in particular on the effectiveness of existing measures and compliance with them. It is also necessary to constantly monitor vulnerabilities, which are changing e.g. with new technologies or changes in the conditions of personal data processing. It could be e.g. system of education of persons authorized to process personal data, penetration testing, simulation of security incidents, etc.

3.5 Time-limited data destruction

The time-limited data destruction means that if the reasons for processing the data have passed, they must be

destroyed (erased). This condition is an expression of the fact that, as subsidiarity applies to the request for data, it also applies to their subsequent processing. Thus, if the reason for their processing in a given quality ceases to exist, the state must minimize the risk of misuse by devaluing or completely removing (destroying) unnecessary data as soon as possible.

In certain circumstances, it is possible for personal data to be retained beyond the purpose for which they were processed. This is the processing of personal data for archiving purposes in the public interest, scientific or historical research or for statistical purposes. This is the so-called privileged processing purposes.

3.6 Notification of the persons concerned

If the data can be obtained directly from the data subject due to the nature of the measure, their processing based on his or her consent should be the rule. This does not preclude that, in justified cases, consent will not need to be sought (e.g. if the nature of the act precludes it).

Obtaining consent strengthens the legitimacy and proportionality of any processing of personal data, as it depends on the individual's confidence in the motives and behaviour of the public authority. However, especially in vertical relations, it should be noted that if the consent was obtained under the threat of a negative consequence, it is not possible to speak of its voluntariness.

If it is not possible to use personal data with the consent of the data subject, notification must be provided. The requirement to notify data subjects means that, as far as possible, the scope and manner of use of the data must be notified to the data subject, even if subsequently. It is an expression of the requirement for access to justice and effective judicial protection. Notifying this person gives the opportunity to defend themselves against the use of their personal data.

The data subject has the right to receive timely and intelligible information on the collection of his personal data for the purposes of their processing in public administration information systems. The data subjects must be informed of the risks, rules, guarantees and rights in the processing of personal data, as well as of the conditions for exercising their rights.

It is very important that the preventive approach to personal data protection is strengthened. This is based on the existence of legislation that creates clear legal rules for such interference before personal data is infringed.

4. Conclusion

From the point of view of the state, the development of information technologies represents not only the ability to provide better services to citizens and companies, e.g. by electronic public administration services or higher security on the basis of better, superior, faster and more comprehensive information, but at the same time, on the

other hand, it has lost its monopoly position in this area. In the field of electronic public administration services, the state is essentially dependent on products developed for it by private companies, supplied and serviced by it, and in the field of security, private companies now have many times better technology than the state and its bodies.

The protection of the right to privacy and especially the protection of personal data consists in the possibility for each person to gain control over himself at the time of the unprecedented onset of global technological development and the Internet, over information and data obtained about us by the surrounding society and further processed without our knowledge or consent and used with the potential risk of invading a person's privacy and integrity.

References

- [1] Orosz, L., Svák, J., Balog, B., *Základy teórie konštitucionalizmu*, pp. 238, 1996
- [2] Valentová, T., Birnstein, M., Golais, J., *GDPR/Všeobecné nariadenie o ochrane osobných údajov. Zákon o ochrane osobných údajov, Praktický komentár*, pp. 102, 2018
- [3] Valentová, T., Birnstein, M., Golais, J., *GDPR/Všeobecné nariadenie o ochrane osobných údajov. Zákon o ochrane osobných údajov, Praktický komentár*, pp. 103, 2018
- [4] Convention for the Protection of Human Rights and Fundamental Freedoms.
- [5] EU Charter of Fundamental Rights.
- [6] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)

INNOVATION TECHNOLOGY TRANSFER: HIGHER EDUCATION INSTITUTION IN EUROPEAN AND LATIN AMERICAN COUNTRIES

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Abstract: Schumpeter was the first to develop the conception of the entrepreneurial innovation as a naturally occurring outcome of the creative disruption that occurs when entrepreneurs change radical, marketable means of innovation [1]. In this sense, public policies that influence these transformations in a direct or indirect way, such as taxation, labor, or monetary issues. As well as the concept of entrepreneurship ecosystems and governance responsibilities that can promote / hinder entrepreneurship and innovation through taxes, incentives, subsidies, and grants. Higher education plays an important role as an important source of innovation. Technology transfer offices are also important as a link between universities and the ecosystem. This paper goes through a literature review to examine the barriers as well as trends in technology transfer offices in higher education institutions in Latin American and European countries.

Keywords: Innovation, technology transfer, European, Latin American, Barriers and trends.

1. Introduction

In the knowledge economy, the rapidly developing scientific and technical technologies and the accelerating process of economic globalization have made technological innovation and progress an important driver of economic growth. It is not only the invention or creation of innovative technologies that determines high economic growth, but also, and more importantly, the diffusion of new technologies so that they can be continuously disseminated and applied across economic and geographical space, becoming an important means of promoting industrial technological progress[12]. Technologies are vital for the improvement of a country's economy, especially in growing countries, where a highly significant function is attributed to the growth of industry. Higher Education Institutions (HEIs) have a crucial position in encouraging scientific and commercial collaboration in innovation systems around the world.

1.1 Technology transfer

Technology transfer has been widely discussed in recent years. It has been defined differently in many different areas, depending on the purpose of the research. The definition therefore depends on how the user defines the technology and in what context. Technology transfer can be described as the processing of developing tangible applications for the findings of the scientific research. Usually two or more people, groups and organizations exchange technology through different mechanisms.

Prior to 1980, the intellectual property rights to all inventions conceived or performed in federally funded research belonged to the federal government. Following the Bayh-Dole Act of 1980, changes were made to allow universities to retain ownership of such inventions and to allow universities to share licensing revenues with inventors. Some university administrators in the United States and other industrial countries claim that university technology transfer has the potential to provide significant

revenues for universities. At the same time, policy makers in these countries have pointed to the potential of technology transfer to contribute to national and regional economic growth. Under this influence, universities around the world have established University's Technology Transfer Units.

The benefits of technology transfer are manifold and involve every individual, organization, and society as a whole. The commercialization of innovation links the various sectors together and affects each other.

1.2 Recent research highlights

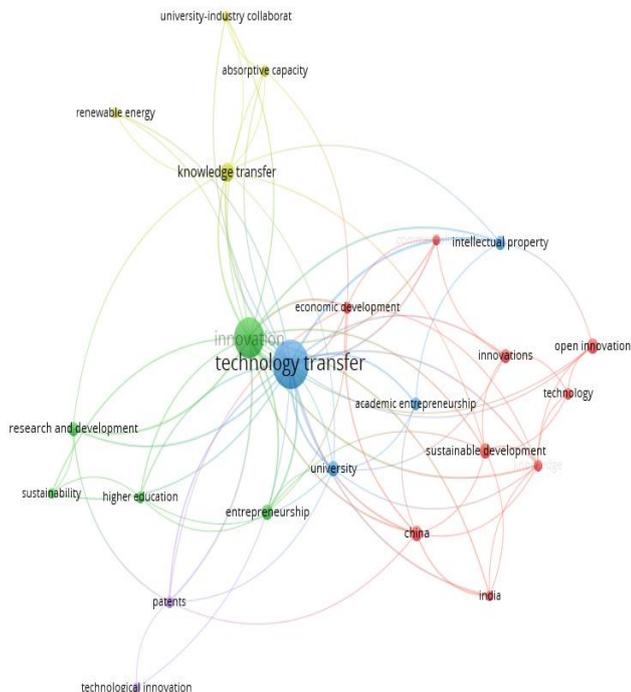
To further understand the recent research trends in technology transfer, this paper here searched 385 literatures related to technological transfers in the higher educational system from the Scopus database by VOS viewer.

As can be seen from Figure 1 below, most of literatures on technology transfer is still focused on how to achieve commercialization and promote economic development. Higher education institutions or universities, as one of the sectors of technology transfer, have taken on the role of academic entrepreneurship.

Equally important to technology transfer is innovation, which is ubiquitous, and which keeps any institution competitive. After this, knowledge transfer also occupies an important place, and with it, research and development, sustainable development and open innovation are mentioned. Studies on technology transfer in China and India also show the corresponding numbers. Technology transfer from foreign and international/national research institutes is the main source of technological information for less developed countries which use technological transfer as a means of promoting and facilitating growth, given the central role that technology plays in development [8]. As the main tool for technology transfer is the transfer

of intellectual property rights and patents, while for the university and industry collaboration, renewable energy also becomes extended perspective in this case.

Figure 1 Technology transfer related research



2. Research Question

There is a considerable amount of literature that demonstrates how university technology transfer offices often fail to function effectively, most notably in terms of low technology conversion rates and the failure of the closed loop of technology transfer to function effectively. Exactly what barriers exist in this process becomes the focus of this paper's research.

Specifically, research technology transfer offices in higher education institutions in European and Latin American countries:

1. What are the barriers in the operation of the process?
2. What are the future trends in this research?

3. Research design

This paper takes a literature review approach to understanding the barriers to technology transfer faced by higher education institutions in European and Latin American countries, followed by a categorical discussion.

As shown in Table 1, the literature search will focus on the last 5 years from Google scholar, Web of Science, Science Direct (Elsevier), ProQuest databases, by critically searching for several peer-reviewed academic papers for analysis and ultimately identifying 105 for inclusion in the

discussion. Excluding documents that included keywords but were not relevant, only eight were ultimately analysed.

Table 1 Research design

Research design	
Research method	Literature survey analysis
Virtual bases	Google scholar, Web of Science, Science Direct (Elsevier), ProQuest
Type of materials	Scientific papers, white reports
Portfolio of selected keywords	'Technology transfer', 'Higher education institutions', 'Latin American/countries', 'European countries', 'barriers', 'Ineffective', 'Inefficient'
Year of publication	Last five years (2018-2022)
Selection criteria	1. Priority will be given to peer-reviewed publications (referenced or academically based) from the fields of management. 2. Search for key words in the titles and abstracts.
Material collection method	Textual/Content analysis. Emphasis on targets and main findings.
Search refinement	Search refined Key words were being retrieved from multiple searches (cycles) to include the most up-to-date publications.
Total No. of literature survey	105 articles

4. Classified discussion

Barriers to technology transfer are accompanied by individual differences, and from a micro perspective there are many, such as the lack of accurate assessment of technology transfer, conflicts between technology transferors and technology recipients, and higher education institutions that do not have well-developed mechanisms for technology transfer [7]. And from a macro perspective, there are inter-regional differences between countries and regions.

4.1 Barriers in European

In general terms, innovation is an important source for policy makers to improve competitiveness [11] and promote economic development. European governments have established a variety of intermediary organizations (technology transfer offices, technology centers, science and technology parks, incubators, and clusters), and some countries have support from funds coming from EU funds [2]. This makes for a relatively smooth transfer of technology in Europe.

However, there are many European countries and some, for example, regulations and administrative barriers can lead to unnecessary transfer difficulties [3]. Despite assistance from EU legislative aid, progress on technological know-how transfer was very slow. [6]. Technology transfer driven by the bureaucracy should be combined with overall economic and political reform actions of national concern in order to obtain meaningful outcomes from their technology transfer endeavors.

4.2 Barriers in Latin American

In the case of the Latin American countries, the results of Latin America's technological transfers targets are not promising due to historical events that have led to technological dependence in the region and the failure to consolidate a mature technological base. [9]. And there is a lack of innovation, in which the configuration of the strategic and operational areas of the technology transfer office is defined and operated, which is very important to change the situation of technological dependence experienced by the region.

While Latin American higher education institutions attempt to develop science-based intellectual entrepreneurship and provide a supportive context for entrepreneurial trainings, know-how shares, idea trials and academic learning for students, the significance of student entrepreneurs has so far not been given the attention it deserves. While recent work has highlighted universities as a dominant factor in the dynamics of entrepreneurial systems [10], there is still a long way to go to understand the causal conditions that shape student entrepreneurship.

There are strong initiatives in some Latin American countries based on replicating the approach taken in developed countries - even though the surrounding environment may be different. Does this put higher education institutions at odds with systems that do not conform in terms of stimulating student entrepreneurial behavior [4]. As a result, Latin American countries have been slow to try to replicate the technological development policies of developed countries, but this has proved ineffective for their socio-economic environment and has not managed to achieve a real social contract with science and technology.

For the agreements made by the state to contain provisions on technology transfer, for example some on the promotion of innovation and technology transfer, or on the obligation of industrialised countries to provide incentives for technology transfer, the obligation of industrialised countries to provide incentives to companies that promote technology transfer, technology transfer to less developed countries, etc. However, few effective initiatives have been taken by the other side, leaving some Latin American countries with eroded trust in the good faith and intentions of the industrialised countries and, indirectly, in the IP system[5]. Further the system of agreements on intellectual property rights favours the owners of intellectual property rights and leaves the users of technology defenceless. The commercial practice of technology transfer is thus called into question.

4.3 Summary

The development of technology transfer in higher education is highly geographically specific, subject to policy, institutional, cultural, and local environmental constraints and limitations.

Firstly, in terms of geographical characteristics. With the rise of new and emerging technologies, global imbalances and capacity gaps in science and technology development have increased. Many less developed countries face many challenges, including how to establish standards and systems to improve the management of science and technology, and how to build capacity to bridge the gap with developed countries. This fourth industrial revolution, the digital economy and digital technology have indeed brought many opportunities to mankind, but at the same time there are also some challenges that worry them, and there are still many issues that need more research, including the use of robotics and the extensive use of artificial intelligence. Many less developed countries are now full of worries, not only about the standards system, but also about capacity. The capability gap may be further away from the world frontier because of the new wave of technology.

The developed countries support the LDCs and other less developed countries in their economic development through the necessary technology transfer, technology stockpiling, personnel training, and financial support. The source of technology is that there is a lot of publicly available technology, as well as some expired patents. At the same time, countries receiving technology transfers are actively trying to achieve convergence with the developed countries, and although it is possible to achieve technological breakthroughs in certain areas as early as possible and increase productivity, the lack of innovation is still a drawback.

Second, from the perspective of IPR protection, the relation between IP protection and technology innovations and economic development is not a single linear one, this is the conclusion of the "Stiglitz Report" study. The diversity and differences in IPR regimes are determined by the different national circumstances and stages of development of countries. Differences in IPR regimes exist both between developing and developed countries. As a result, an IPR regime that truly promotes innovation and is consistent with less development countries' stage of development and industrial characteristics needs to be carefully designed. Consideration should be given to promoting technological innovation by institutions and individuals, as well as balancing the interests of IPR creators and society.

5 Conclusion

All the types of barriers mentioned can occur at different levels and include mainly the following:

1. Lack of trust in the IP protection system, where the system does not function effectively and protects to the interests of each party to the technology transfer.
2. A primary focus on administrative matters rather than science.
3. Conflict between different attitudes in science and industry.

4. The need for higher education institutions to continue to develop the potential of research and to provide an appropriate focus and environment for innovation and entrepreneurship.

It is believed that future trends in technology transfer research not only lie in refining and addressing different barriers at the regional level, but also that research and innovation, which are essential for economic growth in order to achieve the goal of smart, sustainable and inclusive growth, will lead to more international cooperation between countries and regions, leading to greater scale and impact.

References

- [1] Schumpeter J. *Creative destruction. Capitalism, socialism and democracy.* 1942;825:82-5.
- [2] Westmore, B. and Adamczyk, P., *Public policy reforms to further improve Portuguese export performance*,2019.
- [3] Slimane, S.B. and M'henni, H., *Entrepreneurship and Development: Realities and Future Prospects.* John Wiley & Sons.2020.
- [4] André, C. A., Fischer, B., Paola Rücker Schaeffer, & Queiroz, S. *Determinants of student entrepreneurship: Revista de administracao e inovacao.* Innovation & Management Review, 16(2), 96-117. 2019. doi: <http://dx.doi.org/10.1108/INMR-02-2018-0002>
- [5] González-Gómez, S., & García-Santillán A. *The TRIPS agreement implementation in mexico. implications for social responsibility and development.* Journal of International Studies, 12(2) ,2019. doi:<http://dx.doi.org/10.14254/2071-8330.2019/12-2/3>
- [6] Guerrero, M., Urbano, D. *Effectiveness of technology transfer policies and legislation in fostering entrepreneurial innovations across continents: an overview.* J Technol Transfer,44,1347–1366, 2019. <https://doi.org/10.1007/s10961-019-09736-x>
- [7] Mazurkiewicz, A. and Poteralska, B., 2017. *Technology transfer barriers and challenges faced by R&D organisations.* *Procedia engineering*, 182, pp.457-465.2017.
- [8] WIPO, *Committee on Development and Intellectual Property (CDIP), Sixth Session, Geneva, November 22 to 26, PP1-5.*2010.
- [9] H. S. Fuquen, E. S. Olaya Escobar, *A technology transfer strategy based on the dynamics of the generation of intellectual property in Latin-America,* *Intangible Capital*, pp. 772-781,2018
- [10] Strang O, Ács N, Wirth R, Maróti G, Bagi Z, Rákhely G, Kovács KL. *Bioaugmentation of the thermophilic anaerobic biodegradation of cellulose and corn stover.* *Anaerobe.* Aug 1;46:104-13.2017.
- [11] Fudenberg, D. and Tirole, J., *A theory of income and dividend smoothing based on incumbency rents.* *Journal of Political economy*, 103(1), pp.75-93.1995.
- [12] Hall, A.,*Capacity development for agricultural biotechnology in developing countries: an innovation systems view of what it is and how to develop it.* *Journal of international development*, 17(5), pp.611-630.2005.

THE IMPACT OF THE COVID-19 PANDEMIC ON PARTICIPATORY BUDGETING IN SMALL MUNICIPALITIES IN SLOVAKIA

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Abstract: Participatory budget is an innovative tool for public policymaking, which is characterized by the participation of citizens of local administrative units. Citizens are involved in the process of deciding how public money is spent. The aim of the paper is to evaluate the impact of the COVID-19 pandemic on the use of participatory budgeting in the conditions of selected small municipalities in Slovakia.

Keywords: participatory budgeting, local self-government, the Slovak Republic

1. Introduction

Participatory budgeting is a natural implementation of citizen participation in resource allocation. With the participation of citizens, the decisions of policy makers are made more legitimate, the accountability and confidence in public decisions are improved [1]. Participatory budgeting creates an opportunity to use smart solutions.

Participatory budgeting began in Porto Alegre in Brazil in 1989. Since its start the participatory budgeting has been applied in Africa, Asia, Europe as well as North America. Participatory budgeting in Slovakia was first used in 2011 by the city of Bratislava. Since then, it has been applied by more than 65 local self-governments.

2. Participatory budgeting

The participatory budgeting has been one of the most important tools of civic engagement, especially over the last two decades. In the primary setting, the needs of the community are met, based on which the convergence of local politics with the will of the citizens is identified [2].

According to Peixot, each participatory budget should meet the following seven characteristics:

1. The subject of participatory budgeting is a defined part of the public budget.
2. Civic participation has a direct impact on budget creation.
3. Protecting the interests of the community by applying a deliberative element.
4. Long-term repetition of the process.
5. An institutional framework is established to ensure the control function of the management of public finances.
6. Process settings with redistribution elements are present.
7. Citizens do co-decide on the rules of the process [3].

2.1 Application practice of participatory budgeting in local self-government of Slovakia before the pandemic COVID-19

Territorial self-government in Slovakia consists of regional level (8 regions) and local level (2 890 municipalities). Local self-government is represented by municipalities and towns (municipalities with the status of a town). There are currently 141 towns in Slovakia. The actual number of municipalities in Slovakia is 2 890, which is the number of municipalities without city districts of Bratislava and Košice, including Bratislava and Košice as a whole. Number of municipalities and city districts in Slovakia is 2 927 (Bratislava has 17 city districts and Košice has 22 city districts). Figure 1 shows the number of municipalities in Slovakia by size (2 752 municipalities have less than 5 000 inhabitants).

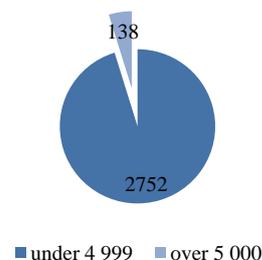


Figure 1: Number of municipalities in Slovakia

Source: Self-elaboration (according to official website of the Statistical Office of the Slovak Republic) [4]

However, there are 2 929 local units with their own budgets in Slovakia (local units with the real opportunity to implement a participatory budgeting in practice). This number includes all municipalities, the capital city - Bratislava, Košice and their city districts.

The use of participatory budgeting in the practice of local government is monitored, evaluated, and supported by the Ministry of the Interior of the Slovak Republic. The Ministry of the Interior of the Slovak Republic has published a list of active participatory budgets in the conditions of the territorial self-government of Slovakia.

Table 1 Current use of participatory budgeting in the conditions of local self-government of Slovakia

Implementation since	Participatory budgeting in local self-government
Since 2014	Bratislava-Nové Mesto, Banská Bystrica
Since 2015	Šaľa
Since 2016	Trnava, Liptovský Mikuláš, Piešťany, Partizánske, Poltár
Since 2017	Nové Mesto nad Váhom, Prievidza, Spišská Belá, Topoľčany, Bratislava-Rusovce, Bratislava-Vajnory, Bratislava-Vrakuňa, Kežmarok, Rožňava
Since 2018	Hlohovec, Nitra, Žabokreky, Poniky, Sološnica
Since 2019	Svidník, Trebišov
Since 2020	Bánovce nad Bebravou, Hnúšťa, Hruštín , Humenné, Jelšava , Levice, Martin, Nová Baňa, Púchov, Rimavská Sobota, Rovinka, Snina, Stará Turá

Source: Ministry of the Interior of the Slovak Republic 2020 [5]

Table 1 shows active participatory budgeting in the conditions of local self-government. Participatory budgeting was first used in 2011 by the city of Bratislava. Since then, it has been applied by more than 65 local self-governments.

2.2 Participatory budgeting in small municipalities of Slovakia during the COVID-19 pandemic

The first positive case of COVID-19 was confirmed in Slovakia at the beginning of 2020 (it was confirmed on March 6, 2020). Then the pandemic came in consecutive epidemic waves. Local government (as well as other public or private sector entities) has been confronted with high uncertainty due to the crisis, increasing costs, reducing revenues, and difficult policy decisions. The pandemic had and still has various impacts on the local self-government. It also affected the implementation and realization of participatory budgeting in the conditions of municipalities or towns.

However, because of the COVID-19 pandemic, many participatory budgets have been canceled, its implementation was changed or stopped until the situation will be stabilized. Some participatory budgets were implemented in 2020 (Examples is Snina). Despite the pandemic, some municipalities continue to apply participatory budgeting without change (the town of Hlohovec, etc.).

The aim of the paper is to clarify the changes in the use of participatory budgeting in the conditions of small municipalities in Slovakia. The starting point for the analysis is the data given in Table no. 1, which summarizes the active participatory budgets registered by the Ministry of the Interior of the Slovak Republic in 2020 (the year of the beginning of the Covid-19 pandemic in Slovakia). The object of research are 5 municipalities (out of 37 municipalities, cities, or city districts of the capital Bratislava) with the smallest population. The five the smallest municipalities include: Jelšava (participatory

budgeting from 2020), Hruštín (participatory budgeting from 2020), Sološnica (participatory budgeting from 2018), Poniky (participatory budgeting from 2018), and Žabokreky (participatory budgeting from 2018). Municipalities are ranked according to the number of inhabitants. The current state of use of participatory budgeting is summarized in Table 2 and Table 3. The years 2018, 2019, 2020, 2021 and 2022 were examined (i.e., 2 years before the pandemic, 2 pandemic years and one focused on the future).

Table 2 Participatory budgeting in the conditions of small municipalities of Slovakia

City / Municipality	Year of implementation of PB	Date of approval of the official document	The name of the official document
Jelšava	2020	Nov 8, 2019	Statute of the Participatory Budget of the City of Jelšava for the Year 2020
Hruštín	2020	Nov 29, 2019	Principles of Participatory Budget of the Municipality of Hruštín
Sološnica	2018	Call for projects published annually	Call for Small Civic Projects for the Year XX
Poniky	2018	March 16, 2018	Principles of Participatory Budget of the Municipality of Poniky
Žabokreky	2018	Jan 22, 2018	Rules of the Community Participatory Budget of the Municipality of Žabokreky

Source: Self-elaboration (according to official websites and documents of the municipalities) [7-18]

Table 3 Funding of participatory budgeting in the five smallest cities in Slovakia

City / Municipality	Region	Inhabitants of the city/ municipality (2020)	Year	Approved / Allocated funds
Jelšava	Banská Bystrica Region	3 312	2018	-
			2019	-
			2020	20 000 = 0
			2021	X
			2022	X
Hruštín	Žilina Region	3 133	2018	-
			2019	-
			2020	15 000
			2021	9 000
			2022	project call not yet published
Sološnica	Bratislava Region	1 643	2018	500/ 1 P
			2019	500/ 1P
			2020	500/1P
			2021	500/ 1P
			2022	Call 500/ 1P

Poniky	Banská Bystrica Region	1 573	2018	9 000
			2019	X
			2020	X
			2021	X
			2022	X
Žabokreky	Žilina Region	1 218	2018	X
			2019	X
			2020	X
			2021	X
			2022	X

Source: Self-elaboration (according to official websites and documents of the municipalities) [7-18]

According to Table 2, the municipalities have approved an official document for the area of participatory budgeting (these documents take the form of statutes, rules, or principles). An exception is the municipality of Sološnica, which annually publishes a call for small civic projects.

Table 3 shows that the municipalities of Hruštín and Sološnica have the only active participatory budgeting among the 5 smallest municipalities. The municipality of Hruštín (for the pandemic) has reduced the amount of allocated funds and the municipality of Sološnica provides a constant amount of funds (It is 500 euros per project). The municipality of Žabokreky approved an official document for participatory budgeting, but never implemented it. The municipality of Poniky realized the participatory budgeting at the beginning but stopped it due to lack of funds. The city of Jelšava wanted to implement participatory budgeting in 2020 but ended it due to a pandemic. Table 3 confirmed that the municipalities dealt with the pandemic differently in the context of participatory budgeting.

3. Discussion

The aim of the paper is to evaluate the impact of the COVID-19 pandemic on the use of participatory budgeting in the conditions of selected small municipalities in Slovakia. There have been various impacts. Some local unites continue to apply participatory budgeting, while others have stopped participatory budgeting.

It is possible to summarize several conclusions from the application practice of local government.

Characteristics of participatory budgeting in the pre-pandemic period:

- Gradual implementation of this method among local unites (local self-government).
- Problems with the lack of financial resources of small municipalities.
- Small amount of allocated funds.
- Problems with the lack of interest of the population (possibility to use smart solutions).
- Incorrect realization of the participatory budgeting in the form of a grant scheme.
- Weak promotion of participatory budgeting among the population (possibility to use smart solutions).
- Lack of presentation of participatory budgeting outputs (possibility to use smart solutions).

The effects of the COVID-19 pandemic on participatory budgeting in small municipalities are as follows:

- Complicated participation of citizens in some steps of the participatory budgeting process due to the existence of national / regional restrictions (restriction of movement, restriction of group meetings, etc.).
- High costs of removing the effects of the pandemic (limited financial resources).
- Loss of interest in participatory budgeting due to existential problems of municipalities and its inhabitants.
- Lack of technical support for the participatory budgeting process (online platform, etc.) - smart solutions.

4. Conclusions

Participatory budgeting in the conditions of local self-government of Slovakia is only at the beginning of its implementation. In 2021, it was 10 years since the first use in the capital Bratislava. The COVID-19 pandemic in 2020 has affected local self-government (whole public administration) and lives of citizens. It impacted the economic side of life, it changed behavior, practices, and daily processes. The COVID-19 pandemic affected the participatory budgeting of the local government in Slovakia, too. The municipalities dealt with the pandemic differently. Some local unites continue to apply participatory budgeting, while others have stopped participatory budgeting. The future use of participatory budgeting in local government conditions depends on several aspects. It depends on the amount of financial income, technical or smart equipment of local government (political and smart support), the willingness of local management and the interest of the inhabitants.

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References

- [1] Maja Klun and Jože Benčina, *Slovak Journal of Political Sciences*, Vol. 21, No. 2, pp. 186-208, 2021
- [2] Llegretti Giovanni and Copello Kalinca, *Winding around money issues. What's new in PB and which windows of opportunity are being opened?* In: Dias, N. ed. *Hope for democracy: 30 years of participatory budgeting worldwide*. Faro: Epopeia Records, 2018, pp. 34-53.
- [3] Dias Nelson, *Hope for democracy: 30 Years of Participatory Budgeting Worldwide*, Faro, Epopeia Records, 2018, 638 pp.
- [4] http://statdat.statistics.sk/cognosext/cgi-bin/cognos.cgi?b_action=cognosViewer&ui.action=run&ui.object=storeID%28%22i0C852CAA5451437C92774DB33EC08675%22%29&ui.name=Ve%C4%BEkoston%C3%A9%20skupiny%20obc%C3%AD%20-

%20SR%2C%20oblasti%2C%20kraje%2C%20okresy%2C%20mesto%2C%20vidiek%20%5Bom7023rr%5D&run.outputFormat=&run.prompt=true&cv.header=false&ui.backURL=%2Fcognosext%2Fcps4%2Fportlets%2Fcommon%2Fclose.html&run.outputLocale=sk

[5] https://www.minv.sk/swift_data/source/rozvoj_obcianskej_spolocnosti/participacia/2020/otvorene_temy/Zoznam%20%20samospstav%20PR_2020.pdf

[6] <https://bratislava.sk/sk/rozpocet>

[7] https://uradnatabula.jelsava.sk/download_file_f.php?id=1240802

[8] <https://uradnatabula.jelsava.sk/rozpocet-a-financie.phtml?id5=24728>

[9] <https://uradnatabula.jelsava.sk/participativny-rozpocet.phtml?id3=156784>

[10] <https://uradnatabula.jelsava.sk/zaverecny-ucet-mesta.phtml?id3=112232>

[11] <https://uradnatabula.jelsava.sk/vyrocnna-sprava-mesta.phtml?id3=112233>

[12] https://www.hrustin.sk/files/2021-06-01-152410-Z_sady_participat__vneho_rozpo__tu_Obce_Hru__t__n_pr__lohy.pdf

[13] https://www.hrustin.sk/files/2020-03-10-074948-Hrustin_03_2020.pdf

[14] https://www.hrustin.sk/files/2021-07-12-091447-Hrustin_07_2021_internet.pdf

[15] https://www.solosnica.sk/evt_file.php?file=1898&original=v%C3%BDzva.pdf

[16] https://www.solosnica.sk/e_download.php?file=data/uredni_deska/obsah555_1.pdf&original=MOP-2020.pdf

[17] https://www.poniky.sk/modules/file_storage/download.php?file=af5809fd%7C169

[18] https://www.zabokreky.sk/download_file_f.php?id=917826

THE AUTOMATION OF WORK—CURSED OR BLESSED

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Abstract: Automation, driven by technical progress, artificial intelligence or big data technologies, has recently found its way into public discourse. The opinions regarding the overall economic effects, especially on the question of the work of the future, are of different nature. On the one hand, the end of work, as it is currently prevalent, is proclaimed, and on the other hand, the ongoing technological changes are welcomed with high productivity growth, which would result in strong increases in overall economic welfare. The second scenario would therefore do without mass unemployment. This article outlines an analysis of some of the determinants that serve as the basis of the working and meritocratic society. Empirical data are discussed with reference to the current economic literature and economic policy options are derived.

Keywords: Digitization, automation, productivity, working hours, gainful employment

1. Introduction

Big data, digitization and artificial intelligence (AI) will fundamentally change society and the understanding of work. Intelligent machines in the 'smart' factories, it seems, will free employees from monotonous, repetitive work and cause social upheavals comparable to the first and second industrial revolutions in scale of their redesign.

On the other hand, these upheavals will also have an impact on income, the concept of work as such, the concept of performance and finally on the entire social value system. In particular, the world of work with regard to the wage labor of a performance society should change drastically in the course of increasing automation. In 1930, the British economist John Maynard Keynes predicted that thanks to technological progress, more and more people would be replaced by machines. By 2030, according to him, the weekly working time will fall to 15 hours a week, so that three hours of work per day is enough. [1] Not only did Keynes see the possibilities of technologization as a blessing rather than a curse, Karl Marx also postulated that “[...] the worker who is freed from the obligation to work [can use [his time] for work that is not directly productive]. Thus, everyone's 'disposable time' could increase. [2] Marx considers the developed productive power to be the real wealth of a society. The freely available time of the working people is thus the indicator of wealth, not the working time. Ergo: the more free time a society has at its disposal, the more prosperous it is. Marx's son-in-law, Paul Lafarquet, also called for a 21-hour week in his small work 'The Right to Freedom' as early as 1891. [3] The vision of freeing mankind from monotonous and alienated work through technical progress seems within reach thanks to intelligent technical possibilities such as artificial intelligence and platforms that enable collaborative work. Increasing industrialization and automation transformed most Western cultures within a few decades from a needs-fulfilment society into a needs-creation society.

According to Oscar Wilde, technical progress is “[...] the only true liberation of man.” [4] From his point of view, the

aim of a society must be to create living conditions where free development, the actual meaning, is the focus instead of gainful employment. Technological advances could help here.

2. Working time vs. non-working time

Most societies of the late 20th and 21st centuries in Europe, despite high productivity, find themselves in a contradiction between abundance and a lack of educational opportunities, poverty, unemployment or social inequality. Despite steady growth and the increase in material wealth, the distribution of wealth is extremely unequal in favor of the wealthiest households worldwide. The world's richest 10% own about 85% of global wealth, and the top 10% own over 45% of world wealth, and growing. [5] According to the Harvard economist John Kenneth Galbraith, these differences are due to the fact that economists and politicians pursued a maxim of maximization – the way of thinking that was dominant in the 19th and 20th centuries. [6] This analysis by Galbraith seems to have lost little of its relevance today. On the one hand, limitless growth should guarantee the necessary prosperity and social peace in society with the help of cheap consumer goods, and on the other hand, technical progress should “on the side” meet the challenges of the 21st century, such as climate change and social inequality. Even against the background of the current war in Ukraine, according to the head of the Austrian Economic Research Institute (WiFo) Felbermayr, 'purchase reluctance' would be disadvantageous. [7] Fears of slowing growth as a result of falling demand seem to overshadow everything else. Keynes already recognized that the growth in prosperity and the satisfaction of needs do not go hand in hand and do not necessarily develop in parallel.

The reductions in working hours prophesied by economists such as Keynes, Heilbroner or the German futurologist Herman Kahn almost did not materialize. Despite the enormous increase in production and prosperity, the weekly working hours hardly decreased. The following figure, based on Germany, illustrates this: [8]

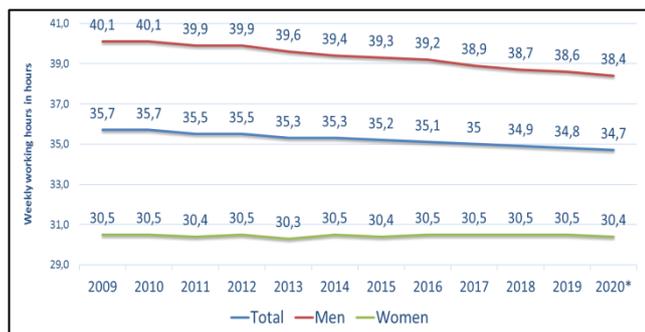


Figure 1 - Average weekly working time in Germany by gender until 2020 (Own presentation, 2022)

Despite the fact that the economy of scarcity should have been overcome long ago in purely quantitative terms and compensating for scarce resources through longer working hours would be obsolete, looking back at the last 10 years and beyond, the basic working hours have hardly reduced. Across Europe, the weekly working hours remain almost at the same level. The average working hours of full-time employees fell minimally between 2011 and 2019 from 41.6 hours to 41.1 hours and in 2022 to 40.7 hours. The average working hours of part-time employees, on the other hand, rose from 19.9 hours to 20.6 hours in the same period.[9]

3. The affluent society

One explanation for the minimal reduction in weekly working hours with full employment could be that the unfulfilled material needs of consumers in western industrialized countries are not decreasing. It is suggested that western society in the early 21st century does not live in a real scarcity, but at least in a culturally based scarcity. [10] A demand-creation society as justification for more growth and increases in productivity.

Those attributes, which in turn represent the prerequisite for the creation of jobs. What's more: the purchasing power of consumers must always be secured, because consumption is considered a prerequisite for growth.

Based on income and family members, an average household in Europe currently owns around 10,000 properties. [11] Against this background, the question arises as to whether this abundance of consumer products, which include household appliances, entertainment media, toys, furniture or hygiene items, would necessarily have to be expanded more and more in order to be able to apparently lead a happier life.

According to anthropology professor Anthony Graesch, the opposite is true. His study comes to the conclusion that almost all households complain about the abundance. [12] The thesis found to date in standard economics teaching literature, that human needs are limitless and infinite, can therefore at least be declared an exaggeration, if not an understatement. If human needs and the human urge to trade postulated by Adam Smith [13] were previously

seen as the motor for a constantly growing society, they are rather the catalyst of a certain systemic compulsion. This is apparently responsible for the fact that an incessant substitution of objects in the household that are mostly still functional is supposed to serve as the drive for a permanently growing economy. As a result, the amount of work can also grow with the steady increase in productivity. In addition, a possible explanation for the fact that the working time (measured in hours) has hardly changed in contrast to the enormous technical progress has been found through an uninterrupted creation of demand.

Another thesis that the demand for gainful employment increases with production progress and prosperity can also be refuted. The following figure shows the development of the gross domestic product (GDP) of Germany, Italy, Great Britain and the USA from 1920-1992. [14]

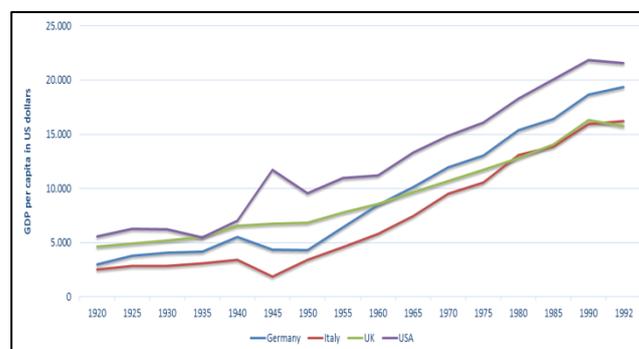


Figure 2 - GDP per capita in selected countries worldwide 1920-1992 (Own presentation, 2022)

According to this, GDP per capita in Germany increased almost fivefold after the end of the Second World War by 1990 and is today, adjusted for inflation, twenty times higher than in the 19th century (2000 USD in 1870 and around 43,000 euros in 2021). [15] The demand for workers in the period mentioned was not nearly as high or grew to this extent.

The expectation that generally strong increases in productivity will be generated by automation is often inextricably linked to the feared negative effects on employment, but on the other hand to positive productivity growth rates. The empirical evidence shows an opposite trend. Compared to the growth rates at the turn of the millennium, the growth rates decreased significantly. [16] It is verifiable that the change in productivity per employed person has hardly changed in recent years. The calculation is carried out by converting the GDP to each individual employed person. Labor productivity growth has been declining in almost all industrialized countries for around 50 years.

In Germany, the average growth between 2006 and 2016 was only 0.7% per year. 10 years earlier it was 1.7% p.a. [17] Indirectly, this development seems to confirm the thesis that work is becoming more and more profitable, but that there is hardly any growth. All in all, this means that either the utilization of human labor is falling or more

people are doing the same amount of work, but are hardly influencing the growth rate of labor productivity.

The following figure shows the GDP index on the one hand and the labor productivity index per employed person on the other in Germany from 2000 to 2021 (index year 2015=100).[18]

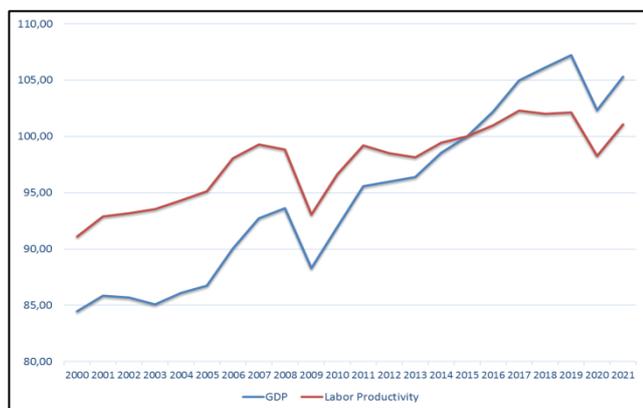


Figure 3 - Index of GDP and labor productivity per person employed in Germany (Own presentation, 2022)

It is becoming clear that the growth rates of labor productivity compared to GDP are clearly weakening and since 2015 there has been a clearly declining growth dynamic. The result is an ever widening production-productivity gap, which has been evident for many decades. [19] The resulting difference also implies a change in the volume of the input factor work. Figure 3 with the harmonized data for 2015 clearly shows that this trend is intensifying.

From this it can be concluded that automation through increasing technical progress, the use of big data technologies and artificial intelligence leads to increases in productivity and this in turn leads to job losses.

As shown, the increases in productivity are attributable to the 'intelligent machines' and not to human work performance. The result will be a substitution of human labor, especially in jobs that are characterized by repeatable processes that can be mapped by algorithms. An example of this could be any position in the service sector of banking, including service employees in the front office.

The scenario developed by the economists Carl B. Frey and Michael A. Osborne describes a picture in which around 47% of employees who are employed in the USA will most likely be replaced by automation within the next 10 to 20 years. tion could be substituted. [20] According to MIT professors Acemoglu and Restrepo, the following possible explanation suggests itself: "A single-minded focus on automating more and more tasks [leads] to lower productivity and wage growth and a declining share of labor in value creation." [21]

4. inspiration for possible solutions

This article outlines an analysis of some of the determinants that serve as the basis of the working and achieve-

ment-oriented society. Empirical data are discussed with reference to the current economic literature and economic policy options are derived.

Automation, or the consequences of the digital revolution, have the potential to completely change the world of work. The current trend indicates that the substitution of labor by automation capital will accelerate and lead to a fall in the wage share. Accordingly, it cannot be assumed that, in the sense of David Ricardo's theory of compensation, new jobs will be created as a result of increased production. [22] Substituted jobs will probably not be compensated by more efficient production, as Ricardo originally published as a theory. From his point of view, more efficient production leads to higher quantities, which means that economies of scale are generated, which means that production can be made more cost-effective and products can be offered at lower prices. This means that these mass-produced products are affordable for more buyers, the range of products on offer from producers is increasing and the need for more jobs is increasing at the same time.

However, Ricardo's compensation model is not to be understood as a fixed law of nature. The logic of technical progress, which makes products cheaper, generates mass demand and thus justifies more production, must be offset by increased purchasing power. An example of this is the sales crisis in France in 1818/1819, in which the market failed to meet this need. The English cloth goods of his time - despite higher purchasing power - could not be brought to the buyer. Reasons that could be explained in theory with market mechanisms do not exist. [23] With a view to the present and future, it can therefore be assumed that future income will not have to be secured through gainful employment but through politics.

In this context, it also makes sense to check the requirements for an unconditional basic income (BGE), which is available as an alternative to income. In the course of the digital transformation and the resulting decline in wage labor, a society needs the certainty that the existential basis of life is and will remain secure. In addition to ethics geared towards the common good, the UBI could contribute as a further building block to political, economic and social stabilization. The future of the company's work is uncertain and so is the income. Consequently, the decoupling of today's work system from state financing must be a mandatory item on the political agenda in order to enable income beyond wage and gainful employment.

In addition, in this context, the recommendation should be made to increase investments in education and to adjust the budget provided for this accordingly. It would make sense to invest in the ability to create one's own meaning and in the training of those areas of activity that will be difficult to automate in the foreseeable future, not least because it would be desirable to maintain these professional fields and give them appropriate social appreciation. This currently applies, for example, to professional groups in the natural sciences, high technology and other areas of

activity that require interpersonal communication (nursing professions, teachers, childcare, etc.).

Overall, it can be stated that the measures in the economic policy sense by no means claim to be complete. In the context of the forthcoming upheavals, a redesign of many sub-areas of the welfare state is necessary, the old-age provision and pension system being explicitly mentioned here.

References

- [1] Keynes, J. M.: Economic possibilities for our grandchildren: Essays in persuasion 2010.
- [2] Marx, K.: Das Manifest 2012.
- [3] Lafargue, P.: Das Recht auf Faulheit 2014.
- [4] Frank Gillert, Mike Lange, Jens Wollenweber, Andreas Preis, Katja Wenger, Bertram Meimbresse, Mareike Rammelt, Jan Seitz, Steffi Kowalski, Anne Schmidt: Logistikstudium in Corona-Zeiten. Die TH Wildau – eine Hochschule geht in den Lockdown ... und wächst mit den Herausforderungen über sich hinaus. In: DVZ Deutsche Verkehrs-Zeitung (2020) MKAR2, S. 6.
- [5] World Inequality Report 2022: The World #InequalityReport 2022 presents the most up-to-date & complete data on inequality worldwide. URL: <https://wir2022.wid.world/download/>. Abrufdatum 06.04.2022.
- [6] Galbraith, J. K.: Gesellschaft im Überfluss, Vollst. Ausg. München, Zürich 1963.
- [7] Schumi, M.: Der Krieg zerstört den Wohlstand. In: Kronen Zeitung 2022 (2022) 22.235.
- [8] Eurostat: Eurostat - Data Explorer. Durchschnittliche normalerweise geleistete Wochenarbeitsstunden in Haupttätigkeit, nach Geschlecht, Alter, Stellung im Beruf, Vollzeit-/Teilzeittätigkeit und Wirtschaftszweigen (ab 2008, NACE Rev. 2). URL: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=lfsa_ewhun2&lang=de. Abrufdatum 06.04.2022.
- [9] Eurostat: LFS series - detailed annual survey results (lfsa). URL: https://ec.europa.eu/eurostat/cache/metadata/en/lfsa_esms.htm. Abrufdatum 07.04.2022.
- [10] Siegenthaler, H.: Arbeitsmarkt zwischen Gleichgewicht und Ungleichgewicht im Zeitalter modernen Wirtschaftswachstums. In: Kocka, Jürgen/Offe, Claus (Hg.): Geschichte und Zukunft der Arbeit. Frankfurt am Main, New York (2000), S. 88–109.
- [11] DIE MINIMALEN DADDIES: 17 überraschende Statistiken über wie viele Dinge wir besitzen. URL: <https://minimalen.net/17-statistiken-wie-viele-dinge-wir-besitzen/>. Abrufdatum 07.04.2022.
- [12] Schweizer Radio und Fernsehen (SRF): Mensch - Unser Leben platzt aus allen Nähten. URL: <https://www.srf.ch/wissen/mensch/unser-leben-platzt-aus-allen-naechten>. Abrufdatum 07.04.2022.
- [13] Smith, A.: Der Wohlstand der Nationen. E. Unters. seiner Natur u. seiner Ursachen, Vollst. Ausg. nach d. 5. Aufl., London 1789, für d. Taschenbuch-Ausg. rev. Fassung, 2. Aufl., 11. - 12. Tsd. München 1982.
- [14] Universität Münster: Reales Bruttoinlandsprodukt pro Kopf in Deutschland, Italien, Großbritannien und den USA in den Jahren 1870 bis 1992. URL: <https://www.wiwi.uni-muenster.de/wisoge/md/studium/histdatenbank/dat57.xls>. Abrufdatum 07.04.2022.
- [15] Federal Statistical Office: National accounts, domestic product. URL: https://www.destatis.de/EN/Themes/Economy/National-Accounts-Domestic-Product/_node.html?sessionId=C498C5420AC1309FFD0ACA14E5C97C19.live722. Abrufdatum 07.04.2022.
- [16] Brynjolfsson, E.: Artificial Intelligence and the Modern Productivity Paradox. A Clash of Expectations and Statistics. S.I. 2017.
- [17] Neuhaus, C.: Rätsel der Produktivität: Die Wirtschaft wächst - wird aber kaum effizienter - Wirtschaft - Tagespiegel. URL: <https://www.tagesspiegel.de/wirtschaft/raetsel-der-produktivitaet-die-wirtschaft-waechst-wird-aber-kaum-effizienter/19736838.html>. Abrufdatum 07.04.2022.
- [18] Statistische Bundesamt: Statistisches Bundesamt Deutschland - GENESIS-Online: Tabelle abrufen. URL: <https://www-genesis.destatis.de/genesis/online?operation=table&code=81000-0001&bypass=true&levelindex=1&levelid=1649412950561#abreadcrumb>. Abrufdatum 08.04.2022.
- [19] Jäger, K.: Eu klems growth and productivity accounts 2017 release, statistical module1. URL: <http://euklems.net/>.
- [20] Frey, C. B.; Osborne, M. A.: The future of employment: How susceptible are jobs to computerisation? In: Technological Forecasting and Social Change 114 (2013), S. 254–80.
- [21] & Restrepo, P.: Die Revolution muss nicht automatisiert sein by Daron Acemoglu & Pascual Restrepo - Project Syndicate. URL: <https://www.project-syndicate.org/commentary/ai-automation-labor-productivity-by-daron-acemoglu-and-pascual-restrepo-2019-03/german>. Abrufdatum 08.04.2022.
- [22] Ricardo, D.: The principles of political economy and taxation. Mineola, N.Y. 2006.
- [23] Precht, R. D.: Freiheit für alle. Das Ende der Arbeit wie wir sie kannten. München 2022.

LEGAL PROTECTION OF THE SELF-EMPLOYED TO THE EXTENT OF SAFE AND HYGIENIC WORKING CONDITIONS – ASSESSMENT OF POLISH REGULATION

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Abstract: *The following study was prepared as part of a project financed by the National Science Centre in Poland pursuant to the decision number DEC-2018/29/B/HS5/02534 (the project's registration number is: 2018/29/B/HS5/02534). The subject of the foregoing study is the analysis of legal protection of the self-employed persons in the field of safe and hygienic working conditions under Polish labour law. The Polish regulation is in line with the standards of international and EU law, guaranteeing these people a level of protection similar to that of employees. The disadvantage of these solutions is the method of regulation used by referring to the relevant regulations regulating the situation of employees. In practice, this raises a number of interpretation doubts, creating uncertainty in the legal situation of the self-employed in the context of protecting their life and health at the workplace.*

Keywords: *self-employment, sole proprietorship, occupational health and safety, protection of life and health, atypical forms of employment.*

1. Introduction

According to the GUS [Statistics Poland] report on the first quarter of 2020, the number of self-employed people in Poland reached over 1.33 million. At the same time, OECD research conducted in 2019 showed that around 16% of working people in EU countries were self-employed. In Poland, this ratio is slightly lower and amounts to over 14% of all working people. The prevalence of self-employment is determined by the need to reduce the costs of activities carried out by the entity commissioning the work and the need to make the production process more flexible. The spread of self-employment, under which people who engage in gainful activity very often operate in conditions similar to those of employees, necessitated the need to cover these contractors with protection, which until recently was reserved exclusively for those having an employee status. Therefore, both in the Polish legislation and in the regulations of many European countries, we are observing a tendency to extend some employee rights to self-employed people [1]. This trend is to a large extent a consequence of the adaptation of national legal orders to standards resulting from the norms of international and EU law, under which the legislator, when introducing protective regulations, covers all working people, using the term "pracownik" in a broad sense ("workers" or "travailleurs"). In addition, in Poland it is also associated with the need to adapt labour legislation to constitutional requirements, which broadly define protective guarantees [2]. *De lege lata* under Polish law, the self-employed already benefit from legal protection in the field of life and health, non-discrimination and equal treatment in employment; guaranteed minimum wage and protection of wages for work; motherhood and parenthood; and the right to associate in trade unions, which consequently gives them broad collective rights.

The subject of the foregoing study is the analysis of legal protection of the self-employed to the extent of safe and hygienic working conditions. In Poland, it was introduced into the Act of 26 June 1974 – Labour Code (consolidated text Journal of Laws of 2020, item 1320, as amended, hereinafter: KP) in July 2007 and it was the first area in which the Polish legislator saw the need to include the self-employed [3]. Even though such direction of regulation needs to be positively assessed, it should be noted that no separate regulations which would take into account the specificity of work provided by self-employed people running a sole proprietorship have been made, and Polish Labour Code extended the provisions regulating the protection of life and health of employees to cover this category of workers. Such a solution raises a number of interpretation doubts both in the doctrine of labour law and in practice [4]. Analysing the title issue, for the purposes of the study, I assume that the self-employed are natural persons who personally, under their own responsibility and risk, provide services as entrepreneurs for one or several (many) contracting entities in B2B conditions, without the possibility of hiring employees or using someone else's work on the basis of civil law contracts [5].

2. Legal protection of the self-employed to the extent of safe and hygienic working conditions in the light of international and EU standards

Occupational health and safety is a key aspect of any work performed by a human being, regardless of the legal basis and regime in which it is performed. One of the postulates of the social doctrine of the church, visible even in the encyclical *Laborem exercens* written by John Paul II, is the need to guarantee all working people decent working conditions, including above all the right to work in a safe and healthy environment which would not endanger their lives and health [6]. At the root of the introduction of regulations regarding safe and hygienic working

conditions for the self-employed lies the need to protect the life and health of every human being as a universal and fundamental value. Such protection should cover every human being, especially workers who are exposed to a number of dangerous factors and threats, regardless of the legal form of the provision of work. This is recognised by the legislator at the level of acts of international and EU law, which for the most part provide for a wide personal scope of protection of life and health covering all workers, regardless of the basis of employment, including self-employed persons. The United Nations Universal Declaration of Human Rights of 10 December 1948 in Article 23 guarantees every human being the right to work in safe, decent and favourable conditions. Under Article 3 of that Act, every human being has the right to life, liberty and the security of his person, including in the working environment. In turn, the International Covenant on Economic, Social and Cultural Rights of 19 December 1966 (Journal of Laws of 1977 No. 38, item 169) in Article 7b states that the States Parties to the Covenant recognize the right of every person to enjoy fair and favorable working conditions meeting the requirements of health and safety. Article 12 of that Act guarantees everyone the right to enjoy the highest attainable level of protection of physical and mental health, which relates in particular to the improvement of environmental and industrial hygiene in all respects (paragraph 2(b)), the prevention of occupational diseases (paragraph 2(c)) and the creation of conditions which would provide medical assistance and care to all in the event of illness (paragraph 2(d)). International Labour Organization (ILO) acts also call for the need to ensure safe and hygienic working conditions not only for those having an employee status, but also for civil law contractors, including the self-employed [7]. This can be seen not only in ILO Convention No 155 of 22 June 1981 on Safety, Workers' Health and the Working Environment and its complementary ILO Recommendation No 164 of 22 June 1981 on Safety, Workers' Health and the Working Environment, but also in the ILO Acts regulating the protection of health and life in various sectors and occupations, where the need to cover safe and hygienic working conditions for the self-employed is expressly stated (e.g.: ILO Convention No 62 of 23 June 1937 on Safety Regulations in the Construction Industry; ILO Convention No 167 of 20 June 1988 on Safety and Health in Construction). In turn, the Council of Europe Convention for the Protection of Human Rights and Fundamental Freedoms of 4 November 1950, in Articles 2 and 5, guarantees everyone the right to life and to liberty and security of person, which applies to all spheres of human activity, both personal and professional. Similar regulations can be found in acts of EU law [8]. Particularly noteworthy here is the Charter of Fundamental Rights of the EU of 7 December 2000 (OJ EU. C. of 2007 No. 303, as amended), which in Article 6 indicates that everyone has the right to freedom and personal security, also in the field of professional activity. In turn, Article 31 of the Charter guarantees every worker, regardless of the basis of employment, the right to working conditions that respect

his health, safety and dignity. Article 35 of that act grants, also to self-employed persons, access to preventive health care and the right to receive treatment in order to achieve the desired high level of human health protection. The acts of secondary legislation of the European Union also indicate the need to ensure safe and hygienic working conditions for the self-employed who work at the registered office or other place designated by the contracting entity [9]. This applies both to Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work (OJ EU. L. of 1989 No. 183, as amended), as well as sectoral directives, in particular Council Directive 92/57/EEC of 24 June 1992 on the implementation of minimum safety and health requirements at temporary or mobile construction sites (OJ EU. L. of 1992 No. 245, as amended), which postulates the protection of life and health of self-employed people personally involved in working at the construction sites. This issue is also addressed by the European Pillar of Social Rights of 17 November 2017, which states in Chapter II, entitled *Fair Working Conditions*, that persons performing work should be guaranteed the right to a high level of protection of health and safety at work (Article 10(a)). Point b, on the other hand, states that such people performing work (including the self-employed) have the right to a working environment adapted to their professional needs, allowing them to extend the period of their participation in the labour market.

3. Legal protection of the self-employed to the extent of safe and hygienic working conditions in the light of the standards of the Polish Constitution

Constitution of the Republic of Poland of 2 April 1997 (Journal of Laws No. 78, item 483, as amended) *expressis verbis* grants every person a universal and independent right to safe and hygienic working conditions regardless of the legal regime in which this work is performed [10]. Under Article 66(1) of that Act, everyone has the right to safe and healthy working conditions, which means that that guarantee also applies to the self-employed. This provision should be interpreted as their freedom from working in unsafe and unhealthful conditions, which covers all sectors of the economy and places where work is carried out [11]. However, this regulation cannot be directly asserted by the self-employed on the basis of the Constitution of the Republic of Poland, since this provision refers in this respect to ordinary legislation. The legislator indicates that the manner of exercising this right and the obligations of the entity commissioning the work are determined by ordinary laws. Such a solution allows for a certain rationing of the constitutional right to safe and hygienic working conditions in the direction of its limitation for specific contractors, which, however, may not violate the essence of this right. This results from Article 31(3) of the Constitution of the Republic of Poland, which additionally indicates that restrictions on the exercise of constitutional freedoms and rights may be established only if they are necessary in a democratic state for its security or public order, or for the protection of the

environment, public health and morals, or the freedoms and rights of others. Therefore, it is permissible under Polish law to differentiate the right to safe and hygienic working conditions, but it cannot lead to discrimination in employment. According to Article 32 of the Constitution of the Republic of Poland, everyone is equal before the law and has the right to equal treatment by public authorities, also in terms of protecting their life and health in employment. No one shall be discriminated against in social or economic life for any reason. An additional strengthening of the constitutional guarantees of safe and hygienic working conditions for the self-employed is Article 24 of the Polish Constitution, according to which every job is under the protection of the Republic of Poland, and the state supervises the conditions of work [12]. Therefore, this provision also applies to the working conditions of self-employed persons [13], including the protection of their health and life, which is undoubtedly under the supervision of state authorities, in particular the National Labour Inspectorate. Article 24 of the Constitution of the Republic of Poland provides for the obligations of the state in the area of creating and enforcing regulations protecting the life and health of people performing any work, regardless of the regime in which it is performed, also in relation to the self-employed. Their protection in the field of safe and hygienic working conditions is also based on Article 38 of the Polish Constitution, which guarantees every person the legal protection of life, and on Article 68 of the Polish Constitution, which guarantees every person the right to health protection. According to the Constitutional Tribunal, the subject of Article 68(1) of the Constitution of the Republic of Poland is not abstract health, but the right of every person to use a system that prevents all diseases and disabilities, and therefore also those that arise in the process of providing paid work (Judgment of the Constitutional Tribunal of 23 March 1999, K 2/98, OTK 1999, No. 3, item 38).

4. Legal protection of the self-employed to the extent of safe and hygienic working conditions in the light of Polish legislation

The constitutional guarantee of the right to safe and hygienic working conditions for persons performing work outside the employment relationship (also for the self-employed) has been clarified by statutory provisions, primarily in the Labour Code [14]. Pursuant to Article 304 § 1 of the Labour Code, the employer is obliged to ensure safe and hygienic working conditions for any self-employed persons rendering their services in the workplace or in a place designated by the employer on a self-employed basis. This obligation also applies to entrepreneurs who do not have the status of employers, if they organize the work of the self-employed (Article 304 § 3 of the Labour Code). These provisions refer to Article 207 § 2 of the Labour Code, where the legislator defined a catalogue of basic obligations of the employer in the field of protection of health and life of employees. This means that entities outsourcing work to the self-employed, in so far as they organise their work, which is carried out in the workplace belonging to these entities or in another place designated by them, must provide the self-employed with the same standard of protection in terms of safe and

healthy working conditions as for workers employed on the basis of an employment relationship. Therefore, they are obliged to comply with all labour law regulations that serve to protect the life and health of employees. They must guarantee the self-employed a high level of occupational health and safety at the workplace, eliminate conditions harmful and burdensome to their health, shape a proper working environment free from threats to the life and health of the self-employed, prevent accidents at work and occupational diseases, provide them with preventive health examinations and access to compliance training related to regulations regarding the health and safety at work. Importantly, Article 304¹ of the Labour Code imposed on self-employed persons, performing their work in a workplace or in a place designated by the employer or other entity organizing work, obligations, to the extent specified by such employer or other entity, incumbent on employees as to compliance with the regulations and principles of occupational health and safety. This means that the self-employed must in particular: know the rules and principles of health and safety at work; take part in training and instruction in this field; undergo the required examinations; take care of the proper condition of machinery, devices, tools and equipment, maintain the safety and cleanliness of the workplace; use collective and individual protection products in accordance with their intended purpose; as well as undergo initial, periodic and control and other recommended medical examinations and comply with medical indications and cooperate with the entity commissioning the work in fulfilling the obligations regarding health and safety. Pursuant to Article 304³ in conjunction with Article 208 § 1 of the Labour Code, self-employed persons working in a workplace belonging to the contracting entity or in another place designated by it are obliged to cooperate with each other in order to ensure an adequate level of occupational health and safety. While in relation to employees the Polish legislator clearly indicated in Article 207 § 21 of the Labour Code that the costs of actions taken by the employer in the field of occupational health and safety may not be charged to them in any way, there are no legal obstacles to passing on these costs in relation to the self-employed, even in a civil law contract, to persons running a sole proprietorship.

Protective guarantees for the self-employed in the field of safe and hygienic working conditions are also found in other acts of Polish labour law. The Act of 27 June 1997 on occupational medicine service (consolidated text Journal of Laws of 2022, item 437) in Article 5(3)(1) provides for the possibility of voluntary inclusion of self-employed persons in occupational medicine services, whereby the application of such a person and consent to finance this care from their own resources are required (Article 23 (1)). In turn, Article 10(2)(1) of the Act of 13 April 2007 on the National Labour Inspectorate (consolidated text, Journal of Laws of 2019, item 1251, as amended) explicitly states that the tasks of this body include supervision and control of ensuring safe and hygienic working conditions for self-employed persons performing work in a place designated by the employer or

entrepreneur, who is not the employer for whom such work is provided. In the event of irregularities regarding compliance with health and safety regulations towards the self-employed, National Labour Inspectorate may order the removal of the identified deficiencies within a specified period, and even decide to cease the operation of the plant in which the infringement occurred. Pursuant to Article 26(3) of the Act of 23 May 1991 on Trade Unions (consolidated text Journal of Laws of 2022, item 854), the scope of activity of the company trade union organization includes monitoring the compliance with the provisions and safety rules in the workplace. Union organisations may also request the contracting entity to carry out occupational safety tests on the self-employed in the event of a threat to their life or health (Article 29). It should also be remembered that the self-employed are subject to protection in Poland regulated in the Act of 30 October 2002 on social insurance for accidents at work and occupational diseases (consolidated text Journal of Laws of 2019, item 1205, as amended), and insurance in this respect is mandatory for them.

5. Conclusions

To conclude, the Polish legal regulation regarding the protection of life and health of the self-employed in the workplace is generally consistent with the standards of international and EU law, guaranteeing these people a level of protection similar to that of those having an employee status. The basic doubts are raised by the way in which this issue is normalized. When regulating the scope of obligations of the contracting entity and the self-employed in the field of occupational health and safety, Polish legislator uses a dubious mechanism of references to the relevant provisions regulating the situation of employees. Such a solution raises many problems of an interpretative nature, creating uncertainty in the legal situation of the self-employed in the context of protecting their life and health in the workplace. This hinders the effective enforcement of health and safety regulations by state control authorities. Critically referring to this method, I believe that the legislator should create a separate regulation in this area (modeled on the provisions regarding employees), which will be adapted to the specific conditions in which these persons perform work for the contracting entity. This would eliminate a number of interpretation doubts that arise on the basis of the applicable health and safety regulations. In the case of self-employed persons who are economically dependent on the entity commissioning the work, the costs of actions taken in the field of occupational health and safety should be passed on to this entity by law. The issue of the liability of the self-employed for breaches of occupational health and safety obligations also needs to be clarified. The rules of employee liability will not apply here.

References:

[1] T. Duraj, *Funkcja ochronna prawa pracy a praca na własny rachunek* [w:] A. Napiórkowska, B. Rutkowska, M. Rylski (red.), *Ochronna funkcja prawa pracy.*

Wyzwania współczesnego rynku pracy, Toruń 2018, pp. 37 and next.

[2] M. Gersdorf, *Między ochroną a efektywnością. Systemowe i terminologiczne aspekty objęcia cywilnoprawnych umów o zatrudnienie ustawodawstwem pracy*, *Praca i Zabezpieczenie Społeczne* 2019, No. 1, pp. 2 and next.

[3] S. Kowalski, *Obowiązek zapewnienia bezpiecznych warunków pracy przedsiębiorcom*, *Służba Pracownicza* 2009, No. 12, pp. 9 and next.

[4] M. Raczkowski, *Bezpieczne i higieniczne warunki pracy w zatrudnieniu cywilnoprawnym*, *Praca i Zabezpieczenie Społeczne* 2019, No. 1, pp. 66 and next.

[5] T. Duraj, *Prawna perspektywa pracy na własny rachunek* [w:] E. Kryńska (red.), *Praca na własny rachunek – determinanty i implikacje*, Warszawa 2007, pp. 21 and next.

[6] T. Wyka, *W poszukiwaniu aksjologii prawa pracy – o roli encykliki „Laborem exercens” Jana Pawła II*, *Monitor Prawa Pracy* 2011, No. 9, pp. 456 and next.

[7] T. Wyka, *Powszechna ochrona pracy* [w:] K.W. Baran (red.), *System Prawa Pracy. Tom IX. Międzynarodowe publiczne prawo pracy. Standardy globalne*, Warszawa 2019, LEX.

[8] D. Makowski, *Bezpieczeństwo i higiena pracy* [w:] K.W. Baran (red.), *System Prawa Pracy. Tom X. Międzynarodowe publiczne prawo pracy. Standardy europejskie*, Warszawa 2020, LEX.

[9] T. Wyka, *Bezpieczeństwo i ochrona zdrowia w zatrudnieniu niepracowniczym typu cywilnoprawnego* [w:] Z. Kubot (red.), *Szczególne formy zatrudnienia*, Wrocław 2000, p. 163.

[10] T. Wyka, *Konstytucyjne prawo każdego do bezpiecznych i higienicznych warunków pracy a zatrudnienie na innej podstawie niż stosunek pracy oraz praca na własny rachunek – uwagi de lege ferenda* [w:] J. Stelina, A. Wypych-Żywicka (red.), *Człowiek, uczonek, obywatel. Księga jubileuszowa poświęcona Profesor Urszuli Jackowiak*, Gdańskie Studia Prawnicze 2007, Tom XVII, pp. 331 and next; K.W. Baran, *Zasada zapewnienia pracownikom bezpiecznych i higienicznych warunków pracy* [w:] K.W. Baran (red.), *Zarys systemu prawa pracy. Tom I: Część ogólna prawa pracy*, Warszawa 2010, p. 654; T. Lewandowski, *Prawo człowieka do bezpiecznych i higienicznych warunków pracy*, *Wiedza Prawnicza* 2009, No. 3, p. 16.

[11] A. Kijowski, J. Jankowiak, *Prawo pracownika do uchylenia się od niebezpieczeństwa*, *Państwo i Prawo* 2006, No. 10, pp. 60 and next.

[12] A. Sobczyk, *Prawo pracy w świetle Konstytucji RP. Tom I. Teoria publicznego i prywatnego indywidualnego prawa pracy*, Warszawa 2013, pp. 51 and next.

[13] B. Banaszak, *Konstytucja Rzeczypospolitej Polskiej. Komentarz*, Warszawa 2009, p. 179.

[14] T. Wyka, *Stosowanie przepisów bhp w niepracowniczym zatrudnieniu* [w:] K. W. Baran (red.), *System Prawa Pracy. Tom VII. Zatrudnienie niepracownicze*, Warszawa 2015, pp. 650 and next.

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BUILDING A COMPETITIVENESS OF THE INDUSTRIAL CLUSTER NEC BASED ON THE ASPECTS OF ITS INNOVATION POTENTIAL IN SLOVAKIA

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Abstract: The report briefly presents a very specific research topic in an area of innovations and operational management of the particular organizational business forms – industrial clusters in conditions present in Slovak Republic and points at the currently processed questions, problems and possible workarounds, analysis and methods, all within a frame of an extensive project that is being solved by the authors. It formulates the basic expectational outcomes for the creation of the technology maps and corroboration of clusters competitiveness in the future.

Keywords: innovation, innovation potential, cluster organization, technology map

1. Introduction

National energy cluster NEC (further as „NEC“) is from a legal aspect a group of interest consisting of the legal entities (influential Slovak business subjects, research institutions and SMEs) and from the aspect of its focus a industrial grouping in an industrial segment, more precisely building industry, energy and ecology. NEC has been acting on the market for more than 10 years and is a leader in innovation and applied research in a given field of operation. It guarantees a multiple innovative and learning projects and cooperates with the central branch departments, specialized agencies, universities and chambers in SR.

Building the competitiveness of NEC from the aspect of its innovation potential in Slovakia is built upon a fulfillment of the specific goals and set upon activities not only from the view of the realized research project “Conception and development of the integrated innovative infrastructure and knowledge base in the European area of cluster organization and NEC”, but also from the Strategic development of a cluster organization [13] and is compatible in the area of the chosen domain RIS 3 SK: Digital Slovakia and creative industry, where it falls under the defined product lines therein: Support of the research, development and product innovation, and simultaneously also under Support of the interbranch innovations, research and development, and product innovation.

The need of a project realization is from its beginning during the whole time of solution design connected to the security assurance and adequate internal capacity management and at the same time widely realized by the research of the topics in the area of strategy, departmental technology maps and cluster activities, innovation diagnostics and particularly accompanied by an extensive learning process, which stabilizes and also develops the numbers, structure, impact and mainly innovative ability of NEC members and supports the international presentation through the planned workshops and conferences. This is the reason of the need and also the

meaning of the project implementation into our lives and bolster up the position of NEC.

The following Table 1 documents the content of the main project activities in their chronologic and logic cohesion and the main project criteria specifications, which are required to be fulfilled for its future application. [12] Nevertheless, all the findings and planned outputs from the project should be applied to the highest degree also for the wide cluster spectrum in SR.

Table 1 Specification of the main activities and research criteria [15]

Logic cohesion and chronology of the activities	Content description
Activity I.: INNOVATION AND CLUSTER ENVIRONMENT RESEARCH	Bearing project activity to secure a key position for the requester in the future and solidify their position between the members, partners and in front of the professional general public.
Activity II.: LEARNING AND INNOVATIVE PROFESIONALIZATION	Connected highly effective activity for the development of membership base, as the intermediate research results and achieved innovations are continuously presented in the project, consulted and defended due to the reason of fulfilling the project goals.
Activity III.: INTERNATIONAL AND DOMESTIC COOPERATION AND NETWORKING	Related activity to acquaint the membership base, partnership organizations and domestic and international public, and improve the international position of the requester in energy and ecology.
1. criteria	Geographic concentration of the cluster members. Increase from the current evaluation scale and achievement of the status where more than 70% of members fulfill the criteria.
2. criteria	Usage of the regional growth potential. Increase from the current scale and achievement of a status where a cluster has satisfying regional coverage from the perspective of a membership or the max potential is already achieved.
3. criteria	Level of management: clear team tasks definition for the management of the cluster/implementation of the operational body/engagement rate of members into the strategic decision-making. Increase from the current scale - Weak in order to achieve the status label – Strong.

4. criteria	Acquirement of a third party financing. Increase from the current scale and achievement of a status here 3 from 4 service intensities are above the cluster's average in the same technology area.
5. criteria	Information, comparison and exchange of the experience between the members. Increase from the current scale and achievement of the status where 3 from 4 intensities are above clusters' averages in the same technology area.

2. Starting points and knowledge from the clusters innovation research

The founder of the innovation theory J.A.Shumpeter once said that (cit.): „Innovation is a practical transfer of ideas into a new products, processes, systems and social relationships”. [1] Then it is important to keep in mind the fact, that innovation is a process (not an action, occasion, or occurrence) and as such must be mainly managed. Factors, which address this process could be influenced, hence the results are influenced too. [3]. Innovation capacity and innovation vitality create in their synergy a relevant innovation potential, which determines the ability of cluster to realize its innovative givenness in order to reach an increase in competitiveness [6] and it is reflected in a concrete environment – innovation dimension that consists of an evaluation dimension (status – good, pleasant, prosperous, or bad, inappropriate, etc.), moreover of power dimension (energy charge of the term – dominant, strong, weak, lackcluster, etc.), ultimately also of an activity dimension (its expression – dynamic or on contrary calm and passive, etc.). [7]

The term cluster was defined by the globally renowned author M. E. Porter as a geographic concentration of intertwined businesses, specialized suppliers, service providers, companies in neighboring industries and institutions (i.e., universities, business associations) in each area (sector), which are competing with each other, but also cooperating together. [2, 14] He changed his own definition later, where he defined cluster as a geographically close group of intertwined businesses and associated institutions, connected with the common elements and joint complementarities.

Clusters became globally major phenomena, because they have a great potential to positively influence the economic growth of the companies, sectors, regions, and even the whole countries. Perhaps the most eminent cluster globally is American Silicon Valley in California, which significantly contributed to the development not only in the region, but also in the growth of USA. Mimicking such achievement is conditioned by a creation of a strong bonds between the respective actors of regional and economic growth.

Up till now the official definition of the term “cluster” doesn't exist in Slovak or even in the Central European area despite the fact, that it is being generally, and same goes for “cluster organization”. The scheme for the support of industrial cluster organizations (scheme of aid de minimis, of which part is also the cluster research) – Scheme DM – 3/2013 – defines the industrial cluster

organization respective industrial cluster as a “grouping of the interested parties of legal entities created by a set of intertwined businesses (entrepreneurial subjects), associated institutions and organizations mainly from the area of education and science (colleges, universities, Slovak Academy of Sciences, scientific and research institutions, etc.) and municipal authorities, whose relations have a potential to solidify and increase their competitiveness in a sector of industrial activities”. Clusters increase the productivity and efficiency of their members and contribute to their development and the development of industry and region of coverage in each socioeconomic area. [5, 11]

In order to focus on the research motif, it is important to know the specification of the term technology clustering map, which is understood by the authors as a sort of systemic organizational scheme of elements and bonds coming off the internal and external impacts, needs and expectations put on the cluster organizations. [5] Technology clustering map represents in a way (so on a basis of prior defined and chosen criteria) a traceability and illustration of a relationship of internal and external supplier and value chain in a cluster organization, whereas some are more important and some just supportive. [10] well designed and created map hence shows a scale of interconnected and supporting industries and activities including a client's portfolio, sharing a common innovational, technical, and organizational background. And so, it is necessary to note that under the term clustering map it is not exactly meant to provide some view of a position nor location of a given cluster organization in a geographical area (i.e., in an area of V4 countries, etc.). [10, 13]

Based on the introduction, even the prediction of authors of this report sees the purpose in the need of research and project in the current technology map creation of industrial cluster NEC as an identification and a demonstration of an important business or supplier-customer and partnership relations between the industries (i.e., building, engineering, energy, environmental, etc.) in the competence field of each cluster members and definition of the potential sources and beneficial deposits, therefore an identification of the key problems and opportunities for the enterprise groups and the rest of the cluster actors.

NEC is currently and systematically engaged with the three bearing activities such as:

1. Research and development of the innovative solutions in energy, ecology and affected industrial areas, and joint enterprise diagnostics and their innovation capacity and level;
2. Learning and workshops and enlightenment of the membership base and professional general public in the field of competence;
3. International cooperation and communication mainly in the circle of V4 countries; mapping and creation of the strategic maps and maps of industrial clustering in

Slovakia;

4. Organization of the internationally recognized conventions and workshops in partnership with SIEA and Ministry of Economy SR; internal service and consulting activity for the members and their partners within the frame of the requester’s organizational structure.

The problems identified on the basis of the actual NEC operational activity could be defined as following: carrying-out of a detailed analysis per the own organization, built upon three factors:

1. In connection to the analysis and development of the main sector of activity - energy and the relevant industry and ecology;
2. Based on the analytical results from the assessment report Benchmarking Report from the ESCA organization and its findings and recommendations;
3. Own detailed audit on innovation cluster management level, from which those problems ensued:
 - the organizational approach and staff management has to be changed to management of projects in connection to the sector development, and additionally the strategy of cooperation has to be changed into an offensive strategy (in accordance to the SWOT analysis results per sector),
 - the membership base and its structure is non-homogeneous and there is no pressure created on its motivation and organizational existence and mutual communication,
 - weaker and non-systematic financing of events, weak solving of communication improvement, internationalization and multinational cooperation on the projects,
 - the systematic diagnostics and early problem resolution and risk elimination its not always being used in practice,
 - there is a fall-back in the strategy and ability to sufficiently develop the knowledge base and support for the members and it is necessary to stabilize the processes and organizational structure of the activities itself. [9, 12]

3. Expected research outcomes of the innovations and cluster environment in Slovakia

In the framework of the I project NEC bearing action the intertwined, bound and realized activities are being carried-out along with the relevant research exercises, mainly:

Activity 1.: Research and draw up of the three standalone compact Reports of the current status of the technology cluster organizations and field competence maps within energy, industrial and environmental branch, which will be solved via the external research and capacity assurance of cluster partners and members during the project length and are crucial for its future and success as they improve their position.

Activity 2.: Interim formulated bearing topic of the research is: “Analysis, research and construction of an integrated expertise base and industrial clusters strategy in the energy and ecology sector, design of technology map examples for years 2020 to 2030” and is composed into three individual project research exercises, which are intertwined by their content and further gradually intersected while being carried-out (due to the synergy assurance from the earned outcomes from the individual exercises for another exercises) and relevant supporting activities such as documented in the Table 2 [12] :

Table 2 Overview of the research exercises and the supporting activities per NEC 12 project [authors]

RESEARCH EXERCISE 1.1.	Creation of a common expertise database and analysis of the energy and environmental area in EU, SR and V4 countries.
RESEARCH EXERCISE 1.2.	Research and projection of the innovation principles, tools and databases for the strategy and cluster competitiveness diagnostics in an industrial sector.
RESEARCH EXERCISE 1.3.	Conception and establishment of a member and partnership base and design of an energy and environmental clustering map.
PUBLISHING AND PRESENTING ACTIVITY	Production of an individual, specialized publications towards the particular research exercises’ evaluation reports and their defense and disclosure in the professional sector circles, also in domestic and international cluster network. Outputs from the research to be continuously introduced during the workshops abroad, that are thematically aimed for the correspondent research exercise along with the attendance of the leading experts per given exercise with the aim to receive a know-how, remarks and suggestions for an appraisal of the given exercise results.
CREATION OF THE INFORMATION DATABASES	Research participants receive the information and consultations regarding the problematics during the competent events and institutions , followed by exchanged of the finished results, information and their propagation with the cluster organizations in EU and V4, based on the actual critical expertise recherche inputs from exercises and marketing inputs findings from the competitive position.
FUNCTIONING OF THE LEARNING PORTAL	During the research a specialized and practically validated internal learning webportal Eco & Energo Study Fronter is already running, where the communication is conducted between the domestic and international partners for an assurance of the opposition and large discussion of retrieval and processing the continuous results from the research exercises.

An external body consisting of the domestic and foreign portfolio members and partners of cluster organizations, analysts, systems auditors and designers of industrial structure management systems is continuously participating in the tasks. In terms of content, the research specifically focuses on the analysis and diagnosis of current developments in energy and ecology and related industrial areas (engineering, construction), research of position, strategy and organization of industrial clusters and formulation of rules involving the clusters in an international cooperation, and networking of knowledge

exchange to support business and partnerships, acquisition of information resources, promotion and publishing abroad and at home, solution of specific innovative applications in the sector for an improvement of value chains in the technology field and knowledge and license transfer of the smart solutions.

In order to clarify the concept of project management, according to the authors of this paper, general terminology must be taken into account and that is – project process management is perceived as a set of activities consisting of planning, organizing, managing and controlling the cluster resources with a relatively short-term goal set up for the implementation of specific goals and objectives. At the same time, it is also about the application of knowledge, skills, tools and techniques to project the activities so, that their requirements are met. Finally, there is also the existence of a specially designed and professionally qualified team of managers for project teams of a specific project per specific customer within the production and cluster projects.

Therefore, it is appropriate in the internal author research to find out, whether the following questions are answered, it is clear that the clusters are ready for a change in management:

1. What profound change is actually needed?
2. What happens if the organization does not change at all ?;
3. What if change management control gets out of hand? Such questions need to be asked before any change attempt and propose a new process management of the cluster, generally based on the knowledge and analysis of the authors' research up to this date, based on theory [10, 12], and applying the ten general principles of successful change management in the process – table 2:

Table 3: Ten valid principles of a successful change management [12, authors]

PRINCIPLE 1	Top management plays a key role in managing change.
PRINCIPLE 2	Developing a vision that must be clearly articulated and understandable to all.
PRINCIPLE 3	Awareness of the need for change (it must be clear to everyone that change is a condition for success, even if everything works).
PRINCIPLE 4	Elaboration of a specific project, which will be used to proceed with the change of the cluster organization.
PRINCIPLE 5	Necessity of continuous education with all employees of the organization.
PRINCIPLE 6	Team approach (changes are not made by individuals, but by project teams).
PRINCIPLE 7	Elaboration of a project of gradual implementation of change.
PRINCIPLE 8	Monitoring, evaluation, and correction of all activities so that any deficiencies identified can be remedied.
PRINCIPLE 9	There must be open, ongoing communication between management and other employees.
PRINCIPLE 10	It is advantageous to cooperate with external consultants as partners in the implementation of the change.

According to these principles, one of the most effective changes seems to be the fundamental management of internal cluster processes. The transition to a new management method is also possible by the new innovative approaches and new information technologies, which are part of the management information system and the subject of a separate, relatively extensive policy to support cluster management in the future. [12] At the same time, this development should focus on the quality and improvement (innovation and new approaches) in cluster projects, processes, and products.

The authors' diagram design of the system and processes of innovative project management and coordination aiming the needs of the cluster organization being solved can be seen in these contexts and system elements (Figure 1).

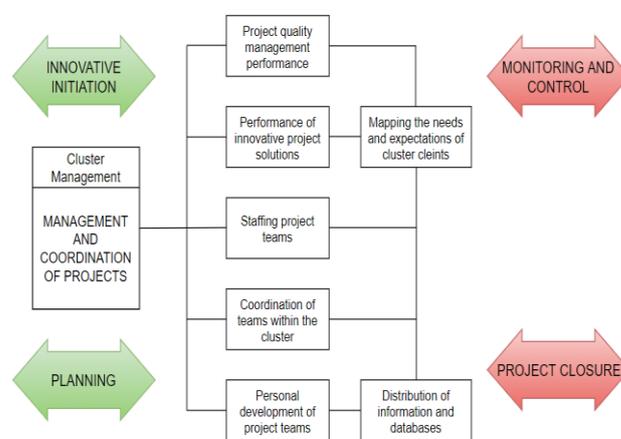


Figure 1: Solution of an activity management and process coordination in clusters [authors]

The proposal sufficiently, responsibly [10], unambiguously and exhaustively describes the supporting elements and connections between them in the conditions of a two-stage project management and engineering activities in clusters for the customers and it is the authors' own application with modifications of the already verified solution. Hence it is appropriate to emphasize the fact, that the result of project process management as a combination of invention and forces is and will always be a commitment of the cluster organization to research, technological development, production and innovation for industrial investment and commercial use by its member businesses and institutions.

6. Conclusions

The implemented authors' research project is designed to strengthen the position of NEC in the domestic and European environment and is based on responsible analysis of the results of previous activities, stemming from the significant experience and situation, diagnostics of its level of innovation based on audit and results of evaluation report 2020 „Benchmarking Report“ of the international organization ESCA. The aim is, coming off the past repeatedly defended bronze EU certification

within the Benchmarking report evaluation, to advance to the level of the silver certificate, which will prove and strengthen the future position of the cluster as a professional organization and at the same time contribute to strengthening Slovakia's position in the international evaluation of the level of innovation and competitiveness in cluster policy.

The main strategic goal of the requester is formulated as: „Building and achieving the final state of a stable, excellent innovation organization at the national level and with an international position, ensuring permanent care for its members in the area of innovation, competitiveness and applied research by 2025 and with a predisposition to 2030 within the Slovak Republic“. NEC wants to become a leader in Slovakia and a major cluster in the V4 countries in its industry for development, research and development of applied innovation solutions and create a strong position at domestic and European scale for synergy of innovations in energy, environmental and related industrial engineering and construction.

This paper is a part of a longer-term and systematic research and builds its hypotheses and results in direct connection with business managerial practice in the implementation of a research grant project NFP313020ANX5, co-financed with the support of the Ministry of Economy SR from the Slovak Regional Development Fund, Operational Program Integrated Infrastructure 2014-2022, scheme DM-3/2020 to support the business networking, challenge code: OPII-MH/DP/2020/10.3-29 under the project title: „Design and development of an integrated innovative infrastructure and knowledge base in the European area of the cluster organization NEC“.

References

- [1] ADAIR, John, *Efektivní inovace*. Alfa Publishing. ISBN 80-86851-0, 2004
- [2] COLLINS Jim and PORRAS Jery, *Jak vybudovat trvale úspěšnou firmu (BUILT to Last)*. Grada Publishing. ISBN 978-80-271-5638-7, 2016
- [3] DYTRT Zdeněk and STRÍTESKÁ Michaela, *Efektivní inovace, Odpovědnost v managementu*. Brno: Computer Press, ISBN 978-80-251-2771-1, 2009
- [4] GRASSEOVÁ Monika, *Efektivní rozhodování. Analýza - Rozhodování – Implementace a hodnocení*. Brno. Edika.2013: ISBN 978-80-266.0179-1, 2013
- [5] KARABÁČ Štefan and KOPOROVÁ Katarína and NOVOTNÁ Simona, *Společná expertná báza pre technologické mapy a inovačné stratégie v priemyselných klastrových habitatoch – Expertný dokument*. Komplexná záverečná výskumná správa. NEK, Bratislava. ISBN978-80-972637-99, 2020
- [6] NOVÁK Adam, *Inovace je rozhodnutí, Kompletní návod jak dělat inovace nejen v byznysu*. Grada Publishing. Praha. ISBN 978-80-271-0333-1, 2017
- [7] NOVOTNÝ Tomáš, *Diagnostika inovačnej dimenzie, kapacity a vitality podnikateľských subjektov*. Recenzovaný sborník příspěvků interdisciplinární mezinárodní vědecké konference doktorandů a odborných asistentů. QUARE, MAGNANIMITAS. Hradec Králové. ISBN 978-80-87952-34-4, 2021
- [8] NOVOTNÝ Tomáš, *Diagnostika dimenzie inovativnosti firiem*. Národný energetický klaster NEK, Bratislava. ISBN 978-80-972637-1-3, 2018
- [9] NOVOTNÝ Tomáš and HRABOVSKÝ Gabriel and MARCIN Ján. *Koncipovanie inovačných nástrojov energetických a environmentálnych klastrových habitatov*. Ťučelová publikácia. MH SR + NEK. Bratislava. ISBN 978-80-973571-0-8, 2020
- [10] NOVOTNÝ Tomáš, a kol., *Analýza a spoločná vstupná expertná báza pre posudzovanie inovačnej kapacity a vitality MSP v podmienkach tvorby technologických máp v Slovenskej republike*. Výskumná správa pre SIEA, MH SR + NEK, Bratislava. ISBN 978-80-973571-2-2, 2020
- [11] NOVOTNÝ Tomáš, a kol., *Koncipovanie inovačných nástrojov energetických a environmentálnych klastrových habitatov*. Výskumná úloha č. 3.1.1. MH SR + NEK, Bratislava. ISBN 978-80-972637-99, 2020
- [12] NOVOTNÝ Tomáš and NOVOTNÁ Simona. *Selected Innovation tools in the Designing Process Management*. Modern Management Review, Quarterly, Volume 26, research Journal No. 4, Rzeszow. Publishing House of Rzeszow University of Technology. P-ISSN 2300-6366, e-ISSN 2353-0758, 2021
- [13] *STRATÉGLIA rozvoja klastrovej organizácie*. Národný energetický klaster NEK, Bratislava. 2021. Zverejnené na: <http://www.nek.sk/wp-content/uploads/2020/06/Strat%C3%A9gia-rozvoja-NEK-Vybran%C3%A9-C4%8Dast.pdf>
- [14] TIDD Joe and BESSANT John and PAVITH Keit, *Řízení inovací: Zavádění technologických, tržních a organizačních změn*. Brno: Computer Press. ISBN 978-80-251-1466-7, 2007

TWO-DIMENSIONAL HEAT TRANSFER PROBLEM SIMULATION OF PRIMARY AND SECONDARY COOLING ZONES IN CONTINUOUS CASTING OF STEEL

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Abstract: The paper carries out the simulation of primary and secondary cooling zones of continuous casting of steel. A symmetric, two-dimensional (1/8), square steel billet cross-section modelling domain is created in MATLAB® Partial Differential Equation Toolbox™. Using the finite element method, a temperature field distribution over the modelling domain is calculated.

Keywords: continuous casting, heat transfer, finite element method, Partial Differential Equation Toolbox™, MATLAB®.

1. Introduction

The continuous casting technology is an effective method to manufacture steel bars, slabs, profiles, and tube. This useful technology, Figure 1: aims to achieve high quality product, minimize the consumption of energy and air pollution.

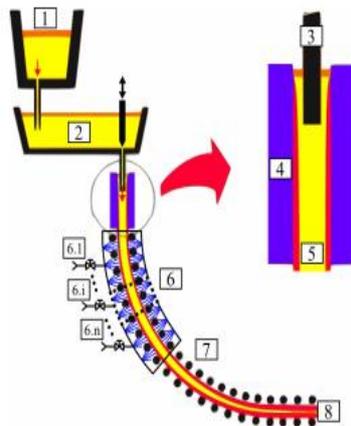


Figure 1: Continuous casting technology scheme [3]

The brief description of the continuous casting technology can be as follows: in continuous casting technology, the melted steel contained in the ladle (1) is poured out into the tundish (2), as the first technological part of the continuous casting machine. The liquid metal enters through submerged entry nozzles (3) into the water-cooled copper mold (4), the first solidification occurs (this is known as the meniscus level). At the mold walls, the solidified shell of the casting strand is being formed while the casting core remains liquid (5). Oscillation of the mold prevents the liquid steel to stick with the mold walls.

After the outer shell of the cast steel solidifies, it enters the secondary cooling zone (6) with a series of water mist cooling jets. This zone is usually divided into several independent sections (6.1, 6.i, 6.n). Preventing the solidifying metal from excessive reheating (7). The casting strand ends with tertiary cooling zone (8), where only

radiation cooling applies to the casting domain, with no water spraying forced convective cooling [3].

1.1 Primary cooling zone in continuous casting

To cool or give a shape to the molten steel, the molten steel must be transferred from tundish to mold. Usually, the mold is a zone in continuous casting where primary cooling of molten steel starts. In this zone, the solidification shell increases in size from 8 mm to 10 mm. From 5 to 20 cubic meters of water, at a pressure of 0.6 MPa is required per ton of steel to allow shell solidification under appropriate conditions within the mold. To prevent adhesion to the mold wall during casting of ingot, vertically oscillating motions are introduced to the mold. When the metal surface reaches a certain height inside the mold, the end of the mold alongside the ingot, is pulled down by a machine [6,11].

1.2 Secondary cooling zone in continuous casting

Secondary cooling zone is located below the primary cooling zone (mold). In this area, the ingot is cooled so that the cooling process progresses to the ingot core and is completely solidified after leaving this area. The secondary cooling zone is designed in such a way that the water is sprayed to all parts of the ingot by nozzles. The model simulated for Khan steel factory located in Afghanistan Kabul. The Khan steel factory secondary cooling zone has three zones with different lengths and different water flow rates from nozzles that are explained in detail in the model. Secondary cooling is a combination of several factors which are: cooling due to radiation, cooling due to the water sprays, cooling by conduction to the rolls. The aim of a secondary cooling zone is as follows:

- Extracting heat from the solidifying strand
- Giving an optimum surface temperature which is necessary to achieve the required surface quality
- The spray water contributes to the cooling of the strand support rollers

The earlier days of continuous casting in the secondary cooling system only water nozzles were used. Later, a mix

system was introduced to the continuous casting technology. This system consists of both water and air supply by nozzles to strand with high pressure resulting in a much finer water particle size whilst also having a wide angle. This enables a much more uniform application of water with smaller particle sizes which have the advantage of increasing the heat transfer coefficients. In Figure 2: below, the left part shows a mix system while the right side show a water only system.

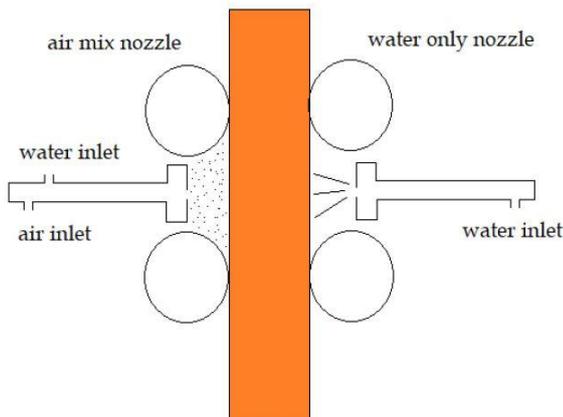


Figure 2: Secondary cooling air/water mist nozzle (left) and water nozzle (right)

Billet heat removal depends on various mechanism including spray cooling and support rollers. In secondary cooling zone heat transfer has the following function [4,9, 11].

- Enhancing and controlling of solidification rate
- Billet temperature regulation by adjusting the water intensity of spray cooling

2. 2D heat transfer model

As mentioned before, primary, and secondary cooling in continues casting is a combination of several factors which causes cooling due to radiation, convection, and conduction. In primary cooling, outer shell of the molten steel is solidified in the water-cooled copper mold. To calculate the cooling power of the mold (under steady state conditions), cooling water initial and final temperatures must be known, as well as the cooling water mass flow rate. Calculated heat flux value is used in the 2D numerical model of the billet, square 120 mm, produced in Khan Steel company, Afghanistan [5].

$$\dot{Q} = \dot{m} C_p \cdot \Delta T$$

Where \dot{Q} is the total cooling power (W), \dot{m} is the mass flow rate ($\text{kg} \cdot \text{s}^{-1}$) of the cooling water flowing through the narrow gap between copper mold and flow jacket, C_p is the specific heat capacity at constant pressure ($\text{J} \cdot \text{kg}^{-1} \cdot ^\circ\text{C}^{-1}$)

and ΔT is the temperature difference, or the delta increase temperature ($^\circ\text{C}$).

To calculate the constant heat flux ($\text{W} \cdot \text{m}^{-2}$) through the copper mold into the cooling water, the area A of the contact surface must be known. Roughly said, it starts at the meniscus level and ends at the bottom of the mold. Then the heat flux is given by:

$$q = \frac{\dot{Q}}{A}$$

However, in the real application the heat flux varies through the length and width of the casting mold. Moreover, it can be a function of some important process parameter, e.g., casting speed ($\text{m} \cdot \text{min}^{-1}$).

In the secondary cooling zone heat transfer happen due to convection and radiation. The heat transfer equation is a parabolic PDE which is written as follow [1,2,7]:

$$\rho C \frac{\partial T}{\partial t} - \nabla \cdot (\lambda \nabla T) = Q$$

Where the ρ is the steel density, C is a specific heat capacity, T is temperature and Q is heat source.

To solve the partial differential equation, the following boundary condions are applied:

- Heat flux of water cooling spray

$$q_s = h(T_s - T_w)$$
- Heat flux of air cooling

$$q_a = \varepsilon \sigma [(T_s + 273)^4 - (T_a + 273)^4]$$

where T_s, T_w, T_a are the surface temperature of the casting billet, water cooling spary temperature and ambient temperature, h is heat transfer coefficient, ε is blackness and σ is Boltzmann constatnt, the value of the Boltzmann constant is $5.675 \times 10^{-8} \frac{\text{W}}{\text{m}^2 \cdot \text{k}^4}$.

In the free cooling zone only air cooling boundry condition is applied which describe in the equation before.

3. Construction of the 2D numerical model of the square billet cross section in PDE Toolbox™

The construction of the 2D numerical model of the square billet cross section in Partial Differential Equation Toolbox™ requires following steps followed to be accomplished [1,8,10]:

- Selection of partial differential equation (parabolic)
- Creating a geometry
- Meshing the model
- Definition of material constants
- Definition of initial and boundary conditions
- Running the simulation
- Post processing the results

There are two ways of creating a thermal model, using a dedicated graphical user interface (GUI) or toolbox functions. Typing a “pdeTool” in the command window opens the GUI. The heat transfer application can be selected through “Options” menu. The cross section of the square steel billet is symmetrical, as well as, applied boundary conditions and therefore a 2D geometry with 1/8 symmetry is the right model for this problem, Figure 3: This reduces the computational time and a number of regions where a boundary condition must be applied.

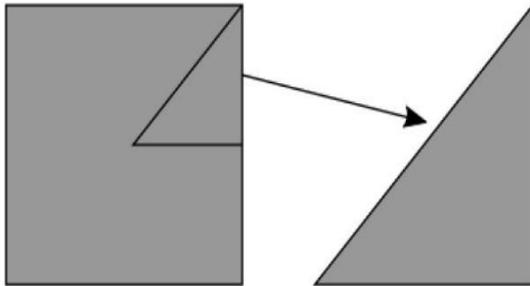


Figure 3: Reduction of 2D computational domain down to 1/8

To create a 2-D 1/8 of the billet square 120 mm, “decsg” function is used along with the definition of coordinates of the triangle. This function decomposes constructive solid geometry into minimal regions and comes with the PDE Toolbox™. Obtained geometry with face and edge labels is in Figure 4.

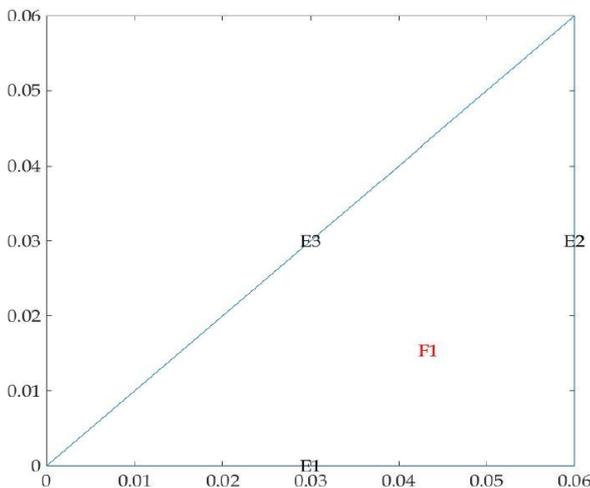


Figure 4: Edge and labels of the triangular definition domain

To solve the model, it is important to specify the characteristics of the material, thermal conductivity, mass density and specific heat capacity. Thermal conductivity and mass density of the material are functions of temperature because with change of temperature these two characteristics of material also change, these data can be obtained in laboratory.

The boundary and initial conditions are applied to the model, the initial condition is the initial temperature that is applied to the model is 1560 °C (casting temperature) and the boundary condition is heat flux that is applied to second edge (E2) of the model. In primary cooling zone, heat flux is a specific number that is calculated by the help of known parameters. In secondary cooling zone, heat flux is a function of time, the function under the name of “transientBCSecondarycooling”, written in MATLAB®. Finally, a triangular mesh is created. The mesh is applied to the model with a maximum element size of 0.003 (m). The element mesh size should be small enough to cover the transition zone of (solid/liquid) region with, at least several elements. The triangular mesh is shown in the Figure 5:

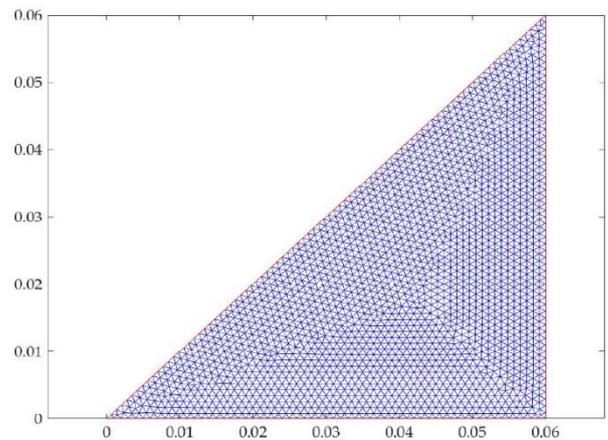


Figure 5: Finite element mesh applied on the triangular definition domain

This model is ready to simulate the cooling process of the primary, secondary and tertiary cooling zone in a continuous casting process. The simulations of heat transfer in this process were performed in MATLAB® (Partial Differential Equation Toolbox™) software, which includes visual interfaces of transient time calculation, parameter input and result output.

3. Simulation result

The parameters of the caster structure and the secondary cooling process used in this model are from Khan Steel mill company. The casting speed is 1.98 (m.min⁻¹) and the initial temperature of liquid steel at the meniscus of the mold (pouring temperature) The temperature distribution over computational domain in the last computational time step is shown in the Figure 6:

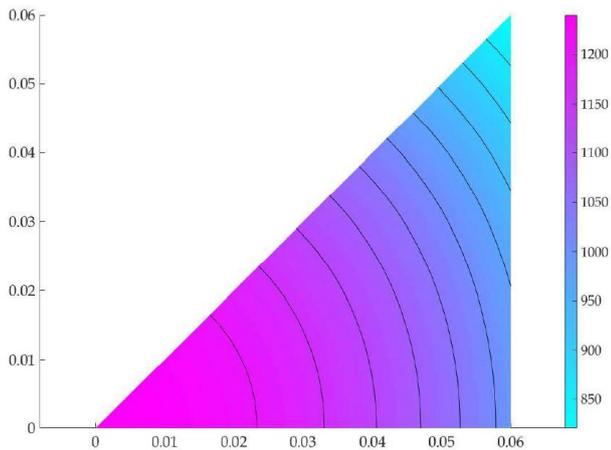


Figure 6: Temperature distribution over computational domain

The computation is quick (order of seconds), utilizing built-in MATLAB® sparse solvers. The temperature evolution of node $[0.06, 0]$ on the surface is in Figure: 7 Notice the reheating behind mold and each secondary cooling zones. This is caused by gaps between spraying sections and if too high, it may cause midway cracks inside the casting domain. The final temperature should be high enough (900 – 1000 °C) to guarantee the unbending and straightening operation of the steel material in the austenite region, see Fe – C diagram.

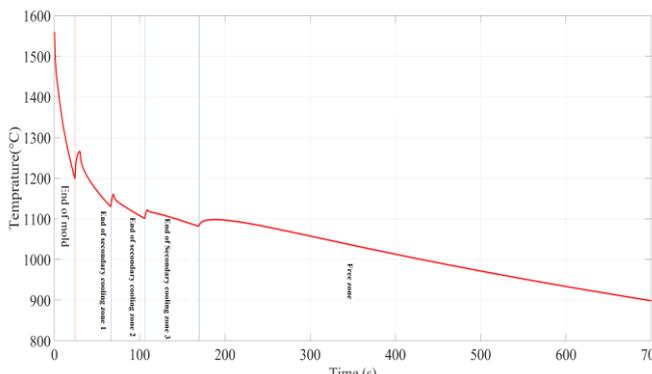


Figure 7: Temperature evolution of the surface node located in $[0.06, 0]$

6. Conclusions

The steel companies have created a number of different empirical rules to cast the steel, but only a part of them are based on physics-based calculations. It is because the steel making and casting are extremely complex processes, involving chemical reactions, heat transfer problem, flow problem, phase transitions and thermally induced stresses in solidifying material. The aim of this paper was to create a basic computational model of 2D heat transfer problem of primary and secondary cooling zone of continuous casting. This model should be considered as some basic computational tool, which in hand of engineers should contribute to primary and secondary cooling zone optimization and efficient management. The model of the

primary and secondary cooling zone of continuous casting is a typical distributed parameter system which is not only dependent on time but also in space. This is a basic model which the measurement point has movement along the casting billet which is clearly shows in Figure 7. Furthermore, in the upcoming work a complex measurement will be done for simulation and control propose.

Acknowledgements

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References

- [1] A Brief Tutorial of the MATLAB PDE Toolbox™. Available online: <https://www.youtube.com/watch?v=r62UoKePegs&ab_channel=noahc66260>.
- [2] F. Costes, A. Heinrich and M. Bellet, 3D THERMOMECHANICAL SIMULATION OF THE SECOND-ARY COOLING ZONE OF STEEL CONTINUOUS CASTING, 10th Int. Conf. on Modeling of Casting, Welding and Advanced Solidification Processes, Destin (Florida, USA), May 25-30, 2003.
- [3] G. Hulko, C. Belavy, P. Noga and K. Ondrejkoovič, Control of technological and production processes as distributed parameter systems – supported by advanced numerical modeling, Bratislava: STU, 2014.
- [4] K. Ehrke and W. Schneider, Continuous Casting, Wiley-VCH Verlag GmbH, D- 69469 Weinheim 2000.
- [5] Khan Steel mill, Kabul Afghanistan.
- [6] K. Ondrejkoovič, L. Bartalsky, C. Belavy and G. Hulko, Control of distributed parameter systems: Exercise instructions, (in slovak), Bratislava: STU, 2019.
- [7] N. Yamasaki, K. Tsunenari, M. Doki, D. Miki, S.Shima, S.Hayashi, Y.Kto, T.Nakanishi, Numerical simulation of the continuous casting process and the optimization of the mold and the strand, UDC 621. 746. 047:681. 3.
- [8] Partial Differential Equation Toolbox™ user's guide. Available online: <<https://www.mathworks.com/help/pde/pde/pde.pdf>>.
- [9] Robert Wilson, A Practical Approach to Continuous Casting of Copper Based Alloys and Precious Metals, in 2000 by IOM Communications Ltd 1 Carlton House Terrace London SW1Y 5DB.
- [10] Utilization of computer modeling in optimization process of continuous casting of steel in Železiarne Podbrezová, Hutnícke listy 01/2019, ISSN 0018-8069.
- [11] W. R. IRVING, et al. Continuous casting of steel, published in 1993 by The Institute of Materials 1, Carlton House Terrace London SW1 Y SOB, introduction.

COMPARISON OF SCIENTIFIC KNOWLEDGE AND PRACTICAL USE OF VALUE STREAM MAPPING

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Abstract: The article focuses on the Value Stream Mapping tool (VSM) and on the first attempts at its use, especially as one of the tools of lean manufacturing in industrial production and its subsequent development through industrial development. Research is based primarily on empirically focused research. The authors secondarily on heuristic observation, the author's practical experience, interviews, and observations with a showcase of VSM evolution and current use in many different industries.

Keywords: VSM, literature review, lean manufacturing, Value Stream Mapping

1. Introduction

From the end of the nineteenth century and especially generally considered Frederick Taylor, who with his book *The Principles of Scientific Management* and his pioneering work with stopwatches in applying engineering principles to the work done in factories, was instrumental in the creation and development of the field of industrial engineering. Many of his colleagues and other followers continued and gradually developed industrial engineering in many directions, procedures, or methods. As well as the development of F. Taylor's ideas and principles began widely not only through research or science, but many manufacturing companies began to apply and implement various procedures. Names like Ford, Ohno, Toyota, Baťa, Deming, but also Shewhard or Womack and Welch are known and often inflected today. However, through research of literature, observations and experience, this article focuses on one of the lean manufacturing tools called Value Stream Mapping, best known to Toyota through the establishment of the Toyota production system and focuses on its development, current use, and further development.

2. Value Stream Mapping

The value stream mapping tool, more commonly known in its English translation as the value stream map (VSM), is most commonly used in continuous improvement activities, both in manufacturing and service companies. The advantage of VSM is an easy and realistic representation of the process from customer to customer, most often to the customer together with the representation of the flow of information and materials. [1] The output of VSM is a comprehensive description of the entire process, from communication with the customer, through order processing, production, and delivery of products or services to the customer.

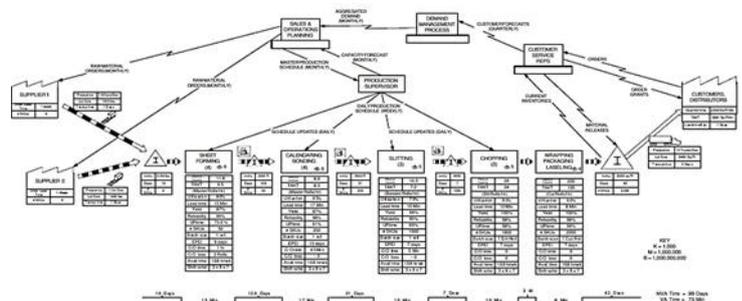


Figure 1: Example of the Value Stream Map [2]

The VSM processing itself can seem like a process diagram at first glance, but the emphasis on the business impact of the whole process, based on lean thinking combined with the use of standardized symbols, makes VSM an advanced tool for traffic management. [3] Symbols to describe the value stream are divided into three main groups capturing the flow of information, material, and timeline of the process; see Figure 1.

The information flow shows both all information flows from and to the customer in terms of managing the requirements of what and when is to be produced and delivered and information flows between business entities. The timeline captures and compares the times of individual value-added-time process activities, along with non-value-added time. The timeline is thus one of the key identifiers of the consequences of waste in terms of its species, not their causes. Material flow, especially from the point of view of manufacturing companies, shows material transformation of material through the production process from its raw form to the finished product and focuses only on the main part of the equipment or the overall process. For a more detailed description and understanding of these main parts, data windows are compiled, which provide the necessary information to understand how, through the individual inputs of activities, flows through the observed process, which in manufacturing companies is mainly material, and then where bottlenecks arise. [4]

To understand the evolution of the VSM tool and describe its beginning, Toyota did not create and invent-ed by Toyota. On the other hand, we move a couple decades backward to the beginning of the 20th century and its gradual development of industrial engineering described in the first chapter. Many researchers and publishers have forgotten one of the many Taylors followers C. E. Knoepfel, who describes in his book *Installing Efficiency Methods* from 1915 is not why greater efficiency should be sought in industrial plants, but what the actual methods are that help increase the efficiency of a manufacturing establishment and how they are put in practical effect. In the chapter *The Diagnosis*, he describes a graphical representation of processes and methods, which from today's perspective looks very similar to the currently used process charts, BPMN or VSM. [5]

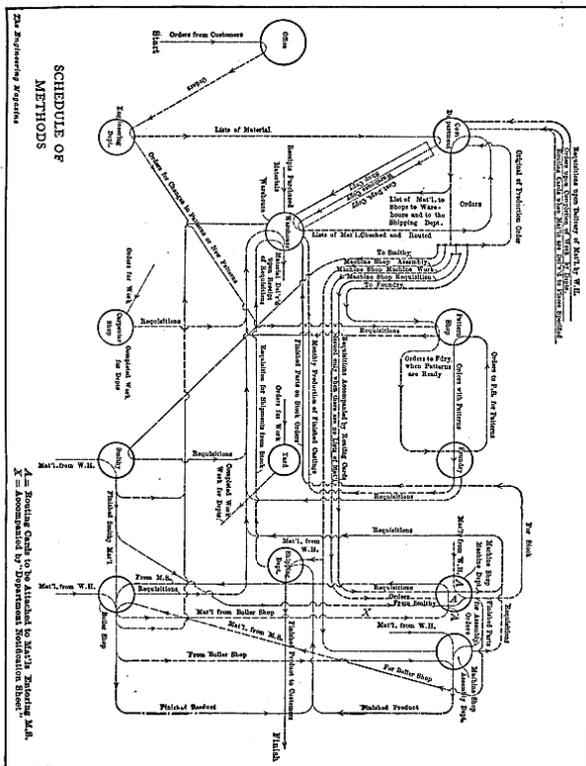


Figure 2: Example of graphic representation of processes by C. E. Knoepfel [5]

What Toyota was focused on was the effectiveness of the Toyota Production System, although supported by a set of lean tools such as TPM, SMED, Kaizen, 5S, and others mostly created by Taiichi Ohno, but to implement the widely known pull system Toyota created a tool to visually represent the flow of material and information in individual processes so called Part and Information Flow Chart (PIFC). PIFC is usually considered as a beginning of today's Value Stream Map. The issue is that there is no standard document or manual on how to develop PIFC as this tool was passed on within the company through learning by doing, which confirms that there is no evidence of PIFC or VSM in Taiichi Ohno published book, *Toyota Production System* from 1978. [6] [7]

Currently known VSM tool is used based on Rother's book *Learning to See*, where he describes how to use this methodology and names it *Value Stream Mapping*.

Both tools, such as Toyota's PIFC or the formalized idea of VSM by Rother have similar functions and serve the same purpose. Only a few differences as slightly different iconic illustrations for the mapping process are occurring, but overall, both tools/ methods are related as one of the most efficient visual illustration mechanisms in capturing the current state of the system identifying long-term vision with a plan to get the target. [6] [8]

3. Literature review

The third chapter is focused on research of empirically focused articles, literature, and case studies from the last 20 years focusing on Value Stream Mapping and its usage in different types of organizations and in combination with other Lean tools, also with examples of innovation.

3.1 A case study of VSM and SMED in the food processing industry

The article describes the successful implementation of lean tools in a food processing company. In particular, the use of the VSM and SMED tools results in a reduction of the so-called change over time by 34% and an increase in line productivity by 11%. [9]

3.2 A Lean Proposal: Development of value stream mapping for L'Oreal's artwork process

A case study describing L'Oreal's use of VSM to eliminate waste, reduce delivery times, and identify phases that can be automated, making the process less prone to human error and more responsive to meeting customers' business requirements, all together with the effort to reduce the implementation time due to delayed deadlines.

In conclusion, VSM has successfully identified process inefficiencies in the lean manufacturing concept and highlighted process activities that should be eliminated or automated. As a result, a new critical path was created, which brought an average reduction of 28% in the time spent on AP (Account Payable) activities and an average savings of 10.5 days on the created works of art, allowing L'Oreal to maximize its value-added activities. Furthermore, as a result of the proposed VSM, the value-added time increased by 73% for renovations and by 75% for new product development. Additionally, the approval levels for the proposed VSM have been reduced by 50% from the current VSM. Such a high reduction has allowed the process to become more agile, as each function has more time to respond to changes and changes in the AP. This has also led to an average reduction in the time required to complete the changes from 13 days to 10 days. Finally, the article presents the VSM method as a paper-and-pencil method, which reflects a certain obsolescence or is outdated, and for this reason, the accuracy of the results is limited. At the same time, the article describes that VSM is not the most suitable tool for highly diversified products, but in this case, where L'Oreal uses a

multistage process where each phase depends on the other, this tool may be appropriate and effective. [10]

3.3 DMAIC-based approach to sustainable value stream mapping: towards a sustainable manufacturing system

The research in this article is based on Sustainable Value Flow Mapping (Sus-VSM), which has recently emerged to advance sustainable production systems. The results of the research revealed that a DMAIC-based approach can be used effectively to systematize Sus-VSM toward sustainable production. The paper also provides guidance for operations managers who wish to undertake similar improvement projects, make their manufacturing operations more sustainable, and hopefully inspire other scientists and experts to expand their study of this under-researched area, which is now gaining increasing interest in various industries.

This study contributes to advances in Lean Six Sigma (LSS) knowledge by proposing a new DMAIC-based approach to systematizing Sus-VSM. In addition to designing this approach, testing it, and expanding body knowledge in LSS, the paper also contributes by providing guidance to operations managers who wish to carry out similar improvement projects and make their production operations more sustainable, and perhaps inspiring scientists and practitioners.

At the same time, the article points to the expansion of an insufficiently researched field, which is the subject of growing interest in various industries, such as healthcare services, logistics, and transport. However, these industries are under increasing pressure to be sustainable, and the systematic implementation of Sus-VSM may provide them with an opportunity to achieve these efforts. It is important to mention that the selected economic (e.g., Value Added Time, Costs, Trainings, Cleaning), environmental (e.g., Water Consumption, Air Cleanliness, Carbon Footprint, Energy Consumption), and social metrics (e.g. Ergonomics, Work Environment) listed in Articles are not specific to certain sectors, as the development of the methodology should be generally applicable throughout the sector. Some industries may require custom metrics. Further studies through further case studies and application to other industries could help develop a portfolio of sustainability metrics in individual sectors as needed. [11]

3.4 Extended Value-Stream Mapping Method: Harmonizing Information Fluxes for the Control of production processes

This article focuses on the need for manufacturing companies to increase the efficiency of operational processes due to the effects of a dynamic environment, especially in connection with the dependence on the quality of information. The article does not describe the traditional principles of lean manufacturing available, but new opportunities that can provide more information through the integration of information and communication technologies into operational processes, hence Industry

4.0. To ensure increased efficiency based on the information provided, it is necessary to harmonize the required information so that its quality meets the requirements of production planning and control.

The article thus focuses on the increasing availability of information provided by industry 4.0, which offers new opportunities to improve production planning and control, current planning and control (PPC) and their key factors, namely the quality of information quality (IQ). To ensure sufficient IQ for effective PPC, the article describes a six-step procedure to harmonize information flows with the requirements of production processes. The application of the procedure and the importance of IQ harmonization are illustrated by an example of a car supplier. The article describes the reasons for ensuring an effective and robust concept when it is necessary to harmonize the IQ dimension of information flow with the variability of operational processes. Harmonized in this context means the definition of requirements for detail, frequency, timeliness, and accuracy of information quality dimensions. The required grain size can be directly derived from the concept developed. An example of greater detail is the queued WIP specification, which can be dated as the number of orders or as the sum of processing times, which may be more appropriate for certain methods. Limits of frequency or timeliness for process failures due to delayed or premature information. For accuracy, it will be determined how strong the values of the information can deviate from the actual value that the information wants to represent. [12]

3.5 Hybrid Integrations of Value Stream Mapping, Theory of Constraints and Simulation: Application to Wooden Furniture Industry

This article studies the production processes of a company producing wooden furniture. The company offers long production lead times and an unbalanced production line. The authors of the article use VSM to visualize and analyze the company's main processes and determine a quantifiable KPI, as well as an OEE indicator. Production utilization increased by 15.8% for the main narrow-necked sources and by 2.4% for the second source. However, the article describes that it is often difficult to persuade the traditional management of a small manufacturing plant to adopt a completely revolutionary, costly, and risky approach to lean manufacturing. [13]

3.6 Implementation of Lean Manufacturing to Reduce the Delivery Time of a Replacement Part to Dealers: A Case Study.

The case study deals with the problem of an automobile company in which there are problems with excessive delivery times of spare parts for its national and international dealers. The Lean Manufacturing methodology was used to shorten delivery time, specifically the value stream mapping tools and the so-called A3 report. Using these tools eliminates activities that add no value. The result is an increase in added value,

a shortening of the delivery time together with a reduction in the number of product variants.

The study describes the process of defining activities that do not add value and then, using waste analysis, analyzes various types of waste of the described process, for which a future map of VSM value flow was created.

The study also points to other studies, articles, and literature that describe the use of VSM in the automotive industry, such as the use to shorten cycle times, process inventory, implementation time, tact-time optimization, workforce improvements, and increased job utilization. Figure 2, which describes the various shortcomings of the automotive industry, and which have been presented in various research articles and in which their authors have carried out optimization projects. However, in none of these sources was the joint use of VSM and the A3 report was found to adjust the logistics flow of spare parts and consequently increase efficiency. [14]

Reference	Drawbacks with Application	Application Area	Tools Used
[3]	Lack of clarity of procedures. Excess complexity in the production flow due to a large number of components.	Production	Value Stream Mapping (VSM) and Simulation
[7]	Lack of integration between processes. Processes with differences between cycle times and takt times.	Production	VSM and Single-Minute Exchange of Die (SMED)
[9]	Low production line performance compared to plan.	Production	VSM and Kaizen
[30]	Lack of Single piece flow. More cycle time in the machines.	Production	VSM and Fault Tree Analysis
[41]	Low performance in process time with respect to takt time	Production	VSM, 5S and Line Balancing
[42]	Lack of process capacity, the cycle time for each process exceeds the takt time.	Production	VSM

Figure 4: Summary of shortcomings presented for various improvement projects in the automotive industry [14]

3.7 Implementation of Lean Service to Reduce Lead Time and Non Value Added Activity in a Banking Institution

This article focuses on the area of services, specifically the use of lean manufacturing tools in the process of providing bank loans, to reduce the implementation time. The authors use value flow mapping to identify and understand the state of society, which, when compiled, results in 42% of value-adding activities and the remaining 58% of non-value-adding activities. The so-called herringbone diagram and the FMEA were used to identify the main causes of the problems and to re-identify the causes. The result of the study is a new business process reduced from 21 activities to 14 activities and a reduction in processing time from 8 days to 4 days. [15]

3.8 Improving the quotation creation through value stream mapping and simulation

This article presents the application of VSM and computer simulations in a company for the production and distribution of heating and cooling equipment for the catering and commercial industries. A product configuration system is in place to improve the bidding process. The performance of the new system design was confirmed by discrete event simulation. The simulation results show several performance improvements. Performed by simulation experiments emphasizing the better performance of the new system design, especially in the activities of creating offers, use of resources, delivery

time, work in progress, time without added value, and the number of required operators. The results of the simulation results show an increase in processed offers, a reduction in the total processing time, a reduction in the total waiting time, and, last but not least, a reduction in work in progress in the order of tens of percent. Other research steps include the possibility of implementing other lean manufacturing tools, such as 5S, Kaizen, or the FIFO system. To improve customer acceptance and documentation management, 5S has been identified as a suitable tool. At the same time, Kaizen events were set up between sales department representatives and operators. [16]

3.9 Lean Methodology for Pathology Laboratories: A Case Study from a Public Hospital

The purpose of the study is to investigate pathological laboratory processes, determine the causes of waste, and choose lean management techniques to eliminate the causes of waste due to the increasing financial demands of laboratories along with the development of evidence-based medicine technologies and applications. A five-phase plan was used to apply lean control in the pathology laboratory. And it:

- top management support,
- observation,
- staff training,
- drawing maps of flows,
- creation of a value flow plan.

The gastric biopsy process was selected as a family of products when mapping the value stream. In addition, a herringbone diagram and Pareto analysis were used to determine the causes of the waste. The results of the compilation of the value stream map found that during the current state, 73.6% of the time spent on the gastric biopsy sample in the pathology laboratory was determined to be waste-related activities. The most common causes of waste were identified as cleaning problems, equipment delivery problems, lack of clinical information, equipment failure, and errors. Subsequently, a future value stream plan was created, thanks to which, together with the implementation of lean manufacturing tools, it expects the elimination of waste activity wastage, specifically with cleaning by 4.6%. Finally, the article presents other examples of the implementation of lean manufacturing elements in other hospital facilities, such as a reduction in total cycle time by 67%, an increase in reporting speed by 37%, or a reduction in the number of errors by 55%. [17]

3.10 Quality Value Stream Mapping

The article focuses on the appropriate integration of business process control systems within the process chain, which are necessary to ensure the required quality of production. For appropriate analysis and correct configuration design, the authors choose VSM as the most modern and suitable tool for this task, which, as described by the authors, is a good tool for visualization, analysis, and quality design assurance measures within process chains in production. However, as VSM further describes,

it is insufficient for the integration of testing processes. However, this creates the potential for a new innovative approach called Quality Flow Flow Mapping (QVSM) to facilitate quality identification and implement a testing process along with overall quality control.

The developed method of mapping the flow of quality values is able to systematically visualize, analyze, and optimize multistage production processes in terms of quality. The model consists of four after the phase, namely: preparation, determination of the value stream quality, design of the value stream quality, and implementation. The method enables visualization of control processes, displays key quality indicators, and quality control loops throughout the process. QVSM also integrates common quality management tools such as Ishikawa analysis and FMEA in a structured way. The advantages of QVSM were illustrated in the article with an exemplary application and in an industrial enterprise, and due to the application, the degree of defects and costs were associated with quality. [18]

3.11 Service Value Stream Mapping in Industrial Product-Service System Performance Management

The article focuses on the implementation of the so-called Performance Management to obtain an overview of the delivered performance. By using these approaches, service activities in manufacturing companies become more transparent through performance measurement approaches and thus offer a useful basis for decision making. The authors use lean manufacturing management, which has been widely used in manufacturing companies in recent years, and specifically cite VSM as a tool for poorly adapting to the integration of performance management.

The PDCA method was used for integration, which was adapted to performance management and specifically through the following steps: planning, measuring performance, evaluating performance, and improving performance. For performance evaluation itself, KPI indicators have already been introduced in the past and used on a large scale but lack the possibility of optimization and the possibility of optimization. It is on these shortcomings that the authors present the VSM interconnection mapping not only the flow of material, but also activities related to the service, specifically interaction with the customer by recording time. This creates SVSM (Service Value Stream Mapping), which integrates and considers KPI metrics. [19]

3.12 Materials and Information Flow Analysis and Optimization of Manufacturing Processes in MSMEs by the Application of Value Stream Mapping (VSM) Technique

The article describes the implementation of VSM in four manufacturing companies, where two of them produce the same group of products and the other two produce different products. EdrawSorf E-draw software is used to implement current and future value flow maps.

Following the application of VSM in these companies, it has been shown that if the proposed situation is implemented, they can expect sudden changes, especially in increased productivity, namely, by 42% in Swan Mechanical Works, 36.46% in Kotla Auto Parts and at BS an increase of 35.37% is expected. Another benefit is the possible removal in terms of movement and transport in terms of material treatment activities by 80.97% for Swan Mechanical, a decrease of 63.73% is estimated in Kotla Carton Box and B.S. Spray Painting Works and Boiler Auto Parts are expected to reduce by 50%. In this regard, the research concluded that value stream mapping can help SMEs. [20]

3.13 Divergence between Value-Stream Mapping Western Understanding and Material and Information Flow Chart Principles: A Japanese Automotive Supplier's Perspective

Through visualization, mapping techniques help production organizations prioritize and manage improvement strategies. For this reason, value chain mapping is used as a method of advancing toward lean manufacturing. The purpose of this paper is to clarify the nature of the Material and Information Flowchart (MIFC), known as Value Stream Mapping (VSM) in the West, to provide a different perspective and understanding, and to identify its way of integrating with measurement systems. Metric complement mapping tools allow you to track the various stages of an organization's lean path and continuous improvement (CI). Although the time dimension predominates in performance metrics in lean environments, these metrics do not directly link the economic factor to improvements.

The research includes a case study in which he learns from the placement of tools and metric determinations. Empirical research included critical case sampling and semi structured interviews, and data were analyzed to compare the conventional Western understanding of VSM with the understanding of a Japanese supplier who learned the principles directly from the source and used his own version of MIFC. Understanding a basic knowledge-based tool will allow organizations to rethink their current measurement systems and choose the most appropriate ones. [21]

4. Autor's observation

The previous chapter, which summarizes the different types and examples of the use of VSM in different industries and industries presented in various scientific articles, always shows the appropriate and successful use or implementation of VSM, either as a tool itself, in its modification or in conjunction with another lean manufacturing tool. However, what is not mentioned in the previous articles is the reason the VSM tool or method has been chosen, not some other tool.

For these reasons, this chapter focuses on the practical experience of the authors, their observations, and interviews with process engineers representing the role of

continuous improvement in various companies, but also with people acting in the role of consultants in such field.

One of the several companies where we had a chance to visit and interview is Czech Airlines Technics, the role of Lean Manager responsible for the continuous improvement and overall implementation of lean culture has existed already for several years, but it was discovered that the support from management for optimization activities was very weak. From a point of view, the use of the VSM tool was not witnessed within its use or utilization. The reason could be the inexperience of the tool or an unsuitable environment and processes.

An interesting experience was the possibility of consulting on the setup and optimization of the new Coca-Cola HBC Czech and Slovakia based in Prague, Czech Republic. Over the last five years, this Coca-Cola subsidiary has become a global leader in the production of Coca-Cola beverages. However, it is interesting that in this branch there is no position of an industrial engineer, or a position focused on continuous improvement that would take part in the optimization of the production line itself or for any other use of any method or tools of lean manufacturing. When asked if they do not use anything like that and have no one in the branch, it was told that production management is trained and is aware of the general concept of lean manufacturing and knows the basic tools, but they use common sense in optimization. Therefore, even the Coca-Cola subsidiary does not use the VSM tool and, for the most part, other lean manufacturing tools and methods to map bottlenecks or new flow design.

One of the other experiences is a discussion with the company GE Aviation Czech, which focuses on the production and service of turboprop aircraft engines. This branch strongly promotes a lean culture. After consulting with the employee responsible for process optimization and implementation of improvement proposals and after inspecting various workplaces right in the company, it must be said that various examples of methods and tools are visible at every step, both in offices and in the service and production workplaces themselves. In terms of using the VSM tool, the company told us that they were actively using the tool. Although not in its full and maximum use in terms of all possible storage, supply, and especially data parts and parameters, but in various modifications and adjustments for a suitable solution to the problem or project, both to capture the current flow of material and information, and especially to proposals for the state of the future.

The last part of this chapter is focused on consultation with industrial engineers who do not work for one specific company but act as consultants or freelancers and help various companies implement a lean culture, optimize current, or set up new production using combinations of lean manufacturing tools and six-sigma methodology. One of those people is Michaela Kovalová, who has been working in the field of lean manufacturing since 2011, she

has worked for several companies and currently works as a consultant for a variety of companies. The interview on the use of VSM showed that this tool is not very used and insufficient due to more complex processes. Currently, and for the past and recent projects she has been working on, she said she did not use this tool, and she mentioned that various software is being used to monitor the processes, which is able to hold a large amount of data.

Another person interviewed was Tomáš Průžek, who has worked in several companies as a lean manager since 2009 and has worked as a lecturer and consultant in the field of lean manufacturing together with several years of experience as an editor of a scientific journal focusing on industrial engineering, productivity, and innovation. Tomáš revealed that he used the VSM tool very often at the beginning of his career he could not imagine anything more appropriate as a VSM tool for understanding the processes of society, together with the flow of material and information at the time he could not imagine anything more appropriate. However, in today's time, he said he does not use VSM at all. On the other hand, he admitted that he is presenting VSM as one of the tools for describing the flow of materials and information in lessons and mentoring lean manufacturing.

Comparable like Tomáš Průžek, another interviewee Marek Pavka, who has been another person interviewed for the usage of VSM in the field of lean manufacturing, where he has been working since 2010 and has been working as a senior consultant for the company API (Academy of Productivity and Innovations) for the last nine years. This company focuses not only on the implementation of innovation-lean manufacturing in various types of manufacturing companies, but also on providing training in the field of industrial engineering. After a discussion with Marek Pavka, he said that VSM is part of the trainings and lectures that the company offers in its portfolio, but in real projects this tool is being used in a very small number of cases, and moreover software programs are being used due to their ability to process data directly from production or as well with minimal modification.

5. Summary

Since the publication of the assistance and benefits of Toyota's material and information flow monitoring with subsequent expansion to the now famous Value Stream Mapping tool, its use has increased, both in terms of frequency and industry diversity. Whether it is due to an increase in job positions focused on innovation and process optimization, pressure from companies in terms of the competitive environment, higher academic interest, or a combination of all the above, VSM is the most common tool for mapping the flow of materials and information. However, as is clear from the scientific articles described in previous chapters, through case studies of companies or scientific publications, the VSM tool itself is slowly becoming obsolete and new variants and combinations are emerging. The main reasons are mostly new challenges

and emerging markets or obsolescence due to new and different characteristics of production environments.

At the same time, when researching scientific articles, there are almost no examples of inappropriate use of the VSM tool, both in case studies of companies and in scientific articles, and if so, these are articles describing new improvements and new variants of the VSM tool.

Article *Applying Value Stream Mapping in Manufacturing: A Systematic Literature Review* focuses on a similar topic, which selected 120 studies dealing with the implementation of VSM itself or a combination thereof. All these studies are from the VSM map from 1990 to 2016. The results of the research show that most articles show that waiting time, inventory excess, and overproduction are the wastes that received more attention in the literature. On the other hand, over-processing is the one that fewer papers have taken into account regarding research on the VSM approach. Furthermore, the analysis showed that more than 44% of the work emphasized the application of other lean tools along with VSM, where the most commonly applied were the kaizen events and pull system. In the subject of performance, the available literature indicates that the reduction of lead time is a key performance indicator that most of the researchers target in their papers, where the average improvement is 52.26 % when applied. [22]

6. Conclusion

The article describes the development of the VSM tool from the first mention of process recording through monitoring the flow of material and information to the current VSM tool and its possible modifications and improvements. When an increase in articles describing the use of VSM is recorded, both in the scientific and practical spheres, it is necessary to confirm that VSM significantly helps to improve the view of the production flow and its performance. On the other hand, it is necessary to mention certain shortcomings of this tool, whether in a high repetitive, high volume, low variable manufacturing, macro view of the flow, with very little consideration of the layout, and the need for some knowledge and experience to compile a map through trained experts or consultants. At the same time, the article seeks to outline the importance of sharing ideas and experiences related to VSM and, in addition to general developments, describes new innovative perspectives that can support further research in this area, both for different sectors and for new and better performance indicators. This study is useful in expanding knowledge about the application of the VSM tool as an unexplored tool and a complementary approach that can improve the results of many areas in addition to manufacturing.

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References

- [1] GULATI, Ramesh. *Maintenance and Reliability Best Practices* [online]. 2nd Edition. New York, USA: Industrial Press, 2013, p. 392-393 [cit. 2020-08-18]. ISBN 978-0-8311-3434-1. Available: <https://app.knovel.com/hotlink/pdf/id:kt00B0DGN6/maintenance-reliability/value-stream-mapping>
- [2] KING, Peter. *Value Stream Mapping: Process Industry Operations*. In: Academia.edu [online]. Academia: Lean Dynamics LLC, 2009 [cit. 2020-08-23]. Available: https://www.academia.edu/37512520/VALUE_STREAM_MAPPING_PROCESS_INDUSTRY_OPERATIONS
- [3] BURKE, Sarah a Rachel SILVESTRINI. *Certified Quality Engineer Handbook* [online]. Fourth Edition. Milwaukee, Wisconsin: American Society for Quality (ASQ), 2017, p. 282-284 [cit. 2020-08-20]. ISBN 978-0-87389-944-4. Available: <https://app.knovel.com/hotlink/pdf/id:kt011FEC7C/certified-quality-engineer/value-stream-mapping>
- [4] KING, Peter a Jennifer KING. *Value Stream Mapping for the Process Industries: Creating a Roadmap for Lean Transformation*. 1st Edition. USA: CRC Press, 2015, p. 5-20. ISBN 978-1-4822-4769-5.
- [5] KNOEPEL, C. *Installing Efficiency Methods*. 1. New York: The Engineering Magazine, 1915.
- [6] *Part And Information Flow Chart (PIFC) Mapping For Establishing Pull System In Heat Treatment And Machining Line*. *International Journal of Mechanical Engineering and Robotics Research*. 2013, 2(3), 357-364. ISSN 2278 – 0149.
- [7] OHNO, Taiichi. *Toyota production system: beyond large-scale production*. 1. Portland, Oregon: Productivity Press, 1988. ISBN 09-152-9914-3.
- [8] ROTHER, Mike a John SHOOK. *Learning to See*. 1. Cambridge, USA: Lean Enterprise Institute, Inc., 2009. ISBN 0-9667843-0-8.
- [9] MAALOUF, M. a M. ZADUMINSKA. *A case study of vsm and smed in the food processing industry*. *Management and Production Engineering Review*. 2019, 10(2), 60-68. Available: doi:10.24425/mper.2019.129569
- [10] GHOSH, S. a K. LEVER. *A lean proposal: development of value stream mapping for L'Oreal's artwork process*. *Business Process Management Journal*. 2020. ISSN 14637154. Available: doi:10.1108/BPMJ-02-2020-0075
- [11] JAMIL, N., H. GHOLAMI, M.Z.M. SAMAN, D. STREIMIKIENE, S. SHARIF a N. ZAKUAN. *DMAIC-based approach to sustainable value stream mapping: towards a sustainable manufacturing system*. *Economic Research- Ekonomska Istraživanja*. 2020, 1(33), 331-360. ISSN 1331677X. Available: doi:10.1080/1331677X.2020.1715236

- [12] BUSERT, T. a A. FAY. Extended value stream mapping method: Harmonizing information flows for the control of production processes. *IFAC-PapersOnLine*. 2019, 52(13), 54-59. ISSN 24058963. Available: doi:10.1016/j.ifacol.2019.11.129
- [13] ALZUBI, E., A.M. ATIEH, K. ABU SHGAIR, J. DAMIANI, S. SUNNA a A. MADI. Hybrid Integrations of Value Stream Mapping, Theory of Constraints and Simulation: Application to Wooden Furniture Industry. *Processes*. 2019, 7(11), 816. ISSN 22279717. Available: doi:10.3390/pr7110816
- [14] Implementation of Lean Manufacturing to Reduce the Delivery Time of a Replacement Part to Dealers: A Case Study. *Applied Sciences (Switzerland)*. 2019, 9(18), 3932. ISSN 20763417. Available: doi:10.3390/app9183932
- [15] Implementation of Lean Service to Reduce Lead Time and Non Value Added Activity in a Banking Institution. *IOP Conference Series: Materials Science and Engineering*. 2019, 505(1), 012076. ISSN 17578981. Available: doi:10.1088/1757-899X/505/1/012076
- [16] Improving process of quotation creation through value stream mapping and simulation. *International Journal of Simulation Modelling*. 2019, 18(4), 563-573. ISSN 17264529. Available: doi:10.2507/IJSIMM18(4)484
- [17] Lean Methodology for Pathology Laboratories: A Case Study from a Public Hospital. *Turk Patoloji Dergisi*. 2019, 35(3), 228-236. ISSN 10185615. Available: doi:10.5146/tjpath.2019.01462
- [18] Quality Value Stream Mapping. *Procedia CIRP*. 2014, 2014(17), 254-259. ISSN 22128271. Available: doi:10.1016/j.procir.2014.01.093
- [19] Service Value Stream Mapping in Industrial Product-Service System Performance Management. *Procedia CIRP*. 2015, 2015(30), 457-461. ISSN 22128271. Available: doi:10.1016/j.procir.2015.02.128
- [20] Materials and Information Flow Analysis and Optimization of Manufacturing Processes in MSMEs by the Application of Value Stream Mapping (VSM) Technique. *Materials Today: Proceedings*. 2018, 5(14), 28420-28426. ISSN 2214-7853. Available: doi:10.1016/j.matpr.2018.10.128.
- [21] CHAVEZ, Zuhara. Divergence between Value Stream Mapping Western Understanding and Material and Information Flow Chart Principles: A Japanese Automotive Supplier's Perspective. *Journal of Service Science and Management*. 2018, 11(2), 219-241. ISSN 1940-9907. Available: doi:10.4236/jssm.2018.112016
- [22] ROMERO, L. a A. ARCE. Applying Value Stream Mapping in Manufacturing: A Systematic Literature Review. *IFAC-PapersOnLine*. 2017, 50(1), 1075-1086. Available: doi:https://doi.org/10.1016/j.ifacol.2017.08.385

ENHANCED CAPABILITIES OF A DIGITAL CALIBRATION CERTIFICATE

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Abstract: The article deals with some possibilities of extending the digital calibration certificate, especially in terms of additional information. It initially defines a calibration process that consists of two steps. It describes the main structure of the classic calibration certificate and digital certificate and the procedure for creating a digital calibration certificate. It also presents the authors' analyzes concerning individual aspects of digitization in terms of additional information used to improve digital certificates.

Keywords: calibration, digital calibration certificate, processing of measured data

1. Introduction to the calibration process

When we paraphrase the international definition, calibration is a two-step process, which in the first step establishes a relationship between the indication of the measuring instruments and the quantity value (as realized by measurement standard) and in the second step employs the obtained information for obtaining a measurement result [3]. In the metrology practice, one often considers only a first step as a calibration. The first phase is carried out by specialized laboratories (providers of metrological services), while the second phase is basically carried out by the user of a measuring instrument when performing the measurement.

In practice, the result of the first step is delivered to a customer in the form of a calibration certificate. The relation between the indication of a measuring instrument and the respective quantity value, obtained during the first step of a calibration process, can be stated in a calibration certificate in several different ways - by a statement, calibration function, calibration diagram, calibration curve, or calibration table. In some cases, it may consist of an additive or multiplicative correction of the indication with associated measurement uncertainty.

Any of these forms can be employed by a provider of metrological services, however, the statement is used most often. And it is left to the user of a calibrated measuring instrument, in which way he/she employs the information provided in the calibration certificate during the use of a measuring instrument (for applying corrective parameters, for evaluation of measurement uncertainty, etc.). And here is a gap that may be addressed by a digital calibration certificate (DCC).

The digitalization of metrological activities has its significance in a wide range of industrial, medical, environmental and other applications. It enables further improvement of the evaluation of measured data, which provide a more comprehensive and credible picture of the researched phenomena. There are already a number of applications that link metrology and a specific area of

knowledge, e.g. medicine, where the digitization of metrological activities plays a key role [4; 5].

2. Analogue and digital calibration certificate

Calibration of the meter usually results in the issuance of a calibration certificate, which contains information about the operation of the calibrated meter. This information is used by the customer to improve the measurement process with a calibrated meter. Therefore, the logical sequence of the main activities associated with the calibration certificate includes:

- Certificate creation,
- Its delivery to the customer,
- Customer use.

This logical sequence applies to both analogue and digital calibration certificates.

2.1 Classic calibration certificate

The calibration certificate contains mandatory content, although its format may vary depending on the organization and measurement area. In general, the content of a calibration certificate can be categorized in several ways depending on the perspective. For the purposes of this document, we divide the contents of a typical calibration certificate into four categories:

- 1) certificate information,
- 2) information on facilities,
- 3) calibration information and
- 4) administrative information.

2.2 Digital calibration certificate

The digital calibration certificate is a calibration certificate in electronic form, which enables automatic creation, insertion and processing of measured calibration results directly in digital form.

The most intuitive way to digitize a calibration certificate is to leave the scanned paper certificate in some digital document format, such as pdf, or in some image format, such as jpg, without any modifications. This solution is

simple, as certificates are often created in digital form before printing. It can be widely used in a variety of settings for electronic certificate storage, archiving, and exchange.

2.3 DCC formation

International documents [2] define the detailed requirements for a calibration certificate; therefore, the set of operations involved in its creation must also meet these requirements. FIG. 1 is a schematic flow chart with the main activities involved in creating a DCC. The resulting certificate must meet the requirements set out in section 4, so the DCC creation process is a very complex activity, resulting in an output file suitable for further processing (storage, delivery to the customer, etc.).

Creating a DCC involves several steps that require the necessary inputs from different sources. As shown in FIG. 1, these inputs come either from the digital environment (databases, measurement and control systems, data processing software, etc.) or from human operators (administrative and laboratory staff and approval bodies).

The data are arranged in a hierarchical structure (Fig. 2). The DCC core is represented by administrative data and measurement results with comments and other information stored in a comprehensive document.

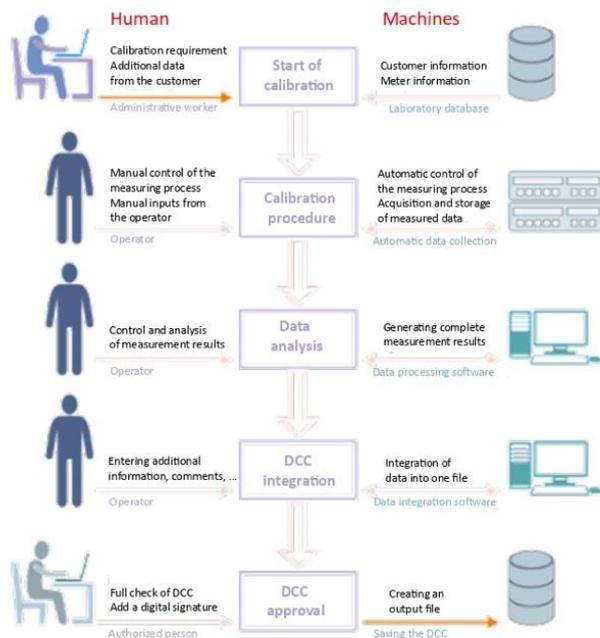


Figure 1: Schematic procedure for creating DCC

3. Additional information that can be carried by a DCC

According to [1], DCC contains following types of data

- administrative data,
- measurement data,
- comments,
- document.

All these data can be supplemented by additional information, if comparing to the analogue calibration certificate.

1. Administrative data (regulated area)

Administrative data contains information of central interest. Data fields are mandatory and have a prescribed structure. The information is usually on the first page of the analog calibration certificate. The data is used to uniquely identify the calibration laboratory, the calibration object and the calibration customer. Data such as calibration dates are formatted according to international standards. Letters are allowed in Unicode format. The numbers are presented in the form of Arabic numerals. The main language is English, but information can be provided in another language.

2. Measurement results (partially regulated area)

Representation of measurement results is one of the most challenging tasks to be solved in the form of DCC. The reason is the variety of presented measurement results. In addition, existing and established data exchange formats need to be integrated into the concept. At the same time, it is possible to present a simple structure for those who do not yet have an existing data exchange format. Therefore, this area cannot be regulated in general. However, it is strongly regulated that the measurement results must be presented completely and only on the basis of SI.

3. Comments (unregulated area)

The comments section contains individual information about the measurement process, which provides additional information about the measurement results. This range can be used optionally and without requirements. Possible data are, for example, graphics from measuring curves, visual or audio information, as well as individual series of measurements in any format.

4. Document (unregulated area)

In this area it is possible to save an electronic version of the calibration certificate saved in PDF format, which can be converted to XML. This allows DCC users to see the image of their usual calibration certificate during the transition to the digital world. Using the Base64 coding scheme, PDF-A can be stored in XML together with the above information set.

According to the DCC, this area will be in high demand and used to control customer measurements.

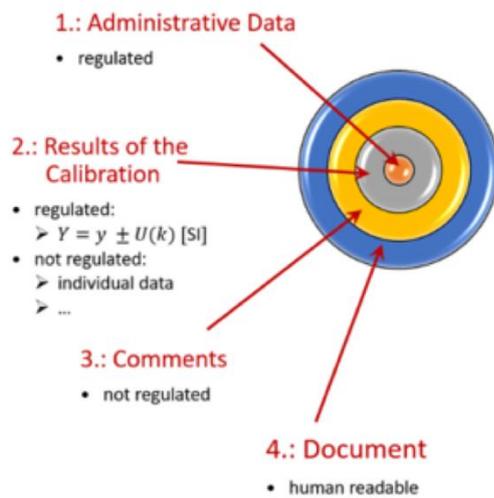


Figure 2: DCC structure [1]

4. Use of DCC for measurement

As written in the previous part of the paper, a DCC can carry a wide variety of additional information. If we focus on data obtained during calibration, several additional information can be distinguished:

- all readings (indications) obtained from a calibrated instrument,
- all data coming from the calibration setup, i.e. data from a measurement standard, data from additional sensors and equipment, etc.,
- the measurement model and procedure for processing the calibration data including evaluation of measurement uncertainty.
- various identification marks and references to individual authorities and regulations as well as a cryptographic signature.

These information can be employed by a calibrated instrument user for

- reconstruction of a calibration process and a control evaluation of calibration data – the so-called raw data (values indicated by the calibrated instruments as well as by a calibration setup) can be provided
- an own evaluation of calibration process – this may be beneficial if the user requires the form of the calibration results in a form different from that stated by a calibration provider in a calibration certificate, e.g. when employing a least squares method for calculation of respective corrections, etc.,
- simulation of calibrated instrument behavior during a measurement, e.g. by a Monte Carlo method,
- processing of additional characteristics of a calibrated instrument, e.g. estimating a drift, long-term stability, determination of re-calibration interval, etc.
- subsequent verification of the correctness of the calibration certificate.

The above mentioned possibilities can be efficiently introduced only if a standardized format of a DCC exists. A wide variety of measuring instruments can be calibrated and different type of data can be obtained during calibration. The necessity is to develop and implement:

- A user interface on the side of a metrology services provide that enables acquiring and storing the data from the calibration process, their processing according to the respective evaluation methods and models and transferring into a form suitable for a DCC;

- A DCC having a standardized structure and formal features that all together enable store and delivery of all information to the user;

- A user interface on the side of a metrology service user that enables the user to process the obtained DCC automatically or manually for a given purpose (e.g. evaluation of measurement result when using the calibrated instrument, or processing the respective correction if the calibrated instrument will be installed in an automated process, etc. – the variety of possibilities is large).

An international effort is made to address all those three points, both theoretically (developing suitable methods and procedures) and practically (developing the respective technical, namely software, solutions).

5. Summary

The introduction of digital calibration certificates can significantly change the whole paradigm of exchanging information between the provider and user of metrological services. While analogue (classical) calibration certificate is a well-established document recognizable worldwide, implementation of digital calibration certificates for everyday use still requests a lot of research work, harmonization activities, awareness-raising campaigns, etc. This should be an overarching process, internationally coordinated and nationally accepted, enhancing the efficiency of information exchange and extending the possibilities for evaluation of measurement data. The new features of digital calibration certificates require standardized methods, procedures, exchange formats, user interfaces, etc., all components of which shall be newly developed and designed. The paper introduces some challenges and opportunities, connected with the implementation of a digital calibration certificate.

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Literature

- [1] HACKEL, S. – HÄRTIG, F. – HORNIG, J. – WIEDENHÖFER, T.: *The Digital Calibration Certificate*. [online]. Cited 18. februar 2022. Accessible: <https://oar.ptb.de/files/download/5a9803864c91840b9b2a3ce5>
- [2] ISO/IEC 17025: 2017 *General requirements for the competence of testing and calibration laboratories*.
- [3] JCGM 200: 2012 *International vocabulary of metrology – Basic and general concepts and associated terms (VIM)*. 3rd edition. 2008 version with minor corrections. [online]. Cited on 16. april 2022. Accessible: <https://www.bipm.org/en/committees/jc/jcgm/publications>

- [4] PAVLÁSEK, Peter; RYBÁŘ, Jan; ĎURIŠ, Stanislav; HUČKO, Branislav; CHYTIL, Miroslav; FURDOVÁ, Alena; FERKOVÁ, Sylvia Lea; SEKÁČ, Juraj; SUCHÝ, Vítězslav; GROSINGER, Patrik. *Developments and Progress in Non-contact Eye Tonometer Calibration*. In Measurement Science Review [online]. Vol. 20, no. 4 (2020), s. 171-177. ISSN 1335-8871 (1.319 - 2020). In database: CC: 000562833800003 ; WOS: 000562833800003. <https://www.measurement.sk/2020/msr-2020-0021.pdf>
- [5] RYBÁŘ, Jan; HUČKO, Branislav; ĎURIŠ, Stanislav; PAVLÁSEK, Peter; CHYTIL, Miroslav; FURDOVÁ, Alena; VESELÝ, Pavol. *Factors affecting measurements of iop using non-contact eye tonometer*. In Strojnícky časopis = Journal of Mechanical engineering, vol.70, no.2, 2020, pp.133-140. ISSN 0039-2472 (2020). In database: SCOPUS: 2-s2.0-85099079234. <https://sciendo.com/article/10.2478/scjme-2020-0026>

ASSESSMENT OF CARBON FOOTPRINT BY IPCC AS A TOOL FOR EFFECTIVE CONTROL OF THE CYCLE OF EXISTENCE OF A PHOTOVOLTAIC POWER PLANT

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Abstract: *The increase in the level of pollution and the depletion of energy resources resulted in the creation of legal regulations protecting the environment. Legal provisions are intended to limit the negative impact of products and technological processes on the environment and people. Developed methods are used to determine the level of contamination. The aim of the study was to show that the carbon footprint assessment using the IPCC method can become one of the tools for effective control of the life cycle of a photovoltaic power plant. A selected 2 MW photovoltaic power plant was used for the study, the data needed for the analysis were taken from manufacturers and from the SimaPro 8.4 program databases. The total potential lifecycle greenhouse gas emissions for the PV plant under study are $1.20 \cdot 10^4$ kg CO₂ eq. The largest amount of greenhouse gas is emitted during the production of photovoltaic modules, and the smallest during the production of electrical components.*

Keywords: *PV power plant, carbon footprint, Life Cycle Assessment*

1. Introduction

The concept of sustainable development assumes the creation of activities aimed at reducing the negative impact of products and technological processes on the environment. These activities are also aimed at limiting the excessive extraction of energy resources. In recent years, legal regulations have been created in the European Union countries to limit greenhouse gas emissions, including carbon dioxide. Changing the nature of the economy to a low-emission is associated with the necessary financial outlays. At the beginning, it is necessary to calculate the greenhouse gas emissions of a given product or process to implement a low-emission policy. For this purpose, many methods of calculating the impact of pollutants on the environment have been developed. One of those ways is carbon footprint. It is defined as the total amount of CO₂ emissions for a product over its entire life cycle. This value is given in the equivalent of carbon dioxide – CO₂ eq. With this method, you can calculate carbon dioxide emissions by a product or process and take actions to reduce the negative impact of the product or process on the environment [1,2].

The aim of the study was to show that the carbon footprint assessment using the IPCC method can become one of the tools for effective control of the life cycle of a photovoltaic power plant.

2. Materials and Methods

2.1 Object and Plan of Analysis

A life cycle assessment was carried out for a 2 MW photovoltaic power plant located in northern Poland, based on silicon monocrystalline photovoltaic modules. Life Cycle Assessment of plastics, materials and components of photovoltaic power plants is possible thanks to the use of various models, including Life Cycle Assessment.

The LCA (Life Cycle Assessment) method has been defined as the quantification of the environmental load by a technical object, process or structure during the entire lifetime of a product. On the basis of a standardized scheme of operation, this method allows to determine or compare the impact of the considered objects, processes on the environment or people. The LCA method can be used as a tool in the work on improving the condition of the environment. It consists of five main stages: definition of the purpose and scope of research, inventory, environmental impact assessment, interpretation, proposition for improvement [3,4].

2.2 Determination of goal and scope

The purpose and scope of the analysis should be defined in the first stage of LCA. This stage determines the place of the researched object in the environment. This is at the most important stage of the analysis as it determines the level of detail and the method of conducting the research. This stage also includes the determination of the scope of the assessment and the boundaries of the product system under consideration, the functional unit, and the data quality requirements. It is recommended that the data taken into account consists of: time period, geographical area, data completeness, technological area and accuracy. The effects of the implementation of this stage are: a detailed description of the product that is the subject of the research, indication of properties that are typical for the product, specification of the criteria according to which the product will be considered and the determination of the time and place of the tests [5,6].

Most of the processes carried out as part of the studied life cycle of a photovoltaic power plant took place in Europe, so the geographical scope of the analysis was precisely the area of Europe. The time span covers the lifetime of the PV power plant of approximately 20 years. The cut-off level was 0.01%. The conducted analysis was mainly used

to describe the existing reality (retrospective analysis), but also to model more pro-environmental solutions (prospective analysis). The data used for the research was obtained from manufacturers or from SimaPro 8.4 databases (Ecoinvent 3.4 database). The main function of a photovoltaic power plant is to generate electricity. For this reason, the value of the installed power in the research facility, 2 MW, was adopted as the functional unit.

2.3 Life cycle inventory (LCI)

The second stage of LCA analysis is abbreviated as LCI, which stands for collecting data to quantify the inputs and outputs of a given product system. At this stage, all environmental impacts of the facility at all stages of its existence are collected. At the entrance to the system, first of all the consumption of raw materials and energy carriers is taken into account. At the exit from the system, the generated waste and emissions of harmful substances polluting the air, water and soil. The result of this stage is the development of a list of interaction of the research object with the environment. This process should be based on material and energy balances, prepared for individual stages of the life cycle of a technical facility [7,8].

Due to the conclusion of a confidentiality agreement, all detailed information on the structure of the analysis object and technological data are not disclosed in this paper.

The total mass of plastics, materials and components of the tested photovoltaic power plant is approximately 300 tons. PV modules have the largest share in the mass of the object - approx. 60% (of which less than half of their mass is solar glass, and approx. 45% - aluminum). Other, most important elements of the tested PV power plant include supporting structures accounting for approximately 20% of the weight of the entire facility (mostly made of steel), an inverter station with approximately 15% of the weight of the facility (components of which are mainly made of steel - approx. 40% and aluminum - approx. 35%) and the electrical installation (mostly made of copper conductors) [9].

2.4 Life cycle impact assessment (LCIA)

The purpose of the third stage of the Life Cycle Environmental Assessment (LCIA) is to determine the magnitude of the environmental effects of the tested object. At this stage, the obligatory element is the selection of the impact categories, category indicators and the characterization models. Then assigning the LCA results to the appropriate category and characterizing them, for example: calculating the results of the category indicators. Normalization can be used to calculate the results of category indicators. What enables the determination of the share of the tested object into a particular category in the adopted area and time. The normalization values for individual impact categories can be classified according to the principles defined for the purpose and scope of the analysis (grouping). Weighing should be done to identify the category that has the greatest impact on the environment. What makes possible to determine the

environmental index, by means of an integer number, of the environmental impact of the test object [10,11].

The analyzes were performed using the SimaPro 8.4 software (PRé Sustainability, LE Amersfoort, Netherlands) and the Ecoinvent 3.4 database. The life cycle assessment of the photovoltaic power plant was carried out using the IPCC 2013 GWP 100a method (V1.03).

2.4 Interpretation

Interpretation in the LCA methodology is the stage in which the results of the analysis of the set of inputs and outputs of the LCI life cycle are summarized. The purpose of this stage is to present the results, formulate final conclusions and explain the limitations. The ISO 14043 standard defines three important elements related to how to interpret the results of an analysis. It should identify the most important environmental impacts of the test object, evaluate the results in terms of completeness, accuracy and compliance, and formulate conclusions and recommendations that may reduce the negative environmental impact of the test object. The results should be presented in a legible, understandable and detailed manner so that the recipient can understand the complexity of the problem and the possibilities of the solution [11,12]. The completeness check of the analysis ended positively. The data needed for the interpretation was complete. Compliance checks were also carried out during the tests. The adopted assumptions, methods used, the depth of the analysis, its detail and precision of data were consistent with the purpose and scope of the research. The obtained results and their interpretation are presented in sections 3 and 4.

3. Results

The most important gases that increase the greenhouse effect are: CO₂, N₂O, CH₄ and CFC's. During the analyzes, it is important to take into account the residing time of a given gas in the atmosphere. It is crucial for the estimation of the greenhouse effect that the impact effects are long-lasting and have a global scope. In the IPCC (Intergovernmental Panel on Climate Change, Global Warming Potential) method, the greenhouse effect is measured by a quantity called GWP - Global Warming Potential. Carbon dioxide was chosen as the reference substance. For this reason, the obtained results are presented in kg CO₂ eq. The total indicator of the impact assessment on the greenhouse effect related to CO₂ is 1. The time horizon in the IPCC method is assumed at 20, 100 or 500 years. During the analyzes, 100 was assumed as the period of considering the impact of various gases on the greenhouse effect - the chosen procedure was IPCC 2013 GWP 100a. The obtained results of the carbon footprint analyzes were compiled for four groups of elements of the analyzed photovoltaic power plant: supporting structure, photovoltaic modules, inverter station and electrical installation. The total potential level of emissions of substances favoring the deepening of the greenhouse effect in the life cycle of the tested PV power

plant was $1.20 \cdot 10^4$ kg CO₂ eq (Tab. 1). The largest amount of greenhouse gases is emitted during the production of plastics, materials and components used in the production of photovoltaic modules and has a value of approx. $8.74 \cdot 10^3$ kg CO₂ eq, while the smallest - of electrical installation components (approx. $2.09 \cdot 10^2$ kg CO₂ eq) (Fig. 1).

Table 1 The results of characterizing the environmental consequences occurring in the life cycle of the analyzed photovoltaic power plant - IPCC 2013 procedure GWP 100a

Impact category	Unit	Pv power plant	Supporting structure	PV moduls	Inverter	Electrical installation
IPCC GWP 100a	kg CO ₂ eq	$1.20 \cdot 10^4$	$1.07 \cdot 10^3$	$8.76 \cdot 10^3$	$1.95 \cdot 10^3$	$2.09 \cdot 10^2$

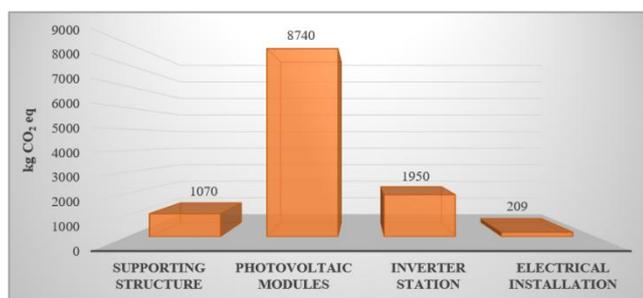


Figure 1: The results of characterizing the environmental consequences occurring in the life cycle of element groups of the analyzed photovoltaic power plant - IPCC 2013 procedure GWP 100a

Today, the increase of the greenhouse effect have the influence of many substances. Thanks to this treatment, the greenhouse potential of each substance can be expressed in units of CO₂ mass (most often in kg). This type of procedure makes it possible to determine the equivalent emissions of all substances included in a given analysis. The equivalent environmental load, expressing the global greenhouse potential for quantified greenhouse gases, is calculated using the relationship:

$$\Omega_{GWP} = \sum_{i=1}^m GWP_i O_i$$

where, GWP_i - the i-th substance equivalent in relation to carbon dioxide [kg CO₂ eq]; O_i - mass of i-th substance emitted to the environment [kg] [12].

In turn, the equivalents of individual loads to the potential global greenhouse effect are described by the formula:

$$GWP_j = \frac{\int_0^\tau a_i c_i(\tau) d\tau}{\int_0^\tau a_{CO_2} c_{CO_2}(\tau) d\tau}$$

where, a_i - radiation energy density of the i-th substance [W·(m² · kg)⁻¹]; c_i - concentration change of i-th substance in time [kg· m⁻³]; a_{CO₂} - CO₂ radiation energy density [W·(m² · kg)⁻¹]; c_{CO₂} - changes in CO₂ concentration over time [kg·m⁻³]; τ - considered time horizon of impact [years] [12].

Through this, it became possible to estimate the potential impact of individual substances on the formation of the total carbon footprint of individual groups of elements of the analyzed photovoltaic power plant. In the case of the supporting installation, made mainly of steel, the highest level of harmful emissions was recorded for carbon dioxide ($9.65 \cdot 10^2$ kg CO₂ eq) and methane ($9.4 \cdot 10^1$ kg CO₂ eq) (Tab. 2).

Table 2 The results of characterizing the environmental consequences occurring in the life cycle of the supporting structures of the analyzed photovoltaic power plant - IPCC 2013 procedure GWP 100a

No	Substance	Compartment	Unit	Total
1	Carbon dioxide,fossil	Air	kg CO ₂ eq	$9.65 \cdot 10^2$
2	Methane, fossil	Air	kg CO ₂ eq	$9.45 \cdot 10^1$
3	Dinitrogen monoxide	Air	kg CO ₂ eq	$3.65 \cdot 10^0$
4	Carbon dioxide, land transformation	Air	kg CO ₂ eq	$1.67 \cdot 10^0$
5	Methane, chlorodifluoro-, HCFC-22	Air	kg CO ₂ eq	$8.65 \cdot 10^{-1}$
6	Sulfur hexafluoride	Air	kg CO ₂ eq	$7.70 \cdot 10^{-1}$
7	Methane, biogenic	Air	kg CO ₂ eq	$1.95 \cdot 10^{-1}$
8	Methane, tetrafluoro-, CFC-14	Air	kg CO ₂ eq	$1.13 \cdot 10^{-1}$
9	Remaining substances	Air	kg CO ₂ eq	$2.19 \cdot 10^{-1}$
Total of all compartments				$1.07 \cdot 10^3$

Emissions of tetrafluoromethane ($1.86 \cdot 10^2$ kg CO₂ eq). together with methane ($9.05 \cdot 10^2$ kg CO₂ eq), and carbon dioxide ($7.50 \cdot 10^3$ kg CO₂ eq) are important for the structure of potential greenhouse gas emissions. Progressing global warming has for years remained one of the most important global problems in the field of environmental protection. In addition to the commonly known necessity to reduce CO₂ emissions, it is also very important to reduce emissions of methane, soot, hydrofluorocarbons, and ozone precursors (Tab. 3).

Table 3 The results of characterizing the environmental consequences occurring in the life cycle of photovoltaic modules of the analyzed photovoltaic power plant - IPCC 2013 GWP 100a procedure

No	Substance	Compartment	Unit	Total
1	Carbon dioxide,fossil	Air	kg CO ₂ eq	$7.50 \cdot 10^3$
2	Methane, fossil	Air	kg CO ₂ eq	$9.05 \cdot 10^2$
3	Ethane, hexafluoro-, HFC-116	Air	kg CO ₂ eq	$1.85 \cdot 10^1$
4	Dinitrogen monoxide	Air	kg CO ₂ eq	$5.45 \cdot 10^1$
5	Carbon dioxide, land transformation	Air	kg CO ₂ eq	$2.54 \cdot 10^1$
6	Methane, chlorodifluoro-, HCFC-	Air	kg CO ₂ eq	$1.52 \cdot 10^0$

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7	Sulfur hexafluoride	Air	kg CO ₂ eq	3.13·10 ¹
8	Methane, biogenic	Air	kg CO ₂ eq	1.52·10 ¹
9	Methane, tetrafluoro-, CFC-14	Air	kg CO ₂ eq	1.86·10 ²
10	Remaining substances	-	-	2.39·10 ¹
Total of all compartments			-	8.74·10 ³

The inverter station, built mainly of steel and aluminum, the structure of environmentally hazardous emissions substances was analogous to that of supporting structures, reaching the highest level for carbon dioxide (1.70·10³ kg CO₂ eq) and methane (1.68·10² kg CO₂ eq). Methane is an important greenhouse factor. It is true that it occurs in the atmosphere at a much lower concentration than CO₂, but its greenhouse potential is almost 20 times greater (Tab. 4).

Table 4 The results of characterizing the environmental consequences occurring in the life cycle of the inverter station of the analyzed photovoltaic power plant - IPCC 2013 GWP 100a procedure

No	Substance	Compartment	Unit	Total
1	Carbon dioxide, fossil	Air	kg CO ₂ eq	1.70·10 ³
2	Methane, fossil	Air	kg CO ₂ eq	1.68·10 ²
3	Ethane, hexafluoro-, HFC-116	Air	kg CO ₂ eq	2.87·10 ⁰
4	Dinitrogen monoxide	Air	kg CO ₂ eq	3.38·10 ¹
5	Carbon dioxide, land transformation	Air	kg CO ₂ eq	7.70·10 ⁰
6	Methane, chlorodifluoro-, HCFC-22	Air	kg CO ₂ eq	5.05·10 ⁻¹
7	Sulfur hexafluoride	Air	kg CO ₂ eq	6.25·10 ⁰
8	Methane, biogenic	Air	kg CO ₂ eq	2.25·10 ⁰
9	Methane, tetrafluoro-, CFC-14	Air	kg CO ₂ eq	2.89·10 ¹
10	Remaining substances	-	-	1.25·10 ⁻¹
Total of all compartments			-	1.95·10 ³

The electrical installation was the last considered group of elements of the tested photovoltaic power plant. Its carbon footprint (2.09·10² kg CO₂ eq in total) (Tab. 5) was the lowest because the weight of cables and wires was small compared to supporting structures, photovoltaic modules or inverter stations. However, it should be noted that the main material of the cables is copper. Copper production is an material-intensive and energy-consuming process. The big importance of activities promoting the recycling of elements made of this raw material. Obtaining a ton of copper from primary sources is related to the energy expenditure of approx. 140 GJ, from low-copper scrap - it is 90 GJ less, from copper scrap of the 2nd grade - by 120 GJ less, and from the 1st grade - only approx. 5 GJ is needed energy [13].

The results of characterizing the environmental consequences occurring in the life cycle of the electrical installation of the analyzed photovoltaic power plant - IPCC 2013 procedure GWP 100a

No	Substance	Compartment	Unit	Total
1	Carbon dioxide, fossil	Air	kg CO ₂ eq	1.78·10 ²
2	Methane, fossil	Air	kg CO ₂ eq	1.42·10 ¹
3	Ethane, hexafluoro-, HFC-116	Air	kg CO ₂ eq	4.45·10 ⁻²
4	Dinitrogen monoxide	Air	kg CO ₂ eq	1.47·10 ¹
5	Carbon dioxide, land transformation	Air	kg CO ₂ eq	1.60·10 ⁻¹
6	Methane, chlorodifluoro-, HCFC-22	Air	kg CO ₂ eq	4.23·10 ⁻¹
7	Sulfur hexafluoride	Air	kg CO ₂ eq	5.15·10 ⁻¹
8	Methane, biogenic	Air	kg CO ₂ eq	4.77·10 ⁻¹
9	Methane, tetrafluoro-, CFC-14	Air	kg CO ₂ eq	4.23·10 ⁻¹
10	Remaining substances	-	-	1.25·10 ⁻¹
Total of all compartments			-	2.09·10 ²

4. Conclusions

The aim of the study was achieved by demonstrating that the carbon footprint assessment using the IPCC method can become one of the tools for effective control of the life cycle of a photovoltaic power plant. The study used the selected LCA - IPCC 2013 GWP 100a procedure. The differences in the level of the carbon footprint generated during the material phases of the life cycle of selected groups of elements of a 2 MW photovoltaic power plant was defined. The total potential level of greenhouse gas emissions in the life cycle of the tested PV power plant was 1.20·10⁴ kg CO₂ eq (Tab. 1). The largest amount of substances favoring the deepening of the greenhouse effect is emitted during the production of plastics, materials and components used in the production of photovoltaic modules (approx. 8.74·10³ kg CO₂ eq). While the smallest - during the production of electrical installation components (approx. 2.09·10² kg CO₂ eq) (Fig. 1).

References

- [1] Łasut P., Kulczycka J., *Metody i programy obliczające ślad węglowy*, No. 87, pp. 137-147, 2014
- [2] Kłós, L. (2014). Ślad ekologiczny jako nieekonomiczny miernik jakości życia społeczeństwa. *Studia Ekonomiczne*, 166.
- [3] Horvath A., *Life-Cycle Assessment of Semiconductors*, London, Springer, 2012
- [4] Ciambone D.F., *Environmental Life Cycle Analysis*, CRC Press, 2018
- [5] Jolliet O., Saade-Sbeih M., Shaked S., Jolliet A., Crettaz P., *Environmental Life Cycle Assessment*, CRC Press, 2016
- [6] Flizikowski J., *Rozprawa o konstrukcji*, Bydgoszcz-Radom, Wydawnictwo I Zakład Poligrafii Instytutu Technologii Eksploatacji, 2002
- [7] Baran J., *Life Cycle Approach-based methods-overview, applications and implementation barriers*, No. 136, pp. 9-23, 2019

- [8] Lewandowska A., *Environmental life cycle assessment as a tool for identification and assessment of environmental aspects in environmental management systems (EMS) part 1 – methodology*. *Int. J. Life Cycle Assess*, 16(2), 178-186, 2012
- [9] Zarębska, J., Dzikuć, M., *Determining the environmental benefits of life cycle assessment (LCA) on example of the power industry*. *Scientific Journals Maritime University of Szczecin*. 34, 97-102, 2013
- [10] Górczyński J., *Podstawy analizy środowiskowej wyrobów i obiektów*, Warszawa, Wydawnictwo Naukowo-Techniczne, 2007
- [11] ISO 14043-2000 *Environmental management – Life cycle assessment – Life cycle interpretation*
- [12] Guinée J., *Handbook on Life Cycle Assessment: Operational Guide to the ISO Standards*, Springer, Berlin, 2012
- [13] Sasmal J., *Resources, Technology and Sustainability*, Springer, Singapore, 2016

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REGULATION OF PROTEASE ACTIVITY BY SYNTHETIC INHIBITORS

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Abstract: Serine proteases are an important group of enzymes involved in many physiological processes, especially digestive processes. However, higher protease activity may pose a potential risk of serious gastrointestinal diseases such as pancreatitis, inflammatory bowel disease or cancer. Protease activity can be regulated by inhibitors, and these compounds may not only be part of natural compounds, but a large group also consists of synthetic compounds. Therefore, the aim of this work was to perform a mini-review focusing on synthetic compounds. Of particular interest are benzimidazole or aniline derivatives which have shown a competitive and mixed type of serine protease inhibition, respectively.

Keywords: serine protease, inhibition, inhibitor, gastrointestinal tract

1. Introduction

Proteases (proteinases, peptidases) represent a significant group of enzymes involved in various physiological processes. These enzymes are present in all living organisms, and an important group are mainly serine proteases, which are also involved in digestive processes [1-4]. Serine proteases found in the gastrointestinal tract (GIT) are trypsin, chymotrypsin, chymotrypsin C or pancreatic elastase [5,6]. Although they represent physiologically important proteins, their activity must be regulated in the body by specific mechanisms such as expression in the form of inactive zymogens, or activation in defined tissues and at time. Other options are inhibitors produced directly by the organism (endogenous) or produced by microorganisms, plants or other animals (exogenous). This regulation is essential for the proper functioning of the human body because when the activity of serine proteases is increased or decreased, the homeostasis of the organism is disturbed and serious GIT diseases occur [7-10].

2. Regulation of protease activity

The involvement of endogenous proteases in pathophysiological conditions is a relatively new area of pharmacology and medicine research [11-15]. The primary regulatory mechanisms of serine proteases in the human body are their production in the zymogens and their subsequent activation and termination in defined tissues and over time. However, this system can be easily influenced by various genetic, physiological, and exogenous factors disrupting this system, leading to the emergence and development of GIT diseases.

2.1 Synthesis of proteases as zymogens and their activation in defined tissues and at time

Most proteases are produced as inactive precursors, zymogens, which are activated during proteolysis, exceptionally by other activation mechanisms. Activation of zymogens is ensured by activation cascades in which the protease zymogen is a substrate for the active serine protease [16]. This process runs in parallel with the

digestion of nutrients from food, and pancreatic trypsinogen is activated directly in the small intestinal lumen by enteropeptidase or by serine proteases located in the brush border of intestinal epithelial cells [17]. Active trypsin subsequently activates other zymogens such as chymotrypsinogen, procarboxypeptidase, proelastase and prolipase [18]. Activation cascades of zymogens generally do not run separately and may even form protease networks, known primarily from the processes of cell migration or degradation of the extracellular matrix [19].

Activation in defined tissues and at time is provided by the localization of proteases in the extracellular or intracellular space and their activation by specific receptors. Mast cell proteases (tryptase, chymase, granzyme B) are produced in response to inflammation, infection or injury to the tissues [16]. Other proteases, such as plasminogen activators, are secreted in the pericellular environment through reaction with specific surface receptors [20]. Their activity is crucial for angiogenesis, inflammatory processes, and cell migration in the GIT.

2.2 Consequences of GIT protease dysregulation

As mentioned above, dysregulation of proteolytic activity leads to the development of various GIT diseases. The pancreas is the first part of the tract negatively affected by endogenous proteases and also is their source. Trypsin referred to as the central pathogenic factor in these diseases, plays a key role in pancreatic diseases. In terms of early trypsinogen activation or lack of inhibition of early-activated trypsin, changes in the PRSS1, SPINK1 and CRTC genes are also key factors influencing the development of pancreatic diseases [21].

Inflammatory bowel diseases (IBD), such as Crohn's disease (CD) or ulcerative colitis, are induced by dysregulation of the immune response to microbial antigens present in the host's GIT. Therefore, disruption of the intestinal epithelial barrier is an essential factor causing inflammatory bowel disease [22], which can progress to cancer in various parts of the GIT [23]. By breaking the

epithelial barrier, the lining of the intestine is damaged by proteolysis [24]. Their negative effect on the development of colorectal cancer and the promotion of proliferation, invasion and metastasis of cancer in the body (specifically trypsin) have also been described by Soreide et al. (2006) [25]. Proteases are involved in the development of these diseases directly, for example, by their hydrolytic activity against collagen, cancer cells can spread to the basement membrane of the intestine, as well as indirectly through the activation of other protease cascades [26]. In addition to trypsin, other endogenously produced GIT serine proteases, such as chymotrypsin and pancreatic elastase, show increased activity in samples obtained from patients suffering from these diseases [27].

Similarly, inflammation can also occur due to protease-activated receptors (GIT PARs), PAR1, PAR2, PAR3 and PAR4, present throughout the GIT. As their name implies, they are activated by proteolytic cleavage, releasing the extracellular N-terminal domain [28]. The newly released N-terminal domains act as ligands to induce intracellular processes leading to anti-inflammatory, prokinetic and proliferative effects. However, as reported in several works [29, 30], activation of PAR1, PAR2 and PAR4 by proteases in the colon leads to inflammatory processes and infections of this part of the GIT.

Conventional treatment of GIT diseases generally involves the suppression of symptoms resulting from a pathological abnormality in the organism [31]. According to the current state of knowledge in this field, therapeutic treatment could be much more precisely focused on the cause of these diseases. This strategy is a more effective and safer method than administering immunomodulators and ligands to selected receptors [32-34].

2.3 Termination of protease activity

Termination of protease activity is a physiologically important regulatory mechanism, enabled by endogenous inhibitors and autohydrolysis of proteolytic activity of the enzymes. Endogenous inhibitors are the body's serpins that irreversibly bind to proteases and the complexes formed are easily detectable for specific receptors [34, 35]. Another termination option is exogenous inhibitors, which may be natural (compounds present in plants, animals and microorganisms) or synthetic [36, 37]. A potentially interesting group of inhibitors are synthetically formed inhibitors, benzimidazole or nitroaniline derivatives [38, 39].

2.4 Synthetic inhibitors of serine proteases

Intestinal diseases and inflammatory diseases of the GIT are currently treated with drugs that keep the disease under control, reduce mucositis, alleviate the symptoms of the disease, but do not inhibit pancreatic enzymes. The most commonly used are aminosalicylates, corticosteroids, immunomodulators and antibiotics, and the latest treatment option is the use of antibodies. However, the use of synthetically produced compounds with serine protease inhibitory activity, such as benzamidazole, benzoxazinone,

benzimidine and aniline derivatives, is also a possible treatment for these diseases [38, 39] (Figure 1).

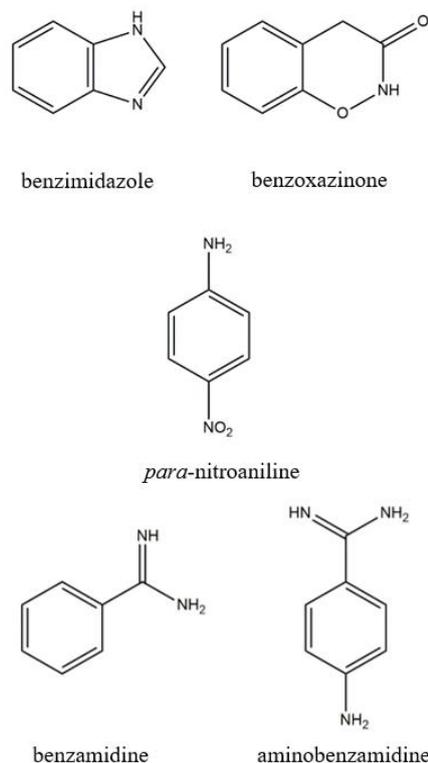


Figure 1: Primary structures of synthetically designed compounds with inhibitory effect against serine protease.

From a structural point of view, benzimidazole and its derivatives are of interest, which possess antimicrobial [40], antiprotease [41], as well as anti-inflammatory activity [42]. Siddiqui et al. [41] evaluated the inhibitory effect of 20 6-chlorobenzenimidazole derivatives on α -chymotrypsin. The strongest inhibitor was derivative 1 (6-chloro-2-(3,4-dimethoxyphenyl)-1H-benzimidazole), which showed a higher inhibition constant $K_i = 16.4 \mu\text{mol/l}$ compared to the standard (chymostatin). Competitive type of inhibition was demonstrated for all derivatives except derivative 17 (3-(6-chloro-1H-benzimidazol-2-yl) phenylmethyl ether), which showed mixed type of inhibition. These results suggest that the location of substituents in the *para* and *ortho* positions of the phenyl ring has an important effect on the inhibitory activity of the synthesized benzimidazole derivatives. Synthetically prepared phenol derivatives were also tested for protease activity in a study by Tamura et al. [43] in which the authors noted their significant effect on trypsin, plasmin, chymotrypsin C, thrombin and esterase. The inhibitory effect of synthesized potassium organotrifluoroborates was studied against α -chymotrypsin and trypsin in Smoum et al. [44]. All synthesized compounds were identified as non-covalent, competitive, reversible serine protease inhibitors.

Similarly, benzoxazinone derivatives have been described as potent inhibitors of chymotrypsin [45, 46] or human

chymase [47]. Neumann et al. [47] synthesized 14 benzoxazinone derivatives and validated their activity against chymase, cathepsin G and chymotrypsin. The highest effect was observed against chymase and the K_i ranged from 11 to 17 $\mu\text{mol/l}$. Similarly, the work of Khan et al. [45] evaluated the inhibitory effect of oxazolones on the proteolytic activity of chymotrypsin, and found that substitutions of functional groups at positions of C-2 and C-4 had a significant effect on inhibitory properties. Marasini et al. [46] further found that the location of strong donor groups on the phenyl ring indicates a suitable inhibitory activity of these compounds in the order of *ortho* > *meta* > *para*, but the presence of any functional group attached to the benzene ring skeleton reduces the inhibitory potential of benzoxazine compounds. The authors studied a series of derivatives and noted in particular mixed types of inhibition with K_i values ranging from 4.7 to 341.2 $\mu\text{mol/l}$. Also, of interest are aminobenzamidine and benzamidine, which Sousa et al. [48] identified as tissue inhibitors effective against tissue kallikrein, and *para*-nitroaniline and *ortho*-nitroaniline, which showed a mixed type of inhibition.

3. Conclusion

Inadequate activity of serine proteases in the GIT can be the cause of several serious diseases, such as pancreatitis or inflammatory bowel disease. Their activity can be regulated not only by the use of natural compounds but also by synthetically produced inhibitors. An important group of inhibitors includes bendamidazole and its derivatives, which have an inhibitory effect on several serine proteases present in the GIT. Substituents and their position on the benzene ring of the synthetic compounds also play an important role. Although the cost of the overall process may increase due to the synthesis and purification of potential inhibitors, this group of compounds represents an interesting therapeutic option for the treatment of GIT diseases in addition to natural inhibitors.

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References

- [1] Haley SA, Wessel GM, *Molecular Biology of the Cell*, Vol. 15, No. 5, pp. 2084-2092, 2004.
- [2] Moffitt KL, Martin SL, Walker B, *Biochemical Society Transaction*, Vol. 35, No. 3, pp. 559-560, 2007.
- [3] Heutinck KM, Berge IJM, Hack CE, Hamann J, Rowshani A, *Molecular Immunology*. Vol. 47, No. 11-12, pp. 1943-1955, 2010.
- [4] Pattel S, *Allergologia et Immunopathologia*, Vol. 46, No. 6, p. 579-591, 2017
- [5] Walker B, Lynas J, *Cellular and Molecular Life Sciences: CMLPP*, Vol. 58, No. 4, pp. 596-624, 2001.
- [6] Horn M, Fajtová P, Arreola LR, Ulrychová L, Bartošková-Sojtková P, Franta Z, Protasio AV, Opavský D, Vondrášek J, McKerrow JH, Mareš M, Caffrey CR, Drořák J, *Plos Neglected Tropical Disease*, Vol. 8, No. 3, e2766, 2014.
- [7] Teich N, Ockenga J, Hoffmeister, Manns M, Mossner J, Keim V, *Gastroenterology*, Vol. 119, No. 2, pp. 461-465, 2000.
- [8] Hedeman PP, Jensen BB, *Archives of Animal Nutrition*, Vol. 58, No. 1, pp. 47-59, 2004.
- [9] Kavutharapu PP, Nagalla B, Abbagani V, Porika SK, Akka J, Nallari P, Ananthapur V, *Saudi Journal of Gastroenterology*, Vol. 18, No. 6, pp. 364-368, 2012.
- [10] Xie Y, Chen L, Lv X, Hou G, Wang Y, Jiang C, Zhu H, Xu N, Wu L, Lou X, Liu S, *Oncotarget*, Vol. 7, No. 22, pp. 32592-32606, 2016.
- [11] Qin X, *World Journal of Gastroenterology*, Vol. 20, No. 35, pp. 12709-12710, 2014.
- [12] Edgington-Mitchell LE, *American Journal of Physiology. Gastrointestinal and Liver Physiology*, Vol. 310, No. 4, pp. 234-239, 2016.
- [13] Vergnolle N, *Gut*, Vol. 65, No. 7, pp. 1215-1224, 2016.
- [14] Zhang Y, Thanou M, Vllasaliu D, *European Journal of Pharmaceutics and Biopharmaceutics*, Vol. 155, pp. 128-138, 2020.
- [15] Wörn W, Bohnert BN, Alenazi F, Boldt K, Klose F, Junger K, Ueffing M, Birkenfeld AL, Kalbacher H, Artunc F, *Journal of Proteomics*, Vol. 230, e103981, 2021.
- [16] Antalis TM, Shea-Donohue T, Vogel SN, Sears C, Fasano A, *Nature Clinical Practice Gastroenterology & Hepatology*, Vol. 4, No. 7, pp. 393-402, 2007.
- [17] Neurath H, Walsh KA, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 73, No. 11, pp. 3825-3832, 1976.
- [18] Halangk W, Krüger B, Rutenbürger M, Stürzebecher J, Albrecht E, Lippert H, Lerch MM, *American Journal of Physiology. Gastrointestinal and Liver Physiology*, Vol. 282, No. 2, pp. 367-374, 2002.
- [19] Sevenich L, Joyce JA, *Genes & Development*, Vol. 28, No. 21, pp. 2331-2347, 2014.
- [20] Miles LA, Plow EF, Waisman DM, Parmer RJ, *Journal of Biomedicine and Biotechnology*, Vol. 2012, pp. 1-3, 2012.
- [21] Hegyi E, Sahin-Tóth M, *Digestive Diseases and Sciences*, Vol. 62, No. 7, pp. 1692-1701, 2017.
- [22] Pastorelli L, De Salvo C, Mercado JR, Vecchi M, Pizarro TT, *Frontiers in Immunology*, Vol. 4, pp. 280-286, 2013.
- [23] Lahey KA, Ronaghan NJ, Shang J, Dion SP, Désilets A, Leduc R, MacNaughton WK, *Plos One*, Vol. 12, No. 7, e0180259, 2017.
- [24] Herszényi L, Barabás L, Hritz I, István G, Tulassay Z, *World Journal of Gastroenterology*, Vol. 20, No. 37, pp. 13246-13257, 2014.
- [25] Soreide K, Janssen EAM, Körner H, Baak JPA, *The Journal of Pathology*, Vol. 209, No. 2, pp. 147-156, 2006.
- [26] Rakashanda PP, Rana F, Rafiq S, MAsood A, Amin S, *Biotechnology and Molecular Biology Review*, Vol. 7, No. 4, pp. 90-101, 2012.
- [27] Keller J, Layer P, *Pancreapedia: Exocrine Pancreas Knowledge Base*. 2015. <https://doi.org/10.3998/panc.2015.37>.

- [28] Kawabata A, *Life Sciences*, Vol. 74, No. 2-3, pp. 247-254, 2013.
- [29] Ramachandran R, Hollenberg MD, *British Journal of Pharmacology*, Vol. 153, No. 1, pp. 263-283, 2008.
- [30] Vergnolle N, *The International Journal of Biochemistry & Cell Biology*, Vol. 40, No. 6-7, pp. 1219-1227, 2008.
- [31] Salaga M, Sobczak M, Fichna J, *Drug Discovery Today*, Vol. 18, No. 15-16, pp. 708-715, 2013.
- [32] Bressler B, Bethel KP, Kleef R, Reynolds SL, Sutcliffe S, Mullins DW, Gunn H, *Gastroenterology Research and Practice*, Vol. 2015, pp. 1-8, 2015.
- [33] Gutiérrez PP, Pérez-Andrés J, Martínez-Blanco H, Ferrero MA, Vaquero L, Vivas S, Casqueiro J, Rodríguez-Aparicio LB, *Molecular Metabolism*, Vol. 6, No. 7, pp. 693-702, 2017.
- [34] Van Spaendonk H, Ceuleers H, Witters L, Patteet E, Joossens J, Augustyns K, Lambeir AM, De Meester I, De Man JG, *World Journal of Gastroenterology*, Vol. 23, No. 12, pp. 2106-2123, 2017.
- [35] Antalis TM, Lawrence DA, *Methods*, Vol. 32, No. 2, pp. 130-140, 2004.
- [36] Habib H, Fazili KM, *Biotechnology and Molecular Biology Review*, Vol. 2, No. 3, pp. 68-85, 2007.
- [37] Jamal F, Pandey PK, Singh D, Khan MY, *Phytochemistry Reviews*, Vol. 12, No. 1, pp. 1-34, 2013.
- [38] Radwan TM, El-Hashash MAA, Wasfy AAHF, Abdallah SA, *Chemistry Select*, Vol. 4, No. 48, pp. 14056-14062, 2019.
- [39] Shi, H, Liu C, Cui J, Cheng J, Lin Y, Gao L, Luo R, *New Journal of Chemistry*, Vol. 60, No. 44, 20921-20929, 2020.
- [40] Özkay Y, Tunali Y, Karaca H, İşikdağ I, *Archives of Pharmacal Research*, Vol. 34, No. 9, pp. 1427-1435, 2011.
- [41] Siddiqui H, Farooq R, Marasini BP, Malik R, Syed N, Syed N, Moin ST, Rahman AU, Choudhary MI, *Bioorganic & Medicinal Chemistry*, Vol. 24, No. 16, pp. 3387-3395, 2016.
- [42] Gaba M, Singh S, Mohan C, *European Journal of Medicinal Chemistry*, Vol. 76, pp. 494-505, 2014.
- [43] Tamura Y, Hirado M, Okamura K, Minato Y, Fujii S, *Biochimica et Biophysica Acta (BBA) – Enzymology*, Vol. 484, No. 2, pp. 417-422, 1977.
- [44] Smoum R, Rubinstein A, Srebnik M, *Organic & Biomolecular Chemistry*, Vol. 3, No. 5, pp. 941-944, 2005.
- [45] Khan KM, Mughal UR, Lodhi MA, Choudhary MI, *Letters in Drug Design & Discovery*, Vol. 5, No. 1, pp. 52-56, 2008.
- [46] Marasini BP, Rahim F, Perveen S, Karim A, Khan KM, Rahman AU, Choudhary MI, *Bioorganic Chemistry*, Vol. 70, pp. 210-221, 2017.
- [47] Neumann U, Schechter NM, Gütschow M, *Bioorganic & Medicinal Chemistry*, Vol. 9, No. 4, pp. 947-954, 2001.
- [48] Sousa MO, Miranda TL, Costa EB, Bittar ER, Santoro MM, Figueiredo AF, *Brazilian Journal of Medical and Biotechnological Research*, Vol. 34, No. 1, pp. 35-44, 2001.

LACCASE PRODUCTION BY THE WHITE-ROT FUNGUS *PLEUROTUS OSTREATUS* UNDER SOLID-STATE CONDITIONS

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Abstract: Laccases are the important enzymes capable of breaking down pollutants in the environment. However, the key factor for their use in industrial applications is their efficient production. *Pleurotus ostreatus* producing laccases with a high redox potential appears to be useful for this purpose. A suitable way of cultivating it is to use solid-state cultivation, which mimics its natural environment. The aim of this work was to prepare a literature review about the use of solid-state cultivation to produce laccases by the white-rot fungus *P. ostreatus*. Although, other lignocellulosic wastes such as peanut shells, sugarcane bagasse, banana peels, rice straw, ground coffee, potato peels, wheat straw, tree leaves, apple peels, neem husk waste or hemp woody core were also used, high laccase activities were measured in media containing wheat bran as a substrate. The use of water as a moistening agent was sufficient to ensure moisture (66 – 80 %), although the addition of an organic or inorganic nitrogen source to the medium meant an increase in laccase production. This culture medium usually contained a source of phosphorus, calcium, magnesium and zinc. Moreover, inducers such as copper ions or ferulic acid are also used in some culture media.

Keywords: laccase, white-rot fungi, *Pleurotus ostreatus*, solid-state cultivation

1. Introduction

Laccases (benzenediol: oxygen oxidoreductase, EC 1.10.3.2) are extracellular enzymes that use molecular oxygen to oxidize a variety of aromatic and non-aromatic compounds by a radical-catalyzed reaction mechanism [1]. They belong to the larger group of blue multi-copper oxidase enzymes. *Pleurotus ostreatus* is a white-rot fungus known to produce laccases with high redox potential. *P. ostreatus* produces several laccase isoenzymes such as LACC10 (POXC), LACC6 (POX1b), LACC2 (POXA3), POXA3a, POXA3b, and LACC12 [2-4]. In addition to these characterized proteins, several other laccase genes have been discovered in *P. ostreatus*, including LACC1 (POX4), LACC4 (POX3), and LACC11 (POX5) [5]. Following the release of the *P. ostreatus* genome, a more complex multi-gene laccase family with 12 members (LACC1-LACC12) was revealed [6].

Currently, one of the methods used for laccase production by the white-rot fungus *P. ostreatus* is submerged cultivation, but solid-state cultivation appears to be more efficient. The advantages of this type of cultivation are that it mimics the growth and reproduction conditions of fungi in nature, very low probability of contamination by bacteria or yeasts, as well as higher enzyme yields in a shorter time [7]. The aim of this research is to review the use of solid-state cultivation for laccase production by the white-rot fungus *P. ostreatus*.

2. Solid-state fermentation

Solid-state fermentation (SSF) is a type of fermentation that is particularly interesting in terms of its industrial applications. It is an attractive alternative to submerged fermentation (SmF). However, most of the enzyme production is carried out via SmF. This technique

reproduces natural microbiological processes such as composting and ensiling. In industrial applications, this natural process can be used in a controlled manner to produce the desired product. However, SSF has several advantages over the traditionally used SmF [7]. One of the advantages often cited for SSF processes is that the number of enzymes is higher than SmF compared to the same strain and fermentation medium [8]. Castilho et al. [9] performed a comparative economic analysis of SmF and SSF processes on the production of lipases produced by the filamentous fungus *Penicillium restrictum*. They found that to produce 100 m³ of lipase concentrate per year, if the SmF-based process requires a total capital investment 78 % higher than the SSF-based production. Table 1 summarizes the general advantages as well as disadvantages of SSF.

SSF is a microbial process occurring on the surface of a solid material that may absorb or contain water in the presence or absence of soluble nutrients. SSF is a technique particularly suitable for the cultivation of filamentous fungi. SSF can be carried out in two different ways. In the first case, the organic material serves as both a carrier and a substrate for the filamentous fungi without free aqueous solution; in the second case, the inert material serves as a carrier for the producing organism and the latter is impregnated with the nutrient solution. Therefore, even the wide range of solid materials used in SSF can be divided into two categories, namely, inert materials, which serve only as attachment sites for the microorganisms, and non-inert materials, which not only serve as attachment sites but also supply some nutrients to the microorganisms [10]. These materials are usually lignocellulosic wastes generated from various industrial applications [11]. In addition, the use of this type of support helps to address

the economic and environmental problems caused by their disposal. However, the production of laccase is greatly influenced by the choice of lignocellulosic material.

Table 1 Advantages and disadvantages of SSF [7]

Advantages	Disadvantages
Higher enzyme yields in a shorter time	Possible use of only microorganisms that can grow at low humidity
Low water availability reduces the amount of potential yeast or bacterial contamination	Substrate usually requires pre-treatment (grinding, homogenization, hydrolysis)
Possible inoculation with spores, allowing them to be evenly distributed throughout the medium	Determination of the amount of biomass is complicated
Culture media are usually very simple in composition (usually only lignocellulosic substrate is sufficient)	Use of larger amounts of inoculum
Simple design reactors with low space requirements	Difficult mixing control
Low energy costs	Difficult removal of heat generated during growth of the microorganism
Better oxygen circulation	Difficult control of culture conditions (pH, temperature, nutrients, etc.)
Resembles the natural environment for the growth of filamentous fungi	Less knowledge of SSF by researchers
Easier down-stream processing	Increased product impurity, thus increasing the cost of product purification

However, there are few experimental articles dealing with the production of ligninolytic enzymes using SSF on inert supports [12,13], despite the fact that the extraction of the products is less complicated than using natural supports because the extracellular product can be easily extracted from the inert support and the products are obtained with fewer impurities [13].

Although SSF works with a non-inert lignocellulosic substrate, which should provide all the nutrients to the producing organism, authors in their work focused on laccase production by white-rot fungi typically wet this substrate with a medium containing carbon and nitrogen sources at low concentrations. In addition, the medium also contained microelements and trace elements such as potassium, phosphorus, sodium and magnesium. The medium had a pH between 4.5 and 6.2, and cultivation was usually carried out at a temperature of 25-30 °C.

2.1 Laccase production by *P. ostreatus*

P. ostreatus (the well-known white-rot fungus) was selected for its relatively high laccase activity compared to other laccase-producing fungi. *P. ostreatus* is a common edible mushroom also known as oyster mushroom. It was first cultivated in Germany as a means of subsistence during World War I [14]. It is now commercially cultivated worldwide for food purposes. This mushroom is a fast-growing fungus, with growth rates ranging from 0.85 to 1.94 cm/day depending on the strain [15-18].

Laccase production by this white-rot fungus is more efficient under solid-state conditions. Mazumder et al. [19], for example, observed that higher yields of laccase produced by *P. ostreatus* were obtained using SSF than SmF. In the works, lignocellulosic wastes such as groundnut shell, sugarcane bagasse, wheat bran, banana peelings, rice straw, spent coffee ground, potato peels, wheat straw, tree leaves, apple peels, neem hull waste or hemp woody core were used as a source of nutrients [20-28]. Although it is generally difficult to compare results from several studies, wheat bran is a suitable substrate for laccase production. Wheat bran is an abundant by-product resulting from the preparation of wheat flour. The physical integrity of wheat bran serves as a support material and provides an environment similar to the natural habitat of fungi, thus promoting their growth, and is also a rich source of hydroxycinnamic acids, especially ferulic and *p*-coumaric acids, which are known to stimulate laccase production [22].

The moisture content of the solid-state media for *P. ostreatus* laccase production ranged from 66 to 80 %. However, in addition to lignocellulosic material, some authors have used the culture medium as a moistening agent, which provided sufficient moisture, but also as a source of nutrients for *P. ostreatus*. In the work of Patel et al. [28], glucose was used as a carbon source, although the medium also contained potato peels. Otherwise, the authors did not typically use the addition of a carbon source to solid-state media. Asparagine, yeast extract, as well as inorganic ammonium nitrate have been used as nitrogen sources [22, 24-28]. Among other compounds, phosphate as a source of phosphorus, magnesium sulphate, calcium chloride, zinc sulphate, cobalt chloride, ferrous sulphate, potassium chloride has been used.

In addition, laccase inducers have also been used in some works. The most common are copper ions at a concentration of 0.15-1.25 mM [22,24,25,28], but also ferulic acid at a concentration of 2 mM [25], resorcinol, methionine or tannic acid [22]. Iron ions are involved in the regulation of laccase production at the transcriptional level by inducing laccase activity in intact cells by transcriptional mechanisms [29], but high concentrations of iron ions can disrupt the electron transfer and substrate conversion system of laccase [30] and affect laccase activity [31]. Manganese is one of the potent inducers of laccases as it stimulates both their activity and expression [32]. The presence of copper enhances the catalytic activity of laccases. There is also a metal responsive element in the promoter region that is responsible for the increase in laccase production induced by the presence of metal [33].

The temperature and pH during cultivation of the white-rot fungus *P. ostreatus* were 30 °C and 5.0, respectively [20-28].

Laccase should be obtained when the cultivation is completed. For this purpose, extraction with distilled water

or a suitable buffer is sufficient. In works focusing on laccase production by the white-rot fungus *P. ostreatus*, the authors used deionized water [21,26] and also buffers such as acetate or citrate buffer with pH ranging from 4.5 to 5.0 [22-24,27,28]. The extraction was carried out at a temperature ranging from 27-29 °C for 0.5-5.0 hours. In rare cases, an ice bath was used to extract the laccases after SSF [23,25], although there is no reason for this as laccases are known to be stable.

3. Conclusion

SSF represents a promising tool for the cheap and efficient production of fungal laccases. *P. ostreatus* is an important producer of laccases with a high redox potential, which are able to degrade even difficult-to-degrade compounds. Wheat bran appears to be a suitable lignocellulosic material for laccase production by *P. ostreatus* under solid-state conditions. The use of distilled water as a moistening agent instead of a complete culture medium seems to be sufficient for laccase production. The advantage of using this type of fungus for laccase production is also its commercial value. Thus, if an environmentally acceptable method of laccase extraction process is used, the fruiting bodies of this mushroom can be further used for consumption.

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References

- [1] Thurston CF, *Microbiology*, Vol. 140, pp. 19-26, 1994.
- [2] Giardina P, Aurilia V, Cannio R, Amoresano A, Siciliano R, Pucci P, Sannia G, *European Journal of Biochemistry*, Vol. 23, pp. 508-515, 1996.
- [3] Giardina P, Palmieri G, Scaloni A, Fontanella B, Faraco V, Cennamo G, Sannia G, *Biochemical Journal*, Vol. 34, pp. 655-663, 1999.
- [4] Palmieri G, Giardina P, Bianco C, Fontanella B, Sannia G, *Applied and Environmental Microbiology*, Vol. 66, No. 3, pp. 920-924, 2000.
- [5] Pezzela C, Autore F, Giardina P, Piscitelli A, Sannia G, Faraco V, *Current Genetics*, Vol. 55, No. 1, pp. 45-57, 200.
- [6] Riley R, Salamov AA, Brown DW, Grigoriev IV, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 111, No. 27, pp. 9923-9928, 2014.
- [7] Robinson T, McMullan G, Marchant R, Nigam P, *Bioresource Technology*, Vol. 77, No. 3, pp. 247-255, 2001.
- [8] Viniegra-González G. *Advances in Bioprocess Engineering II, Dordrecht: Kluwer Academic Publishers*, ISBN 978-0-7923-4923-5, pp. 123-136, 1998.
- [9] Castilho R, Polato CMS, Baruque EA, Sant'Anna GL Jr, Freire D, *Biochemical Engineering Journal*, Vol. 4, No. 3, pp. 239-247, 2000.
- [10] Durand A, Renaud R, Almanza S, Maratray J, Diez M, Desgranges C, *Biotechnology Advances*, Vol. 11, No. 3, pp. 591-597, 1993.
- [11] Pandey A, Soccol CR, Mitchell D, *Process Biochemistry*, Vol. 35, No. 10, pp. 1153-1169, 2000.
- [12] Couto S, *Journal of Hazardous Materials*, Vol. 233-234, pp. 158-162, 2012.
- [13] Ooijkaas LP, Weber FJ, Buitelaar RM, Tramper J, Rinzema A, *Trends in Biotechnology*, Vol. 18, No. 8, pp. 356-360, 2000.
- [14] Eggert C, Temp U, Eriksson KE, *Applied and Environmental Microbiology*, Vol. 62, No. 4, pp. 1151-1158, 1996.
- [15] Hoa HT, Wang C-L, *Mycobiology*, Vol. 43, No. 1, pp. 14-23, 2014.
- [16] Barreto JAR, Anaguano AH, *Ciencia En Desarrollo*, Vol. 5, No. 2, pp. 197-205, 2014.
- [17] Sardar H, Ali MA, Ayyub M, Ahmad R, Pak J, *Phytopathology Journal*, Vol. 27, No. 2, pp. 139-145, 2015.
- [18] Fletcher I, Freer A, Ahmed A, Fitzgerald P, *Cohesive Journal of Microbiology & Infectious Disease*, Vol. 2, No. 5, 2019.
- [19] Mazumder S, Basu SK, Mukherjee M, *Engineering in Life Sciences*, Vol. 9, No. 1, pp. 45-52, 2009.
- [20] Mishra A, Kumar S, *Process Biochemistry*, Vol. 42, No. 4, pp. 681-685, 2007.
- [21] Dong XQ, Yang JS, Zhu N, Wang ET, Yuan HL, *Bioresource Technology*, Vol. 131, pp. 443-451, 2013.
- [22] El-Batal AI, El-Kenawy NM, Yassin AS, Amin MA, *Biotechnology Reports (amst)*, Vol. 5, pp. 31-39, 2014.
- [23] Xie C, Gong W, Yang Q, Zhu Z, Hu Z, Peng Y, *Bioresource Technology*, Vol. 243, pp. 188-195, 2017.
- [24] Ergun OS, Urek RO, *Annals of Agrarian Science*, Vol. 15, No. 2, pp. 273-277, 2017.
- [25] Karp SG, Faraco V, Amore A, Birolo L, Giangrande C, Soccol T, Pandey A, Soccol CR, *Bioresource Technology*, Vol. 114, pp. 735-739, 2012.
- [26] Elisashvili V, Kachlishvili E, Penninckx M, *Journal of Industrial Microbiology and Biotechnology*, Vol. 35, No. 11, pp. 1531-1538, 2008.
- [27] Verma P, Madamwar D, *Applied Biochemistry and Biotechnology*, Vol. 102, pp. 109-118, 2002.
- [28] Patel H, Gupte A, Gupte S, *BioResources*, Vol. 4, No. 1, pp. 268-284, 2009.
- [29] Zhu X, Williamson PR, *Molecular Microbiology*, Vol. 50, No. 4, pp. 1271-1281, 2003.
- [30] Kim Y, Nicell JA, *Bioresource Technology*, Vol. 97, No. 12, pp. 1431-1442, 2006.
- [31] Akpınar M, Urek RO, *3 Biotech*, Vol. 7, No. 2, e98, 2017.
- [32] Piscitelli A, Giardina P, Lettera V, Pezzella C, Sannia G, Faraco V, *Current Genomics*, Vol. 12, No. 2, pp. 104-112, 2011.
- [33] Janusz G, Kucharzyk KH, Pawlik A, Staszczak M, Paszczynski AJ, *Enzyme and Microbial Technology*, Vol. 52, No. 1, pp. 1-12, 2013.

METAL ACCUMULATION IN FLAX (LINUM) AND ITS PERSPECTIVE FOR SOIL REMEDIATION

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Abstract: *Hyperaccumulators are plants capable to remove toxic metals from soils. This approach represents a cheap, environmentally friendly alternative for remediation programmes, albeit it can take several decades. The typical hyperaccumulating plants are unfortunately of low biomass and not well suited for harvesting technologies, therefore, crop species have been considered as well. Flax (*Linum usitatissimum* L.) has been recognized as a species tolerant to metals, and has been tested in some field experiments for removal of toxic metals from soils. Here we review the literature on flax, its tolerance to metals and achievements when used for remediation of metal polluted soils.*

Keywords: *flax, hyperaccumulation, heavy metal, metal tolerance, remediation*

1. Introduction

Heavy metals cause serious environmental pollution and pose various nutritional, ecological and evolutionary risks. Soil contamination with heavy metals such as lead, cadmium, nickel, chromium, copper, and zinc, when introduced into the food chain, threatens food safety and quality [1,2,3]. Their exposure subsequently leads to many adverse effects on living organisms, including both plants and humans. Unfortunately, many metal contaminants are still effective components of relatively widely applied agrochemicals e.g. fertilizers, pesticides, fungicides and nematicides. However, the accumulation of these substances in soil is a growing problem and requires sustainable solutions [4,5].

2. Removing metals from contaminated soils - hyperaccumulation

Conventional methods and physicochemical technologies are generally used to remove toxic heavy metals from soils. However, these approaches are not widely used as they are costly and environmentally unfriendly. They are based on steam extraction, stabilisation, solidification, soil washing, thermal desorption and incineration, among others. Although these practices decontaminate the environment of toxic metals, they can also have detrimental effects due to the spread of pollutants during excavation and handling of toxic substances [6,7].

Phytoremediation, which is based on the capability to accumulate toxic substances in different parts of plants, e.g., roots, leaves, branches, or stems, is considered to be an effective, inexpensive, and environmentally acceptable method of removing toxic metals (or other pollutants) [8]. This method is based on the collection of large amounts of pollutant in the plant tissues, their repeated harvesting or cyclic cultivation of different plant species, which ultimately leads to a reduction of the concentration of toxic metals in the soil [9,10]. The mechanism of phytoremediation is species specific and is based on anatomical, morphological and physiological characteristics of plants that allow the uptake and storage

of large amounts of metals [1,6,11,12]. The inexpensive and ecological nature is particularly useful in areas with high concentrations of heavy metals, such as areas from industrial or mining activities. Its disadvantage is its time-consuming nature (even decades).

For remediation purposes, specific plants are used - the so-called hyperaccumulators, which are tolerant to metal toxicity and are able to store in their tissues even thousand times higher concentrations of metals than common plant species [13,14]. Plants use the same mechanisms for uptake of pollutants as they do for uptake of important substances such as nutrients and organic matter. However, they store them in the tissues in a non-toxic form using various chelating agents or specific proteins (e.g., phytochelatin or metallothioneins). Methods of remediation by plants are used in processes such as phytotransformation, bioremediation in the rhizosphere, phytostabilization, phytoextraction, and rhizofiltration [6,15]. In the most common phytoextraction, plants accumulate large amounts of heavy metals in aboveground tissues [11]. Heavy metals such as Cd, Ni, Zn, As, Se and Cu are readily bioavailable to plants, Co, Mn and Fe are moderately available and Pb, Cr and U are difficult to take up. Metals such as Pb, Cr and U can be removed by so-called rhizofiltration, in which plants bind contaminating metals to soil and root matter [9]. These practices ensure that the risk of metal toxicity is limited, mediate phytoextraction of metals with market value (Ni, Tl and Au), or allow for permanent soil management [9,16]. Most proper plant species are showing high tolerance and accumulation of heavy metals, allowing the transfer of metals from the roots to the aboveground part of the plant, and ideally form a large amount of aboveground biomass. Also important is the availability of comprehensive technologies for promoting plant growth and protection, harvesting, and controlling heavy metal uptake by appropriate agrotechnical measures. Unfortunately, typical hyperaccumulators usually produce little biomass and are not adapted for harvesting. Hybrid poplar is often used for terrestrial species, and hemlock is selected for aquatic

species. Furthermore, agricultural crops are also considered for remediation purposes, as their biomass can compensate for the lower uptake or accumulation of the pollutant.

2.1 Flax (*Linum usitatissimum*)

Linseed flax (*Linum usitatissimum* L.) is a dicotyledonous plant and a fibrous economic crop [17,18]. It is used for fibre and food purposes, especially in colder regions of the world [19,20]. The main flax producers are Canada, Russia, China, Kazakhstan, USA and India [21]. Flax is fast growing, shows tolerance when grown on metal-contaminated soil, is capable of transferring toxic heavy metals to above-ground parts, and is therefore a good candidate for heavy metal phytoremediation. Its root system is fibrous, with shallow and lateral root branches, and can grow to depths of up to 1.2 m [6,7]. Flax accumulates metals in the tissues in the order root > leaves stem > seed > fibre. Flax used for phytoremediation can provide a 100% recoverable raw material that has no harmful residues and forms a fully biodegradable waste [22,23,24].

2.2 Tolerance of flax to heavy metals

A prerequisite for hyperaccumulation is tolerance to heavy metals. Pavlovicova et al. [25] studied different flax varieties and compared their sensitivity to cadmium using different parameters. The tolerance indices ranged from 63 to 89%. Despite the least impact on biomass formation, the cultivar Krasnodar showed significant damage to the photosynthetic apparatus and a relatively lower rate of Cd accumulation in the root tissue. The intensive compensatory mechanism in the variety Belinka maintained a high photosynthetic rate associated with low Cd uptake; therefore, this variety represents a low potential health risk for consumers when growing in contaminated areas. Other studies have also evaluated the tolerance of young flax plants or seedlings to different concentrations of heavy metals, especially cadmium. Saleem et al [14] tested the Longya 10 genotype for tolerance to Cu in soil from a mining area in Hubei Province, China. Although in this case too, Cu phytotoxicity inhibited growth, reduced plant biomass and initiated oxidative stress in the tissues, the authors confirmed the ability of flax to remove large amounts of Cu from the soil. Short-term exposure of flax seedlings to different concentrations of Cd revealed activation of synthesis of various metabolites as components of tolerance, e.g. phosphatidylcholine, phosphatidylglycerol, phosphatidylethanolamine [26], probably mediated by salicylic acid.

Screening of 20 different varieties of flax grown in the Czech Republic in a tissue culture experiment revealed a variable yet significant effect of Cd and Zn on growth, associated with a remarkable uptake and accumulation of these metals in the tissues [27]. In particular, the cultivars Llona, Tabor and Merkur appeared to be tolerant to Zn and Cd, while the cultivars Venice, Lola and Jitka accumulated significant amounts of Cd. The variety Viltstar was the most sensitive to the presence of both Cd and Zn. For two

other varieties of flax (ssp. *Usitatissimum* and cv. Gold Merchant) grown in hydroponic environment, Stritsis and Classen [28] confirmed the uptake and transfer of Cd into the aerial parts of the plants. All growth parameters decreased due to high Cd concentrations. Due to the accumulation of high amounts of Cd the authors underlined the potential of these flax varieties for phytoremediation.

The Cd uptake in some of the flax varieties has been recognized as relatively rapid and massive during the first three days, especially in varieties accumulating high Cd amounts. Oppositely, slow Cd intake resulted in low metal accumulation in the Belinka variety [25]. Dynamics of metal uptake has to be considered in addition to concentration of metal in the environment, genetic determinants of defense or soil characteristics [25].

2.3 Flax and phytoremediation

In a large-scale pot experiment with contaminated soil, Hosman et al. [29] determined that flax plants took up 49% of the Cd, 68.6% of the Pb and 71.76% of the Zn contaminant present from the soil. The results of the study defined flax as a hyperaccumulator plant for both Pb and Zn, but a Cd excluder. The accumulation profile determined under laboratory conditions is a good starting point, but not a guarantee for success in remediation programmes. This is because the availability, mobility and uptake of metal are influenced by many other factors besides biological factors (genetic background, tolerance mechanisms, cellulose fibre sorption processes, etc.) also by others such as soil pH, substrate (soil) composition and structure, metal form, presence of other ions, etc. [25]. The observed differences between varieties in individual laboratory studies are usually more pronounced than in field experiments in naturally contaminated soils. For example, only very small differences have been recorded for 18 different varieties of flax I field conditions [30]. This may be due to lower Cd concentrations in contaminated sites than in experiments, but also to age-dependent plant sensitivity [31], or seasonal changes [30].

The most frequently investigated element for uptake by flax plants is Cd [32]. However, the phytoremediation potential of flax has not yet been intensively tested in natural habitats. In their study, Angelova et al. [33] evaluated flax grown in an industrially polluted non-ferrous metal production area near Plovdiv (Bulgaria) as a suitable hyperaccumulator of various metals, which is even more efficient than hemp or cotton. It accumulated various heavy metals in the tissues in order roots > stems > leaves > seeds. The bioremediation potential of flax in Cu, Cd, Pb and Zn contaminated soils in Bulgaria was also confirmed by Baraniecki et al [34]. Although high concentrations of these heavy metals significantly reduced plant growth and biomass, a relatively high amount of these heavy metals was removed from the soils.

In a study by Bjelkova et al. [31], the cultivar Escalina accumulated 4 to 5 times lower amounts of Cd (per ha per

season in relation to the specific Cd concentration in the soil) than the other 10 cultivars tested, including Jitka and Krasnodor. These results partially corresponded with the results of a laboratory study [25]. In another field experiment, Guo et al [30] determined the Cd uptake by flax plants (flax seed) per hectare as 45 ~ 55% of total Cd in soil. Among the 18 varieties of flax tested, some allowed the extraction of more than 60 g Cd ha⁻¹.

3. Perspective of flax for remediation programmes

The remediation potential of flax has been tested for different varieties, but these are not necessarily effective on different sites with variable conditions. It is therefore important to identify other varieties of flax that are tolerant to heavy metals (not necessarily Cd) and that will allow sufficient biomass to be obtained for phytoremediation programmes. At the same time, remediation efficiency can be increased by adding chelating agents [29] or by adding endophytic bacteria to the soil [35]. Technological or food uses of flax after use for soil remediation will be limited, still flax represents a promising crop for ecological and sustainable solutions for environmental protection and restoration.

Acknowledgements

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References

- [1] Eissa, M. A., Almaroai, Y. A., *Soil and Sediment Contamination: An International Journal*, Vol. 28, No. 6, pp. 569–581. 2019
- [2] Saleem, M. H., Ali, S., Rehman, M., Hasanuzzaman, M., Rizwan, M., Irshad, S., Shafiq, F., Iqbal, M., Alharbi, B. M., Alnusaïre, T. S., *Plants*, Vol. 9, No. 2, pp. 258. 2020
- [3] Rehman, M., Liu, L., Wang, Q., Saleem, M. H., Bashir, S., Ullah, S., Peng, D., *Environmental Science and Pollution Research*, Vol. 26, pp. 18003–18016. 2019
- [4] Nagajyoti, P. C., Lee, K. D., Sreekanth, T. *Environmental Chemistry Letters*, Vol. 8, pp. 199–216. 2010
- [5] Al Naggar, Y., Khalil, M. S., Ghorab, M. A., *Open Access Journal of Toxicology*, Vol. 3, No. 1, pp. 1-9. 2018
- [6] Saleem, M. H., Fahad, S., Rehman, M., Saud, S., Jamal, Y., Khan, S., Liu, L., *PeerJ*, Vol. 8, No. e8321. 2020
- [7] Niazy Abdou, M., and Wahdan, M., Citric Acid-Enhanced Phytoremediation of Lead Using *Corchorus capsularis* L. and *Eucalyptus Camaldulensis*, ResearchGate, Berlin, Germany, 2017. 1-20.
- [8] Xu, L., Wang, W., Guo, J., Qin, J., Shi, D., Li, Y., Xu, J., *Biologia Plantarum*, Vol. 58, pp. 751–757. 2014
- [9] Watanabe, M., *Environmental Science & Technology*. Vol. 31, pp. 182–186. 1997.
- [10] Vareda, J., P., Durães, L., *Environmental Technology*. Vol. 40, No. 4, pp. 529–541. 2019
- [11] Muszynska, E., Hanus-Fajerska, E., *BioTechnologia. Journal of Biotechnology, Computational Biology and Bionanotechnology*, Vol. 96, pp. 265–271. 2015
- [12] Ashraf, S., Ali, Q., Zahir, Z. A., Ashraf, S., Asghar, H. N., *Ecotoxicology and Environmental Safety*, Vol. 174, pp. 714–727. 2019
- [13] Li, L., Zhang, K., Gill, R. A., Islam, F., Farooq, M. A., Wang, J., Zhou, W., *BioMed Research International*, Vol. 2018, No. 9248123. 2018
- [14] Saleem, M., Ali, S., Rehman, M., Rana, M., Rizwan, M., Kamran, M., Imran, M., Riaz, M., Hussein, M., Elkelish, A., Lijun, L., *Chemosphere*, Vol. 248, No. 126032. 2020
- [15] Fabbicino, M., Ferraro, A., Luongo, V., Pontoni, L., Race, M., *Sustainability*, Vol. 10, pp. 636. 2018
- [16] Yadav, R., Arora, P., Kumar, S., Chaudhury, A., *Ecotoxicology*, Vol. 19, pp. 1574–1588. 2010
- [17] Feller, U., Anders, I., Wei, S., *Plants*, Vol. 8, pp. 340. 2019
- [18] Sangeeta, M., Maiti, S. K., *American-Eurasian Journal of Agricultural & Environmental Sciences*, Vol. 9, pp. 560–575. 2010
- [19] Zhang, B., Zheng, J., Sharp, R., *Procedia Environmental Sciences*, Vol. 2, pp. 1315–1325. 2010
- [20] Saleem, M. H., Fahad, S., Khan, S. U., Din, M., Ullah, A., Sabagh, A. E., Hossain, A., Llanes, A., Liu, L., *Environmental Science and Pollution Research*, Vol. 27, pp. 5211–5221. 2019
- [21] Griga, M., Bjelková, M., Flax (*Linum usitatissimum* L.) and Hemp (*Cannabis sativa* L.) as fibre crops for phytoextraction of heavy metals: Biological, agro-technological and economical point of view. In *Plant-Based Remediation Processes*; Springer: Berlin, Germany, 2013; 199–237.
- [22] Saleem, M. H., Rehman, M., Zahid, M., Imran, M., Xiang, W., Liu, L., *Brazilian Journal of Botany*, Vol. 2, No. 581, pp. 590. 2019
- [23] Haghdan, S., Smith, G. D., *Journal of Reinforced Plastics and Composites*, Vol. 34, pp. 1179–1190. 2015
- [24] Ndlovu, J., Afolayan, A., *Asian Journal of Plant Sciences*, Vol. 7, pp. 615–618. 2008
- [25] Pavlovičová, M., Gerši, Z., Bardáčová, M., Raušová, P., Horník, M., Matušíková, I., *Nova Biotechnologica et Chimica*. Vol. 19, No. 1, pp. 70-79. 2020
- [26] Belkadh, A., Hédiji, H., Abbes, Z., Djebali, W., Chaïbi, W., *African Journal of Biotechnology*, Vol. 11, No. 41, pp. 9788-9796. 2012
- [27] Smykalova, I., Vrbova, M., Tejklova, E., Vetrovcova, M., Griga, M. *Industrial Crops and Products*, Vol. 32, pp. 527–533. 2010
- [28] Stritsis, C., Claassen, N., *Plant and Soil*, Vol. 367, pp. 591–603. 2013
- [29] Hosman, M. E., El-Feky, S. S., Elshahawy, M., Shaker, E. M., *Asian Journal of Plant Science & Research*, Vol. 7, pp. 30-40. 2017
- [30] Guo, Y., Qiu, C., Long, S., Wang, H., Wang, Y., *International Journal of Phytoremediation*, Vol. 22, No. 5, pp. 490-496. 2020
- [31] BJELKOVÁ, M., GENČUROVÁ, V., GRIGA, M., *Industrial Crops and Products*. Vol. 33, No. 3, pp. 761-774. 2011
- [32] Uddin Nizam, M., Mokhlesur Rahman, M., Kim, J. E., *Korean Journal of Environmental Agriculture*, Vol. 35, pp. 111–120. 2016

- [33] Angelova, V., Ivanova, R., Delibaltova, V., Ivanov, K., *Industrial Crops and Products*, Vol. 19, No. 3, pp. 197-205. 2004
- [34] Baraniecki, P., Kozłowski, R., Grabowska, L., *National Fibres*, Vol. 4, pp. 1-8. 2001
- [35] Badawy, S. H., Helal, M. I. D., Metwaly, A. M. H., *Journal of Soil Sciences and Agricultural Engineering*, Vol. 10, No. 4, pp. 245 – 251. 2019

WHEAT FOR PHYTOREMEDIATION OF METALS FROM SOIL (?)

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Abstract: The content of hazardous substances in soils with a high degree of biotoxicity for living organisms is one of the most important parameters of soil monitoring. Elements like heavy metals including cadmium occur in soils in different concentrations and in different forms. Cadmium is released into the environment from both natural and anthropogenic sources and pollute the environment, reducing its quality for life. Toxic metals from the soil can enter the food chain in various ways, primarily by plants. This risk can also be exploited for remediation purposes to remove toxic elements from soil intentionally. Plant species, which withstand metal toxicity and accumulate it in tissues, are of little biomass, therefore remediation efficiency is low. Crops species are therefore considered for similar purposes. We analysed four wheat varieties and estimated their potential for metal removal from environment.

Keywords: wheat, heavy metal, cadmium, subcellular level, phytoremediation

1. Introduction

Industrialization and urbanization increase the anthropogenic contribution of toxic substances in the biosphere. Sources of pollution of the biosphere with such substances include wastewater from industries, refineries and metallurgical companies. Heavy metals such as cadmium or lead, enter the soil also through inappropriate pesticide use or long-term application of fertilizers [1]. Heavy metals are not biodegradable and represent a serious risk for plants as well as for their consumers, including human [4]. Despite phytotoxicity, some plant species have the ability to accumulate heavy metals in tissues to some extent, without signs of toxicity [5]. Such plant species have found application in environmental decontamination process, where plants as used for removal, transfer, stabilization, resp. degradation of contaminants in soil, sediment or water [2]. Natural accumulators of toxic metals, unfortunately, produce small biomass, therefore crop species are considered for remediation processes as well. Sunflower or rapeseed are examples of successful use in phytoextraction of toxic elements from contaminated soils. Among the plant species, several authors focus on the study of phytoremediation purposes on wheat, as it has shown greater adaptability to contaminated soils and climatic conditions. Another reason is the knowledge of wheat agrotechnology, its industrial processing and application in many countries [3].

2. Material and methods

For the study of cadmium intake, we chose four varieties of wheat - Durgalova, Zirnitra, Sunanka and Slovenka. The seeds were sterilized for 5 minutes with 0.5% (v / v) sodium hypochlorite solution and then rinsed repeatedly with distilled water. Germination was performed on sterile moistened paper in petri dishes in the dark, at room temperature, until a sufficient root length (6-8 mm) was reached for their hydroponic cultivation [7]. Control samples were hydroponically cultured in Hoagland's

medium solution, in the case of stressed samples we applied Hoagland's medium solution with the addition of cadmium in the form of CdCl_2 with Cd^{2+} 50 mg.L^{-1} labeled by adding a known amount of radioactive cadmium isotope ^{109}Cd (final activity in solution $140 \text{ kBq.L}^{-1} \text{ }^{109}\text{Cd}$). We adjusted the pH values of the solutions to 6. Further cultivation took place in a growth chamber, under constant controlled conditions: temperature max. 24/18 °C; relative humidity 60%; photoperiod 16/8 h; max. light intensity 11,450 lx. After ten days of cultivation, we analyzed the collected material by gamma spectrometry.

3. Results

After 10 days, we analyzed by gamma spectrometry the removal of Cd by plants from the culture medium in terms of total uptake. The amount of Cd received by wheat varieties was calculated from the Cd residue in the liquid medium. The amount of Cd taken up by each variety is shown in Figure 1. The differences between varieties include also absorption of Cd^{2+} metal ions on the surface of the roots [6].

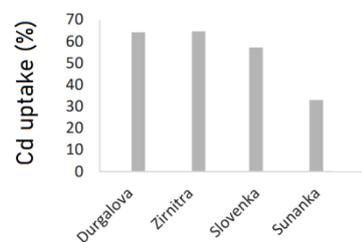


Figure 1: Cd uptake by wheat plants

Plants have different mechanisms that allocate metals not only in certain tissue types but also in different cell compartments to reduce its toxicity and limit its effect on cellular structures. Effective strategies include metal immobilization in the cell walls and/or metal chelation and

allocation to, for example, vacuoles [8]. In the tested wheat varieties, we therefore studied the content of received ^{109}Cd in different cell fractions. Analyzed were the roots and also the aboveground part. After homogenization in liquid nitrogen and successive centrifugation of extraction solution, we obtained the fraction of cell walls (F I), organelles (F II), and the fraction containing cytosol and vacuoles (F III) [10]. The obtained fractions were analyzed for content of metal isotope using a gamma spectrometer.

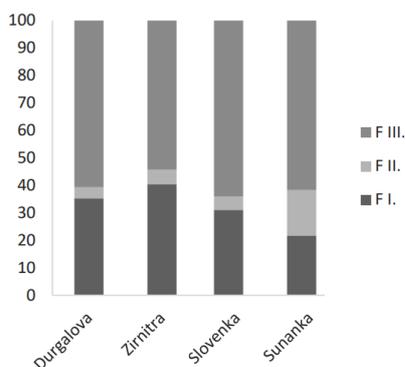


Figure 2: Proportions of ^{109}Cd ions found in wheat root fractions.

Analyses of root fractions (Figure 2) showed that the distribution of Cd in the cell compartments of individual wheat varieties is not uniform. We determined the most Cd in the cytosol, followed by the cell walls, and the lowest content in the organelle fraction, in all studied varieties. These results correlated with the tolerance of individual varieties to the presence of cadmium (data not shown).

Cadmium accumulated mainly in roots in all studied varieties, much lower content was found in shoots (metal transfer rate expressed as amount of Cd in shoots to amount in roots ranged between 0,15 – 0,40). This fact suggests that the internal transport of these metals was limited and this led to low translocation of the metal into the shoots. Therefore, the efficiency of phytoextraction is very low. Based on our results, we can not consider these wheat varieties as suitable for metal accumulator for remediation, but as a plant species tolerant to metals, which is in line with the results of other authors on this topic [3].

4. Conclusion

Gamma spectrometry analyzes indicated that metal allocation in individual cell compartments played a role in the ability of cells to protect sensitive structures from metal toxicity. The accumulation of cadmium in the cell walls of tissues probably contributes to the protection of the photosynthetic apparatus, which even in the presence of a toxic element can efficiently generate resources; these are necessary to implement induced defenses against prolonged exposure to heavy metals. Today, great efforts are being made to improve the phytoextraction properties of plants that could be applied to decontaminant areas. In addition to genetic enhancements, the application of

chelators, hormones and mycorrhizae is being studied. In this respect, field crops represent a reliable alternative to hyperaccumulators, although the process still takes a long time [9].

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References

- [1] Alengebawy, A., Abdelkhalek, S. T., Qureshi, S. R., Wang, M-Q. Heavy Metals and Pesticides Toxicity in Agricultural Soil and Plants: Ecological Risks and Human Health Implications, *Toxics*, Vol. 9, No. 42, pp. 1-33, 2021.
- [2] Babu, S.M.O.F., Hossain, M.B., Rahman, M.S., Rahman, M., Ahmed, A.S.S., Hasan, M.M., Rakib, A., Emran, T.B., Xiao, J., Simal-Gandara, J. Phytoremediation of Toxic Metals: A Sustainable Green Solution for Clean Environment. *Applied Science*, Vol. 11, No. 10348, 2021.
- [3] Brunetti, G., Farrag, K., Soler-Rovira, P., Ferrara, M., Nigro, F., Senesi, N. Heavy metals accumulation and distribution in durum wheat and barley grown in contaminated soils under Mediterranean field conditions, *Journal of Plant Interactions*, Vol. 7, No.2, pp. 160-174.
- [4] Jaishankar, M., Tseten, T., Anbalagan, N., Mathew, B. B., Beeregowda, K. N. Toxicity, mechanism and health effects of some heavy metals. *Interdisciplinary Toxicology*. ISSN 1337-9569, 2014, Vol. 7, No. 2, pp. 60-72.
- [5] Melicherčík, M., Melicherčíková, D. *Vplyv prostredia a účinky látok na ľudský organizmus*. Banská Bystrica: Univerzita Mateja Bela, p. 345, ISBN 978-80-557-0005-2.
- [6] Parrotta, L., Guernierro, G., Sergeant, K., Cai, G., Hausman, J-F. Target or barrier. The cell wall of early- and later-diverging plants vs cadmium toxicity: differences in the response mechanisms. *Frontiers in Plant Science*. No. 6., pp. 1-16.
- [7] Rucińska-Sobkowiak, R., Pukacki, S. Antioxidative defence system in lupin roots exposed to increasing concentrations of lead. *Acta Physiol Plant*, No. 28, pp. 357-364.
- [8] Stolt, J.P. et al. Phytochelatin and cadmium accumulation in wheat. *Environmental and Experimental Botany*. ISSN 0098-8472, No. 49, pp. 21-28, 2003.
- [9] Vamerli, T., Bandiera, M., Mosca, G. Field crops for phytoremediation of metal-contaminated land. A review. *Environ Chem Lett*, No. 8, pp. 1–17, 2010.
- [10] Zhao, Y. et al. Modeling uptake of cadmium from solution outside of root to cell wall of shoot in rice seedling. *Plant Growth Regulation*. ISSN 0167-6903, 82, pp. 11-20, 2017.

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SOCIAL ASPECTS OF QUALITY OF LIFE OF PATIENTS WITH EPILEPSY IN THE CONTEXT OF NURSING

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Abstract: *Epilepsy is the second most common neurological condition after headache. The diagnosis is characterized by recurrent seizures of cerebral origin, up to fifty million people worldwide are estimated to have epilepsy. Worryingly, the diagnosis and management of epilepsy is often suboptimal in developing countries and in the European region. Epilepsy is a medical diagnosis, but it is also associated with a social stigma, as people with epilepsy face many psychosocial challenges (anxiety, social stigma, driving difficulties, unemployment) that can negatively affect quality of life. Such growing recognition of the importance of the impact of epilepsy on the psychosocial domain has led to the need to quantify quality of life in affected individuals. Therefore, in the treatment of epilepsy, the use of an appropriate antiepileptic drug is important to achieve optimal seizure control, along with monitoring for adverse effects and assessing quality of life as an outcome measure.*

Keywords: *social aspects, epilepsy, nursing*

1. Introduction

Epilepsy is the most common chronic disease of the nervous system, specifically the brain, manifested by the recurrence of two or more epileptic seizures more than twenty-four hours apart [1]. The incidence of epilepsy depends mainly on age and is highest in children under one year of age and in the elderly. Each year, newly diagnosed epilepsy in developed countries is at 45-50 cases per 100,000 population [2]. Tefera et al. [3] reported that epilepsy affects approximately more than 50 to 70 million people worldwide, making it one of the most common neurological diseases worldwide, and also that epilepsy is considered a treatable condition with a high therapeutic response rate (75%) when using currently available antiepileptic drugs.

1.1 Quality of life and epilepsy

The concept of quality of life is difficult to define and describe. The reason for this is often the diversity of perspectives on this issue in terms of the number of disciplines that describe it. These disciplines include, for example, philosophy, medicine, sociology, psychology, and others [4]. Over time, the concept of quality of life has also been associated with the field of nursing, where, however, it has only been included in a small number of nursing models. Definitions of the concept of quality of life, from the perspective of nursing, can establish for us its features - individuality of assessment and independence from objectivity [5]. There are two perspectives of understanding the term quality of life, namely from the point of view of professional and scientific literature, where the term quality of life is understood as a characteristic that can be evaluated from both positive and negative aspects, and from the attitude of the non-professional public, which perceives quality of life as something only positive. Ambiguity still prevails in the field of quality of life, as for most users' quality of life moves between two terms:

- standard of living - objectively measurable,

- satisfaction - subjectively measurable [6].

Quality of life is presented at the physical, mental, social levels and these are the levels of personal satisfaction, enjoyment of life despite various worries and problems that a person experience. Nowadays, with the view of society, higher demands are placed on e.g., performance at work, with emphasis on success, increased mental performance, etc., which are caused by the increasing pace of life, and this negatively affects individuals who cannot cope with these demands and subjectively assess that their quality of life does not reach the level they would like even if they are relatively healthy [4]. It is important to know the two dimensions of quality of life, namely objective and subjective. Objective quality of life refers to the measurable living conditions of an individual/population and their achieved standard of living. Among the living conditions we include, for example, the average wage, the availability of various services - health care, access to education, housing, transport accessibility, etc. We also include here a measure of the quality of the environment. We describe the standard of living as a measure of material security, either wealth or poverty, of either a particular social group or the population. The two conditions, living conditions and standard of living, interact. Subjective quality of life is characterized by the perception and evaluation of objective conditions based on one's own satisfaction [6].

1.2 Social support and patient with epilepsy

Inclusion in the social sphere of life is considered to be an important characteristic of a well-lived life of satisfaction, where the individual is aware of the importance of being included in society (closest relationships, community) and knows how to navigate in it, people are friendly in it, the individual himself is part of the events of the society and knows how to navigate in it, and the society is developing in a positive direction [7]. The quality of life itself is characterized by the subjective evaluation of a person, which takes place in a certain cultural, environmental but

also social context. It encompasses a complex of indicators namely, physical health, mental health, beliefs and faith and social relationships are also important which include social support, personal relationships and sexual activity. Important factors that influence the level of satisfaction of individuals in the assessment of subjective quality of life in relation to the social domain are:

- Level of social relationships and family life, also active life in society/community,
- social situation, enforceability of one's rights, security,
- employment - job satisfaction, level of education [8].

However, social solidarity is not enough in ensuring quality of life for the sick, it is important to do more. Quality of life depends not only on the free choice of the individual, but also on the need to strengthen social support and its perception by the patient. It is important to understand that if the patient perceives low social support, he/she may experience various manifestations of dissatisfaction, behavioural disturbances, emotional disturbances, and suicidal ideation [9]. In terms of the disease, there may be a change in social status, social descent but also loss of social and family prestige, which can greatly affect the quality of life of the patient and their psyche. There may also be a situation where social contacts, which may be particularly important for the patient, are reduced or even disappear [10]. In assessing quality of life, the social domain itself is related to the satisfaction of social relationships, to the social support achieved, to the social functioning itself and to the sexual activity of the ill person. There is often a stigma attached to patients who are ostracised from their surroundings. However, as far as social relationships are concerned, the disease can lead to the acquisition of new social relationships, with persons who share the same diagnosis [11].

There are five known dimensions of social well-being, which is referred to as subjective well-being in the Slovak literature. The first dimension includes social integration, which consists in the integration of a person into society, a certain community, and brings with it a sense of satisfaction for the individual and a feeling of support. Social acceptance is the second dimension where trust in others, a positive image and attitude that people are good, friendly, kind is important. Another dimension is social participation, where the person needs to feel that he/she is contributing to the society/community and receives positive feedback from the society. Social actualization, which is the fourth dimension, refers to the belief that society is moving in a positive direction, the world is a more beautiful place, and individuals who are socially healthy find an optimistic view of society for the future. The last dimension described in relation to social well-being is social cohesion, which is understood as concern for a given society/community [12].

The social domain of well-being also includes employment, the opportunity to work. People with disabilities are twice as likely to find a job than people

without any disability. The quality of life of people with disabilities in the work sphere is largely influenced by the state, through its legislation, its very willingness to create appropriate conditions to facilitate the lives of people who are disadvantaged in terms of health. There are several reasons why it is important to provide these people with 'employed status':

- it provides them with a higher standard of living, economic independence,
- the fact that a disabled person is employed has a positive impact on society, and as a result society's attitudes towards them change,
- the working environment ensures the creation of new interpersonal relationships, etc. [13].

Social support is an element of social relationships that promotes health and well-being at different levels. Social support can be classified into different dimensions, namely subjective and objective, with subjective social support referring to experiential or emotional social support, specifically making an individual feel understood and respected, and objective social support referring to actual or visible elements - including direct material support and a network of social relationships. The current study also found that social support, particularly subjective support, was positively associated with mental quality of life, suggesting that the more subjective social support individuals perceive, the better mental quality of life they experience [14].

6. Conclusions

Sclerosis multiplex is a chronic inflammatory disease of the central nervous system that leads to chronic disability. Patients with sclerosis multiplex undergo changes not only in the psychological and social spheres but also in the medical sphere, which means that they require their specific needs to be met. The longer the disease lasts, the more their quality-of-life changes. Quality of life is a phenomenon with a high degree of complexity, which is determined by many factors. It is therefore essential that patients' quality of life is monitored comprehensively through assessment tools that are appropriately chosen. Such monitoring enables health status to be assessed more accurately and objectively, which has a significant impact on the quality of nursing care provided

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References

- [1] KOLLÁR, B., 2014. *Epilepsia*. 1.vyd. Bratislava: Univerzita Komenského v Bratislave. ISBN 978-80-223-3702-1.
- [2] RŮŽIČKA, E. et al., 2019. *Neurologie*. 1.vyd. Praha: Triton. ISBN 978-80-7553-681-5.
- HAVRDOVÁ, E. a kol., 2013. *Roztroušená skleróza*. Praha: Mladá fronta. ISBN 978-80-204-3154-7.

- [3] TEFERA, M, G. Et al., 2020. *Health-related quality of life and its determinants among ambulatory patients with epilepsy at Ambo General Hospital, Ethiopia: Using WHOQOL-BREF*. [online]. [cit. 2022-02-02]. <https://Johnals.plos.org/plosone/article?id=10.1371/journal.pone.0227858> .
- [4] LUDÍKOVÁ, L. et al., 2016. *Vybrané faktory ovlivňující kvalitu života osob se speciálními potřebami*. 1. vyd. Olomouc: univerzita Palackého. ISBN 978-80-244-5059-9.
- [5] CÍNOVÁ, J. et al., 2017. *Kvalita života detí pri vybraných chronických ochoreniach I*. Prešov: Prešovská univerzita v Prešove. ISBN 978-80-555-1827-5.
- [6] HEŘMANOVÁ, E., 2012. *Koncepty, teorie a měření kvality života*. 1.vyd. Praha: SLON. ISBN 978-80-7419-106-0.
- [7] BIRKNEROVÁ, Z. et al., 2013. *Vybrané sociální jevy v kulturních souvislostech*. Výzkumná sonda mezi české a slovenské vysokoškolské studenty. Praha: Hnutí R. ISBN 978-80-86798-41-7.
- [8] DOLEŽALOVÁ, J. et al., 2011. *Kvalita života v kontextech vzdělávání*. Zielona Góra: Zielonogórska univerzita. ISBN 978-83-7481-402-7.
- [9] ŠIP, M., 2018. *Sociálno-spirituálne atribúty v paliatívnej starostlivosti*. Prešov: Prešovská univerzita. ISBN 978-80-555-2181-7.
- [10] ONDŘIOVÁ, I., CÍNOVÁ, J., 2020. *Psychosociálne aspekty zdravotníckej praxe*. 1. vyd. Prešov: Prešovská univerzita v Prešove. ISBN 978-80-555-2416-0.
- [11] MAJERNÍKOVÁ, L., OBROČNÍKOVÁ, A., 2020. *Vplyv svojpomocnej skupiny na kvalitu života pacienta a jeho rodinu*. 1. vyd. Prešov: Prešovská univerzita v Prešove. ISBN 978-80-555-2589-1.
- [12] BIRBECK, G. Et al., 2002. *Seizure reduction and quality of life improvements in people with epilepsy*. [online]. [cit. 2022-02-27]. <https://pubmed.ncbi.nlm.nih.gov/12027916/> .
- [13] STOROŠKA, M., 2010. *Kvalita života II: sociálne a ekonomické aspekty*. 1.vyd. Prešov: Vysoká škola medzinárodného podnikania ISM Slovakia. ISBN 978-80-89372-26.3.
- [14] WANG, J. et al., 2022. *Depressive symptoms, social support, and health-related quality of life: A community-based study in Shanghai, China*. [online]. [cit. 2022-02-02]. <https://www.sciencedirect.com/science/article/pii/S0010440X21000705> .

SOCIAL ASPECTS OF QUALITY OF LIFE OF PATIENTS WITH MULTIPLE SCLEROSIS IN THE CONTEXT OF NURSING

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Abstract: *Sclerosis multiplex is a disease that progresses over a long period of time and disables the patient. Although the life expectancy of patients is not reduced, it can cause a change in the quality of life of patients and their families. Quality of life is a condition that changes dynamically. It is influenced by a complex of personal, clinical, and social factors. Promoting quality of life is one of the goals of nursing and therapeutic intervention, in which a holistic approach is used (a holistic approach based on which the patient is perceived as a personal bio-psycho-social and spiritual creation), putting subjective and objective criteria on an equal footing.*

Keywords: *social aspects, multiple sclerosis, nursing*

1. Introduction

Any chronic disease that contemporary medicine cannot cure disrupts the normal life not only of the patient, but also of those around him, especially his family. Sclerosis multiplex is no exception in this respect. The situation is more serious because during the disease the neurological deficit increases, and the patient's self-sufficiency decreases. The sufferer remains dependent on the help of those closest to him or her, possibly social services, or the state.

1.1 The sclerosis multiplex patient and the family

All the problems that the disease brings, both physical and psychological, are ultimately reflected in the patient's overall quality of life. The quality of life of multiple sclerosis patients is lower than that of the healthy population assessed by any quality-of-life questionnaire [1]. In addition to pharmacological treatment provided in a timely manner, psychotherapeutic support is also important to improve it. It should be available in multiple sclerosis care centres, but also through patient support organisations. Access to information is important. In this respect, the Internet is today an almost inexhaustible resource. However, the data obtained in this way needs to be filtered and often also put into perspective. It is therefore advisable to educate the patient and refer them to valid sources.

Like any chronic disease, multiple sclerosis affects not only the patient, but also his or her loved ones - family and friends. Evaluation of questionnaires found that the lower the quality of their professional and personal life, the lower the quality of social health services [2]. Thus, the partner, children and parents of the ill person also go through different stages of perception of the illness.

In general, we can say that the extent and type of disability in relatives of individuals with chronic illness is primarily dependent on three factors:

1) which family member is ill,

- 2) how serious the illness is, how long it lasts and what the prognosis is,
- 3) what views, social and cultural customs prevail in the family.

As multiple sclerosis is a terminal but treatable disease, the situations of everyday life, in conjunction with relationships with loved ones and one's own family, play an important role in its management. The role of the family in terms of disease management and therapy varies depending on the role of the patient in the family. If the patients are elderly people in advanced stages of the disease, their children often take on the role of their parent, providing food, accommodation, and assistance in daily activities, usually for long periods of time. In this situation, we encounter an inverted parent-child relationship, which is permanent at this stage of the disease.

Ondriová, Cinová [3] say that "the whole immediate family, but especially the partner of the chronically ill person, is exposed to stress and worry about the outcome of the disease and its treatment". Thus, the problems that ordinary life brings are mostly dealt with under the pressure caused by this uncertainty about the future, which stems from fears about the progression of the disease and eventual disability. Failure to deal with these problems is reflected in the patient's general discomfort, psychological difficulties and leads to further deterioration of the condition. Chronic illness often disrupts relationships between partners, which can be observed in marriage. This is mainly due to the inability to break out of the classical way of living together and the difficulty of changing their social roles to which they have become accustomed [3]. Sometimes there can also be a mismatch in the sexual sphere of life, and therefore it is understandable that individuals suffering from multiple sclerosis are more likely to lose a partner compared to the healthy population [4].

It should be noted that just as chronic illness can lead to deterioration in relationships, it can also lead to

improvement [3]. Therefore, education of not only the ill person, but also his/her whole family is essential. Understanding the course of the disease, and the causes of the various changes in the sick person's behaviour can help in resolving partner conflicts. Adherence to the regimen and treatment regime requires the support of other household members. It is therefore advisable for the partner or other family member to attend at least some of the follow-up visits to the neurologist or other treating physician. Open communication with the patient about their health and social problems is essential. A gradual loss of performance and self-sufficiency can lead to loss of employment. Consequently, this can lead to the development of depression from feelings of inferiority and fear of being a burden to the family. If unresolved, this leads to behavioural and conduct disorders which can lead to loss of family background, including the break-up of the patient's family. The strained situation in these relationships is often the cause of the progression or relapse of the illness [1].

1.2 Patient with sclerosis multiplex and employment

In the early stages of the disease, especially after the first attack (CIS - clinically isolated syndrome), we do not encounter any work limitations, mainly because the patient's condition is almost restored to the level it was at the beginning. Patients who have had a first attack and have been diagnosed with multiple sclerosis can be employed in all the spheres and fields offered by the labour market - from the physically demanding work of manual labour and craftsmanship to managerial and scientific roles, which do not come without a heavy psychological burden. Some patients are even involved in sport at a professional level. Patients may also do shift work if they can manage it. However, this is very individual, as it all depends on the individual case and the degree of disability, which is a finding left over from a previous relapse of the disease. Sometimes it happens that after the very first manifestation of the disease during CIS, a severe visual impairment develops, which permanently ends the career of the patient who works as a driver [2].

Undoubtedly, it is in the interest of every patient to maintain their working ability for as long as possible, mainly because the loss of working ability not only leads to serious social consequences, but also means a loss of self-esteem and self-confidence for the patient and marks the beginning of a loss of self-sufficiency. Therefore, the greatest effort of the multidisciplinary team of professionals is to support the patient to keep his/her job. If the disability continues it goes worse, of course, but if the employer is supportive, it is possible to tailor the work assignment to the patient's individual needs (breaks, part-time work, working from home, flexible working hours) [5]. Maintaining work capacity is also very important for maintaining the patient's cognitive abilities. The fact that the patient has a regular routine at work and is forced to adapt to conditions (learning) that are constantly changing leads to the fact that functional synapses in networks of neurons are maintained. If the patient drops out of this

regimen and cognitive activities are not adequately replaced, cognitive decline occurs more rapidly. As mentioned above, if patients are in a stable state, they can perform any occupation that gives them satisfaction. The problem arises, however, in that many patients are performance-oriented and tend to overexert themselves. Since chronic stress is not beneficial for any autoimmune disease, a regimen where work is balanced with leisure activities that provide ample room for mental and physical health care could be a solution. On the other hand, there are the types of patients who seek the opportunity to obtain a disability pension as soon as possible. These are often immature persons with symptoms of psychopathology who manipulate their family members through their illness or gain additional advantages in their community. Counselling in the occupational field is therefore very complex and requires the worker to know in detail both the patient and the situation they are in [6].

1.3 The multiple sclerosis patient and social integration

"Integration represents the full inclusion and merging of the person with a disability into society", according to Novosad [7]. It is seen as successful if disabled individuals achieve the highest possible education, suitable employment, and can lead a quality social and family life [8]. For people suffering from multiple sclerosis, participation in various associations and clubs where they meet patients with the same diagnosis plays an essential role, resulting in sharing the same difficulties, reducing feelings of inferiority, and gaining a sense of belonging. There are 25 clubs in different cities of the Slovak Republic where members meet on a regular basis. In addition, patients can participate in various club activities, including convalescent stays, talks and seasonal events. All this contributes to improving the patient's quality of life in the physical, psychological, or social spheres.

The individual also has access to various associations, which include mainly the Slovak Sclerosis Multiple Sclerosis Association. It was founded in 1990 to help, support and encourage persons with this serious disease. It is an independent, voluntary, and political association, which, in addition to patients, also brings together members of their families and other citizens who want to help these individuals. The main tasks of this association include:

- 1) collaborating with specialised medical centres,
- 2) working towards the creation of sub-departments in neurological departments specialising in the complex treatment of patients,
- 3) encouraging the formation of clubs,
- 4) implementing prevention and social counselling,
- 5) developing relations with organisations from abroad,
- 6) Submitting proposals to governmental bodies aimed at improving the socio-economic, living and working spheres of patients' lives,
- 7) providing assistance to organisations and associations,
- 8) organising convalescent and rehabilitation stays to improve the psychological and physical state,

- 9) providing educational activities,
- 10) organizing cultural and social activities, sports and recreation.

The Sclerosis Multiple Sclerosis Association Nádej is another civic association that operates on similar principles as the Slovak Sclerosis Multiple Sclerosis Association. Among its important activities we can mention the establishment of a static and mobile stationary centre together with the Scarabeus sheltered workshop in Bratislava and Trenčín.

Static stationary - it takes the form of therapies that follow the procedures carried out during spa treatment - occupational therapy, art therapy, oxygen therapy, magnetotherapy, infrared pad, physiotherapy, massages, stationary bicycle.

Mobile hospital - the primary purpose is to provide psychological, psychosomatic, social, and physiotherapeutic assistance to improve the health condition of patients.

Scarabeus Civic Association- offers work activities to persons with disabilities and other volunteers suffering from sclerosis multiplex. The workshop is primarily engaged in the production of gift items that are sold during the Christmas and Easter markets [9].

6. Conclusions

Sclerosis multiplex is a chronic inflammatory disease of the central nervous system that leads to chronic disability. Patients with sclerosis multiplex undergo changes not only in the psychological and social spheres but also in the medical sphere, which means that they require their specific needs to be met. The longer the disease lasts, the more their quality-of-life changes. Quality of life is a phenomenon with a high degree of complexity, which is determined by many factors. It is therefore essential that patients' quality of life is monitored comprehensively through assessment tools that are appropriately chosen. Such monitoring enables health status to be assessed more accurately and objectively, which has a significant impact on the quality of nursing care provided

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References

- [1] HAVRDOVÁ, E. a kol., 2013. *Roztroušená skleróza*. Praha: Mladá fronta. ISBN 978-80-204-3154-7.
- [2] PETERS, M., JENKINSON C. a kol., 2013. *Carer quality of life and experiences of health services: a cross-sectional survey across three neurological conditions*. In: Health Qual Life Outcomes, č. 11, s. 103, ISSN 1477-7525.

[3] ONDRIOVÁ, I., CINOVÁ, J., 2020. *Psychosociálne aspekty zdravotníckej praxe*. Prešov: Vydavateľstvo Prešovskej Univerzity. ISBN 978-80-555-2416-0.

[4] PETERS, M., JENKINSON C. a kol., 2013. *Carer quality of life and experiences of health services: a cross-sectional survey across three neurological conditions*. In: Health Qual Life Outcomes, č. 11, s. 103, ISSN 1477-7525.

[5] BARTOLČIČOVÁ, B., LISÁ, I. a kol., 2018. *Sklerosis multiplex a pohybová aktivita*. Bratislava: Slovenská vedecká spoločnosť pre telesnú výchovu a šport. ISBN 978-80-89075-70-6

[6] HAVRDOVÁ, E. a kol., 2015. *Roztroušená skleróza v praxi*. Praha: Galén. ISBN 978-80-7492-1896.

[7] NOVOSAD, L., 2009. *Poradenství pro osoby se zdravotním a sociálním znevýhodněním: základy a předpoklady dobré poradenské praxe*. Praha: Portál. ISBN 978-80-7367-509-7.

[8] ORGONÁŠOVÁ, M., 2014. *Bio-psycho-sociálny pohľad na osobu so zdravotným postihnutím, predpoklad jej úspešnej inklúzie*. In: Vzdelávanie a zamestnávanie osôb so zdravotným postihnutím. Zborník referátov zo sympózia konaného dňa 17.12.2013 v Bratislave. [online]. S.4-13. Bratislava: Sekcia sociológie zdravotníctva Slovenskej sociologickej spoločnosti pri SAV. ISBN 978-80-85447-23-1.

[9] National Multiple Sclerosis Society. 2022. [online]. [cit 2022-02-14]. [https://www.nationalmssociety.org/For-Professionals/Researchers/Resources-for-MS-Researchers/Research-Tools/Clinical-Study-Measures/Multiple-Sclerosis-Quality-of-Life-54-\(MSQOL-54\)](https://www.nationalmssociety.org/For-Professionals/Researchers/Resources-for-MS-Researchers/Research-Tools/Clinical-Study-Measures/Multiple-Sclerosis-Quality-of-Life-54-(MSQOL-54)).

THE ROLE OF THE NURSE IN MODERN SM TREATMENT

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Abstract: *As a primary source of information for MS patients and their families, nurses are a relevant donor of providing practical information on treatment use, thereby facilitating patients' treatment decisions, ensuring proper drug use and increasing self-care. Nurses play a significant role in monitoring compliance and adherence. Nurses help patients better understand their disease and treatment options, facilitate the initiation and management of treatment, and promote adherence.*

Keywords: *MS, patient, nurse, treatment, role, education*

1. MS treatment

MS is usually diagnosed in young adults (20-40 years), which can have a negative impact on long-term career and work prospects, relationships, family and its planning. Potential financial difficulties, tense family relationships and a sense of social isolation require effective coping strategies [1]. Due to the complex nature of MS and the wide range of symptoms and problems faced by patients with the disease, a comprehensive care team is needed to provide the support needed for effective disease management. Team care includes nurses, doctors, physiotherapists, occupational therapists, social workers, psychologists and dietitians [2]. Key members of this team include nursing professionals who are not only involved in the diagnosis, treatment and management of MS, but also provide patients and their families with the necessary education, support and counseling. The treatment development for MS has seen many developments over the past few decades, in terms of both treatment selection and timing of treatment initiation. In the past, patients with MS were prescribed treatment only when their disease had progressed to a relatively advanced stage and when disability was already present; since then, however, it has been found that the processes leading to irreversible damage in MS can begin in the early stages of the disease. Several clinical studies showing the benefits of early treatment in delaying the conversion of clinically isolated syndrome (CIS) to MS have supported these observations. Consequently, early treatment is now recommended in order to achieve the optimal therapeutic effect [3,4,5]. The choice of treatment strategy in MS depends on the course of the disease, the symptomatology. Episodic treatment is used to reduce relapses. Symptomatic treatment is used to minimize or control specific symptoms such as spasticity, stool and bladder problems and fatigue. Disease modifying treatment (immunomodulatory drugs and other substances) is developed to reduce the frequency and severity of relapses and slowing of disease progression [6]. The nurse's role in the treatment of MS is to provide information at the start of treatment, as well as to monitor and manage any side effects, evaluate treatment outcomes, and encourage patients to adhere to treatment regimens.

1.1 Nurse's role in episodic treatment

Episodic treatment is used in patients with MS relapse - also known as acute attack or exacerbation. It is an episode of new or worsening symptoms of MS that lasts for more than 24 hours but is not related to metabolic changes or steroid withdrawal. Most patients with acute relapse receive high doses of corticosteroids (usually intravenously, or orally). Corticosteroids reduce inflammation in the central nervous system and may help restore the integrity of the blood-brain barrier, speeding up the improvement of symptoms. Intravenous methylprednisolone is initially given in high, intermittent doses for 3 to 5 days. Intravenous methylprednisolone can be given in a hospital or at home and may or may not be followed by a gradual reduction of the oral corticosteroid dose [6].

During steroid treatment, patients and families need to know what to expect. Nurses can provide information on realistic outcomes and side effects that require medical attention. Typical side effects include increased appetite, gastrointestinal upset, nervousness or anxiety, and insomnia. Corticosteroid treatment may also be accompanied by flushing, frequent urination, and taste disturbances. Patients should be advised to call their healthcare provider if they experience anxiety or insomnia. Other side effects that may require monitoring and medical treatment include glycosuria and severe mood swings or mood swings. Patients should be advised to limit salt and sugar intake during treatment with corticosteroids, and patients taking immunomodulatory agents (interferons or glatiramer acetate) should be advised not to discontinue these medications during intravenous methylprednisolone or any other relapse treatment. At the time of relapse, it is important to assess disposability, e.g. in patients with walking difficulties, recommend a safe, mobile device (stick, walker). Nurses should consult on possible adjustments to patients' work and physical activities in relation to changes in mobility [6].

1.2 Nurse's role in symptomatic treatment

Symptomatic treatment is designed to manage persistent symptoms of MS. It is difficult, but treatment can

significantly improve the patient's quality of life. Fatigue, elimination problems (bladder, bowel disorders), pain and other common symptoms can be controlled or alleviated through education, counseling and rehabilitation measures. If these strategies fail, pharmacotherapy may be considered [6]. The first step in treating symptoms is to assess the factors that cause or contribute to them (concomitant medications, concomitant illnesses or other medical conditions). If medication is needed to alleviate the symptoms, a certain algorithm of the treated rules must be followed. A review of health status and medication must be made at the outset (contraindications such as other diseases or concomitant medicine, over-the-counter medications and alternative treatments). Nurses must tell patients what results to expect and what side effects may occur. Such an approach can help strengthen positive therapeutic relationships and can help optimize the treatment of symptoms. Patients should be encouraged to monitor the effects of treatment (even the unexpected) so that nurses can intervene in a timely manner in the event of an unintended treatment outcome [6,7].

Treatment of fatigue requires effective energy management, medications, or both. Nurses can suggest behavioral changes such as conditioning programs, exercise, and improved nutrition.³¹ Patients can be referred to an occupational therapist, who can teach them about and help them implement energy conservation techniques. Drugs that can provide relief include CNS stimulants such as methylphenidate and modafinil. Patients should be advised that these medications may cause nervousness, restlessness, and insomnia. Antidepressants such as fluoxetine and an antiviral agent, amantadine, may also be effective for fatigue. Previous literature has also documented the benefit of conditioning programs with graded exercise to reduce fatigue.

Bladder dysfunction results from pathology in nerve pathways controlling detrusor function, sphincter function, or both. Dysfunction may occur such as urinary hesitancy, frequency, urgency, and/or incontinence or as failure to store urine, failure to empty urine. Urinary tract infection may be a contributing factor and should be ruled out or treated appropriately before initiating other treatment. Effective pharmacologic treatments include anticholinergic agents, antimuscarinic agents, and α -blockers. A bladder training program that includes education, elimination of bladder irritants such as caffeine and aspartame, scheduled voidings, and positive reinforcement can also improve bladder functioning and quality of life. Some patients must be catheterized with either intermittent or permanent placement of a catheter.

Bowel problems may occur such as constipation or bowel urgency and involuntary bowel movements. Constipation is best managed with dietary changes (increased fluid intake, dietary fiber), exercise, alternatively to recommend bulk formers (psyllium) or softeners, prescribed suppository, enema. Patients with bowel urgency may benefit from treatment with an anticholinergic agent or an

antimuscarinic agent. These medications have antispasmodic effects that can ease uninhibited bowel spasms that contribute to urgency.

Pain in MS may be variable. Types of acute pain that occur frequently in patients with MS are trigeminal neuralgia, a sharp, stabbing pain in the face, and a burning, aching sensation known as burning dysesthesia. Pharmacologic treatments that can provide relief include the anticonvulsants carbamazepine, gabapentin and lamotrigine. Though often effective for pain, some anticonvulsants may cause sedation; slow titration can minimize this side effect. Tricyclic antidepressants may relieve pain and can be especially helpful for dysesthesias. Chronic pain is often treated with the same medications used for treatment of acute dysesthesias. Patients with MS also may experience pain as a result of muscle cramping or abnormal musculoskeletal stresses. Musculoskeletal pain can be alleviated by supportive interventions such as an ankle-foot orthosis or by appropriate positioning of seating devices to maintain/sustain appropriate body alignment.

Walking problems can be affected by multiple sclerosis to a greater or lesser extent based on the nature of the disease course, problems with stamina and fatigue and performance of daily activities. Dalfampridine has been approved by the FDA to improve walking in MS. Patient requires appropriate rehabilitative and exercise training to enhance the effect of the medication [6].

Medications also may be prescribed for depression, sexual dysfunction, visual disturbance, tremors, spasticity, insomnia and other symptoms that are associated with MS.

1.3 Nurse's role in disease-modifying treatment

Despite the unpredictability of the disease and multifactorial etiopathogenesis, we can now significantly slow down the course of the disease. Existing therapies approved for the treatment of relapsing forms of MS (RRMS) include several beta-interferon preparations, glatiramer acetate, mitoxantrone and natalizumab. Injectable treatments include interferon beta medications, glatiramer acetate. Oral treatments include fingolimod, dimethyl fumarate, diroximel fumarate, teriflunomide, Siponimod, cladribine. Infusion treatments include ocrelizumab, natalizumab, alemtuzumab. IFN β -1a and IFN β -1b are recombinant proteins that can act by inhibiting inflammation and migration of white blood cells across the blood-brain barrier. Interferon beta is available in forms: subcutaneous, intramuscular [8]. The most common side effects of interferon beta are flu-like symptoms (fever, chills, arthralgia, nausea, sweating, headache, and myalgia), which affect up to 75% of patients [9,10].

They usually start 3-6 hours after the injection and disappear within 24 hours, are most pronounced at the start of treatment and decrease in frequency over time. Approximately 30% of patients report injection site

reactions, especially mild inflammation or redness. Interferon beta therapy may also temporarily worsen the symptoms of MS (spasticity, visual acuity, paraesthesia), especially during the first 12 weeks of treatment, usually 3-24 hours after INF beta administration, with a duration of several hours to several days. It is recommended that depression be screened regularly in patients indicated for INF beta treatment [11], and the presence of depression is not a contraindication to the use of INF beta. Glatiramer acetate (GA) as a synthetic polypeptide stimulates immune suppressor lymphocytes that release antiinflammatory cytokines. It is approved (EMA, FDA) in the 1st line in patients with clinically isolated syndrome (CIS) and relapsing-remitting multiple sclerosis (RRSM) in two dosing regimens: 20 mg subcutaneously (sc) daily or 40 mg sc 3 times a week. The most common side effect is an injection site reaction (ISR - Injection Site Related), redness and soreness. Skin necrosis is very rare. Up to half of patients develop local panniculitis with lipoatrophy during treatment [12]. Natalizumab is a monoclonal antibody that may block the migration of activated lymphocytes, which cause damage to the brain and spinal cord, across the blood-brain barrier. Fingolimod is an oral drug that was approved by the FDA and EMA for the treatment of RRSM in 2010. It is indicated to reduce the frequency of exacerbations and delay the accumulation of disability in relapsing forms of MS [6]. The results of registration studies showed that the most common adverse events were urinary tract and lower respiratory tract infections, transient decreased heart rate and atrioventricular block I, rarely II. degree [12]. In 2013, teriflunomide was approved by the EMA as a once-daily oral treatment for recurrent forms of MS. The most common adverse reactions were gastrointestinal (GI) reactions such as nausea, vomiting, oral ulceration, indigestion and diarrhea, most marked at the beginning of treatment, with resolution within 2 weeks. Other side effects are thinning hair, headaches. Dimethyl fumarate (DMF) was approved in 2013 for the treatment of RRMS. The most common side effects of DMF treatment include: hot flushes, flushes, gastrointestinal disorders (diarrhea, nausea, abdominal pain), proteinuria and itching, especially in the first month of treatment. The flush is caused by the release of prostaglandins [12].

Table 1 Immunomodulatory agents for the treatment of relapsing-remitting multiple sclerosis

Drug	Side Effects	Monitoring
Interferon beta	flu-like syndrome, depression (not confirmed), autoimmunity (thyroid), hepatotoxicity	blood count, liver tests, thyroid hormones, depression screening
Glatiramer acetate	application site reactions, hot flushes, chest pain, hives, skin necrosis	not required
Teriflunomide	gastrointestinal disorders, hepatopathy, lymphopenia, thrombocytopenia, high	liver tests, blood count, blood pressure, tuberculosis

	blood pressure, opportunistic infections, potentially teratogenic	exclusion, pregnancy test
Dimethylfumarate	hot flushes, diarrhea, nausea, vomiting, lymphopenia	white blood cell count
Fingolimod	bradyarrhythmia, macular edema, basal cell carcinoma, transaminase elevation, primo-infection of varicella zoster virus	ECG, eye examination, dermatological examination, number absolute lymphocytes, liver tests, varicella zoster virus antibodies, pregnancy test
Natalizumab	infusion reactions, progressive multifocal leukoencephalopathy, hepatopathy	antibodies against John Cunningham virus

[1,12,13]

Although most side effects (table 1) associated with immunomodulatory agents decrease with continued treatment, they may interfere with treatment adherence [6]. The role of nurses in the immunomodulatory treatment of MS is education and skills development in patients and family members, caregivers [13]. Patients and their families or treatment partners must have a thorough understanding of the treatment options available to them, together with clear and realistic expectations of immunomodulatory agents. They also need to know what side effects are associated with treatment and how these side effects can be managed. After choosing a specific immunomodulatory agent, patients need to know how to perform the self-care aspects of the MS treatment plan and how to administer the drug. Patients with memory impairment should be instructed on the use of specific memory signals to help them remember to take medication as schedule. Nurses help improve treatment adherence by educating patients and maintaining supportive patient relationships. Nurses support the contact of the patient and his family with civic associations and self-help groups associating patients with MS. Nurses monitor the patient's response to immunomodulatory therapy. Nurses identify problems with adherence, and if side effects occur, nurses provide practical advice to manage these effects. If they persist, another immunomodulatory product will need to be re-evaluated and modified by a proposal to the doctor [14].

MS nurses play a crucial role in helping patients better understand their disease and treatment options as well as assisting with treatment initiation and management and encouraging long-term adherence to therapy. In terms of prevention of attacks and relapse, patients are instructed on the regularity of pharmacological treatment. Factors such as smoking, the incidence of dental infection, and respiratory infection contribute to the deterioration of the clinical picture of the disease. Practical advice: daily walks, showering with lukewarm water, not exposing yourself to sunlight, wearing loose clothing, avoiding colds, considering the nature of employment (two-shift, three-shift rule, working at heights) contribute to

maintaining good condition in compliance with regime measures [15]. The emergence of new treatments for MS and the resulting changes in the treatment paradigm will result in the nurses' set of skills being expanded and developed to ensure adequate patient care, both physically and mentally, and to meet the monitoring needs specific to each treatment. The education and training of health professionals must be adapted accordingly and must be effectively coordinated within the various disciplines of the health team [3].

2. Conclusion

With new oral therapies, the potential for increased efficacy, tolerability, adherence, and convenience for patients is evident. However, the resulting change in the treatment model means that the skill set required of an MS nurse will inevitably expand. There will be a growing need for professional training and development to ensure that nurses are familiar with the wider range of treatments and their specific modes of action, dosing schedules, and benefit or risk profiles. In addition, the MS nurse's role will expand to include management of the complex monitoring needs specific to each therapy [3]. The increasing number of available treatments with different dosing regimens and routes requires that nurses with MS expand and adapt their knowledge and skills so that they can serve as a key source of accurate information for their patients.

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References

- [1] Almas S, Vance J, Baker T, Hale T. *Management of Multiple Sclerosis in the Breastfeeding Mother*. *Mult Scler Int*. 2016;6527458.
- [2] Soelberg Sorensen P, Giovannoni G, Montalban X, et al. *The Multiple Sclerosis Care Unit*. *Mult Scler*. Vol. 25, No. 5, pp. 627-636, 2019.
- [3] Burke T, Dishon S, McEwan L, Smrtka J. *The evolving role of the multiple sclerosis nurse: an international perspective*. *Int J MS Care*. Vol. 13, No. 3, pp. 105-112, 2011.
- [4] Kappos L, Freedman MS, Polman CH, et al. *Effect of early versus delayed interferon beta-1b treatment on disability after a first clinical event suggestive of multiple sclerosis: a 3-year follow-up analysis of the BENEFIT study*. *Lancet*. Vol. 370, pp. 389-397, 2007.
- [5] Comi G, Martinelli V, Rodegher M, et al. *Effect of glatiramer acetate on conversion to clinically definite multiple sclerosis in patients with clinically isolated syndrome (PreCISe study): a randomised, double-blind, placebo-controlled trial*. *Lancet*. Vol. 374, pp. 1503-1511, 2009.
- [6] Harris, C.J., Halper, J. 2016. *Multiple Sclerosis: Best Practices in Nursing Care. Disease Management, Pharmacologic Treatment, Nursing Research*. 4th edition. © International Organization of Multiple Sclerosis Nurses. 37 pp. Available to: https://iomsn.org/wp-content/uploads/2016/07/BestPractices_4th.pdf
- [7] Ross AP, Halper J, Harris CJ. *Assessing relapses and response to relapse treatment in patients with multiple sclerosis: a nursing perspective*. *Int J MS Care*. Vol. 14, No. 3, pp. 148-159, 2012.
- [8] Greenberg BM, Khatri BO, Kramer JF. *Current and emerging multiple sclerosis therapeutics*. *Continuum (Minneapolis)*. Vol. 16, pp. 58-77, 2010.
- [9] Walther EU, Hohlfeld R. *Multiple sclerosis: side effects of interferon beta therapy and their management*. *Neurology*. Vol. 53, pp. 1622-1627, 1999.
- [10] Webb, Ute H. *Early Interferon Beta Treatment in Multiple Sclerosis*, *Journal of Neuroscience Nursing*. Vol. 40, No.6, pp. 356-361, 2008.
- [11] Patten SB, Metz LM. *Interferon beta-1 a and depression in relapsing-remitting multiple sclerosis: an analysis of depression data from the PRISMS clinical trial*. *Mult Scler*. Vol. 7, pp. 243-248, 2001.
- [12] Fedičová, M. et al. *Hodnotenie bezpečnosti a monitoringu choroby modifikujúcich liekov roztrúsenej sklerózy*. *Neurológia pre prax*. Vol. 21, No. 3, pp. 176-181, 2020.
- [13] Majerníková, E., Magurová, D., Tkáčová, E. et al. *Špecifická potreba pacienta s ochorením sclerosis multiplex*. Prešov: Fakulta zdravotníckych odborov, 2021, s. 132. ISBN 978-80-555-2727-7.
- [14] Roman, C., Menning. K. *Treatment and disease management of multiple sclerosis patients: A review for nurse practitioners*. *Journal of the American Association of Nurse Practitioners* Vol. 29, No. 11, pp. 629-638, 2017.
- [15] Miertová, M., Kurča, E., Tomagová, M. a kol. *Ošetrovateľstvo v neurológii*. [online]. Univerzita Komenského Bratislava, Jesseniova lekárska fakulta v Martine, 2014. Available: <http://osevneu.jfmed.uniba.sk/>. ISBN 978-80-89544-71-4.

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A FEW NOTES ON THE PUBLICATION *THE CHOSEN*: A TURN IN THE ARTISTIC REPRESENTATION OF JUDAISM

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Abstract: *The main goal of the paper is to demonstrate a turn in the literary treatment of the topic of Judaism in the publication *The Chosen* by Chaim Potok. This work is a certain milestone in the artistic rendering of the theme. The stream depicts disputes that have been and continue to be fanned between various Jewish communities. Emphasis is placed on the influence of adherents, especially the Orthodox branch of Judaism, on education and its image in the approach to life as well as on opinions on global or social events. We have differentiated the transformation of the artistic representation of Judaism into a given narrative into four areas, which we call splits for the purposes of the article. By this term we mean a discrepancy between the literary depiction of Judaism before and after the publication of *The Chosen*, i.e., before and after 1967.*

Keywords: *Chaim Potok, The Chosen, Judaism, turn, split*

1. Introduction

The aim of the paper is to summarize two different approaches to the practice of Judaism and to document the reflection of the method of education in the field of religious education of children in connection with the change of literary depiction of Judaism on the example of *The Chosen* by Chaim Potok. We chose this amendment because we are convinced that it forms a dividing point in the literary treatment of Judaism among Jewish authors who write in English. We see a milestone in the withdrawal from the main goal of such oriented stories, namely the portrayal of the lives of Jews, followers of Judaism or Jews, members of the nation who went into American exile in response to Nazi policy in Europe in the 1930s and 1940s. Prior to the publication of Potok's novel, such works focused mainly on Orthodox Judaism and its reflection in the values of practicing Jews. Jyothsna [3, p. 156] sees the contribution of the publication in connection with the paradigm shift in the elaboration of the defined topic "in the extensive creative interest in theology, liturgy, history and cultural and social manifestation of Judaism".

Changes in the literary depiction of certain disputes within the two Jewish communities are evidenced by excerpts from Potok's publication. We divided the transformation of the thematization of Judaism into a given artistic narrative into four areas, which we call divisions for the purposes of the article. By this term we mean a discrepancy between the literary depiction of Judaism before and after the publication of *The Chosen*. We are aware that the discrepancies defined by us cannot affect the entire spectrum of artistic narratives with a given issue. Our aim is to demonstrate the contribution of Potok's short story in a different view of Judaism and in a certain transformation of the purpose of such works.

The analysis of the schisms from Potok's novel was preceded by a reception of the given artistic narrative. The

main differences in the depiction of Judaism, or rather the differences in its perception by the representatives of two largely different Jewish communities, are evidenced by quotations from selected passages from *The Chosen*.

2. Main Themes of Potok's Literary Works

Chaim Potok, a Jewish author living in the United States, can be classified as a member of American Jewish literature. [5] According to the mentioned scientist, the given connection represents the expression diaspora for cultural adaptation, collective consciousness, and community identity in connotation. Bhabha [1] claims that migrants' culture, associated with their minority position, is an activity related to cultural non-translatability and raises issues of cultural interiorization beyond the assimilation of dreams. Devir [2] notes the issue of the legacy of English-speaking Jewish authors living in the diaspora that these writers who choose to incorporate well-known aspects of Judaic narrative history into their literary texts ultimately generate the meaning of this inclusion through subcultural variables that define the nature of their respective world-famous works. This statement concerns most of Potok's works, which deal with the divide between ideas from Judaism (i.e., narrative history) and aspects of the Western world (subcultural diversity).

It can be stated that the conflict between religious obligations promoting the inclusion and observance of Western secular humanistic values and a certain escape from strict religious practices are the main themes of Potok's novels. Another level of strife in the area is to pursue individual dreams in maintaining the Jewish tradition in America and to break away from the ideas of Orthodox Judaism without being separated from the faith as such. *The Chosen* does not present a contradiction between Judaism and America, but a schism within Judaism. The stream describes conflicts within the family and between Jewish communities. [3]

The direction of the whole short story is indicated in the introductory chapter, when two teams compete against each other in a baseball game. One is composed of members of the Orthodox Jewish wing, the other is of the opposite composition. Samples from the work are presented in the translation of the relevant Czech edition. [4]

“I was looking at a batsman who waved his high ball and missed, and suddenly he got terribly angry. At that moment, the game ceased to be a game for me and turned into a war. All the joy and excitement were gone. Thanks to the team from the yeshiva, the afternoon baseball game thus turned into a clash between what they considered their choice and our sinfulness. I felt my anger grow and turn to Danny Saunders, and suddenly I didn't find it hard to hate him.” [4, p. 32]

For the above reasons, we are of the opinion that Potok's novel debut is a pivotal work, in which the emphasis is on themes that in a way follow the pre-war Jewish work with an emphasis on the issue of Jews living in the diaspora. The main themes of the amendment are the birth and history of Hasidism, rabbinic power within Hasidic religious practice, answers to the questions of Zionism, the establishment of the State of Israel, the academic study of the Talmud, father-son relationship and Freudian psychoanalytic theory.

2.1 Split 1: Freud versus Orthodox Judaism

Freudian psychoanalysis serves as a basis for depicting the schism that comes with practicing Orthodox Judaism. With a certain degree of simplification, it can be stated that there is a clash of two diametrically different theories, which are a priori excluded in the approach to life. We argue with a quote from *The Chosen* - in this section there is a comparison of these two approaches and a violation of a certain Judaism of a given order: “But he couldn't stop reading it, he said, because it became increasingly clear to him that Freud had looked into human nature in a devilish way. This was what bothered Danny so much. Freud's image of human nature was all but flattering, everything but religious. He separated man from God, as Danny said, and married him to Satan. Danny already knew so much about Freud - so successful was his way of learning - that he used Freud's technical terminology with the same naturalness as we used the Talmud's technical terminology. [...] Freud contradicted everything I had learned so far. But Danny didn't seem to reject Freud's thoughts, and that seemed particularly unsettling to me. I began to wonder how it was possible for the Talmud and Freud to live in the same person at the same time. I had the impression that one or the other would have to back down. When I told Danny, he shrugged, said nothing, and began to read again.” [4, pp. 191–192]

2.2 Split 2: A Change in the Perception of the Jewish Nation

We consider it important to emphasize that Chaim Potok, like other American Jewish writers (such as Saul Bellow,

Bernard Malamud, and Norman Mailer), continues to emphasize Judaism as a religious force associated with specific Jewish rituals. [3] That creative literary turn is guided by two basic lines: 1) emphasizing topics which, according to the author, are important for Jews living in the diaspora about a quarter of a century after the end of World War II, and 2) following traditional themes of English-speaking Jewish authors, especially associated with Judaism, and in looking at them critically. These can be evidenced by the following citations: “In the afternoon, there were endless debates during the class about the problem of double loyalty - how could an American Jew be loyal to a foreign Jewish state? - and these disputes usually revolved around this assumption: On whose side would an American Jew fight if America declared war on the Jewish state? I always answered that it was a stupid question, America would never send Jews to fight the Jewish state; in World War II, she sent Japanese Americans to fight against the Germans, not the Japanese. But I had the impression that my answer never satisfied anyone. But what if America did send Jews to fight the Jewish state? Theorists objected. What then? The debates were sometimes quite fierce, but only between those students and teachers who supported the establishment of the Jewish state.” [4, p. 222]

The change in the debates is indicated in their subject matter. The question of the legitimacy of an independent Israel is no longer discussed, but the debates have advanced to the nationalist level associated with the issue of the self-perception of Jews living in the diaspora. To what extent do they consider themselves primarily Jews, followers of Judaism, and to what extent do they consider themselves citizens of the state in which they live? In a sense, then, it is a matter of further schism, namely whether belonging to a religious group (American Jew) or a national point of view (American of the Jewish faith) has more weight and to what extent these entities interact/exclude each other. It is therefore an application of global problems, which in this case are concretized to the level of self-identification.

2.2.1 Reaction to the Rise of Israel

Among *The Chosen* are among the most important narrative lines in which there is a split in the perception of Judaism and its practice, the reaction of two prominent Jewish leaders, Mr. Saunders, a follower of the Orthodox line of Judaism, and Mr. Malter) to the rise of Israel. The representative of the Hasidic branch strongly opposes the establishment of an independent Jewish state, the liberal-oriented one warmly welcomes its provisions.

“What kind of people are they? What kind of people are they? he shouted in Yiddish and his words passed through me like knives. Apikor! Goyims! Will Erec Jisrael build Ben Gurion with his goyim? Will they build a Jewish land for us? Will they bring the Torah to this country? They will bring paganism there, not the Torah. God will build this land, not Ben Gurion with his goyim! When the Messiah comes, we will have Erec Jisrael, our Holy Land,

and not a land poisoned by the Jewish goyim! (...) Should the land of Abraham, Isaac, and Jacob be built by Jewish goyim, unclean people? shouted Rebel Saunders again. Never! Never in my life! Who says such things? Who says Erec Jisrael should build? And where is the messiah? Tell me, should we completely forget about the messiah? Because six million of our people have been murdered? Should we completely forget the Messiah, should we completely forget the Lord of the world? Why do you think I brought my people from Russia to America and not to Erec Jisrael? Because it is better to live in the land of real goy than in the land of Jewish goyim! Who says Erec Jisrael should build us, huh? I'll tell you who says it! The Apikors say that! The Jewish goyim is saying that! True Jews do not say such things!" [4, pp. 194–195]

Reb Saunders, who extremely negatively perceives the birth of Israel, associates its origin with selected Zionist ideas, which can be summarized in the claim that no man (goyim) has the power to try to group Judaism practitioners in one place, under some form of secular government, in one defined territory with other, albeit Judaism-respectful, rules. This is such a serious event for the Orthodox leader that he can understand or at least tolerate the son's fondness for Freudian psychology, which in some respects contradicts the teachings of the Torah and Talmud but is unwilling to accept the emergence of a Jewish country. "Reb Saunders did not mind that his son read forbidden books, but he would never allow his son to befriend the son of a man who supported the establishment of a secular Jewish state, headed by Jewish goyim. (...) Neither the secular literature nor Freud — who knew Danny read Freud, he knew — was decisive for Rebel Saunders, but Zionism. I found that I could not believe it. My father and I were excommunicated - not only by the Saunders family, which was obvious, but also by opponents of Zionism among Hasidic students. (...) Not Freud, but Zionism has succeeded in shaking our friendship." [4, p. 226]

Representatives of Western, humanist-oriented Judaism, on the other hand, welcome the provisions of Israel with undisguised joy. "On Friday, the second week in May, when Israel was born, we cried openly. And the next morning, when I went to the synagogue, I saw headlines in the newspapers announcing the establishment of the Jewish state." [4, p. 249]

According to Emanuela Zirzotti [6, p. 93], the integration of historical events, the (non)acceptance of which can demonstrate different approaches to Judaism, is nothing new, because the consequences of certain historical stages, in this case the Shoah, "often provide an opportunity to reconcile with one's ideas belonging to a religious, ideological or political group."

2.3 Split 3: Different Perceptions of Values

Danny Saunders and Reuven Malter are trying to detach themselves from their families in the sense of uncritically accepting values and norms passed down from generation

to generation, even under the real threat of being expelled from their community, whether orthodox or secular, or at least in some way ostracized. The boys represent two different aspects within the Hasidic and pro-Western approach, so it is a confrontation between Western secular humanism and religious orthodoxy. The basic conflict in *The Chosen* is a different perception of the interiorization and de-integration of values that symbolize Judaism or being a Jew. The differences between the perception of these values can be demonstrated by the following quotation: "My four-year-old Daniel had no soul, only reason. Reason in the body without a soul. That story was from a book written in Yiddish about a poor Jew and his efforts to get to Erec Jisrael before he died. What did the man suffer? And my Daniel liked the story! He liked the last terrible side, because when he finished reading, he realized for the first time his memory. He looked at me proudly then and told me the story by heart. And I cried in my heart. I went and cried to the Lord of the world: What have you done to me? Do I need this for my son? I need a heart, a soul for him, I want to see in my son compassion, justice, mercy, the courage to suffer and endure pain. That's what I want from my son, not reason without a soul!" [4, p. 272]

2.4 Split 4: Critique of Religious Orthodoxy and Its Projection into Education

The main characters, representatives of the Jewish community, are influenced by their surroundings and the relationships and attitudes of their families, especially by the upbringing of their fathers. To a certain extent, family patterns are also adopted by upbringing, which is reflected in the publication on several levels. One of them is formed by Mr. Saunders' relationship with his father: "When I was a little boy, my father, resting in peace, began to wake me at night just to cry. I was a child, but he woke me up and told me stories of the destruction of Jerusalem and the suffering of the people of Israel, and I wept. He's been doing it for years. He took me to the hospital once - but it was an experience! - and often took me to visit the poor and beggars to listen when they told. My father never spoke to me alone, only when we were studying. He taught me in silence. He taught me to look inside myself, to find my own strength, to wander within myself in the company of my own soul. When people asked him why he was so quiet with his son, he told them that he did not like to speak, words are cruel, words are false, they distort what is in the heart, they cover the heart, the heart speaks in silence. Man recognizes the pain of others by suffering his own pain, he said, turning to himself, finding his own soul." [4, p. 273]

The choice between Jewish orthodoxy and other completely different approaches to life is a moral and religious choice. Singh [5, p. 695] remarks: "Jewish men cannot freely pretend to have learned the law, fathers have been ordered to teach their children the right to do so." Mr. Saunders practices the following: "I have such an agreement with my father. I study the required Talmud quota every day and he doesn't care what I do next. And

how much is your daily quota? Two sheets. Two sheets? I stared at him. That meant four pages of the Talmud a day.” [4, p. 73]

Danny doesn't want to come to terms with her predestined future, so she decides to study psychology. The moment when his father communicates the fact to the relevant assembly is one of the most valuable moments of the publication. It is clear from it that even the father's concern for the son's happiness can lead to the disruption of established stereotypes, even though the above causes a certain discomfort for the community. “During the morning service, the first Shabbat in June, Rebel Saunders announced to the assemblies the decision of his son to study psychology. It was received with surprised horror. Danny was in the synagogue at the time, and all eyes turned on him in astonishment. Then Reb Saunders announced that it was the son's wish that he, as a father, respected his son's soul and reason - in the order Danny later told me - and that his son intended to continue to keep the Commandments and that he felt obliged to give bless him. The uproar caused by Rebel Saunders' announcement among his followers was serious. But no one dared question the unspoken transfer of power to his younger son. Cadik's status was hereditary, and abilities passed automatically from father to son - to all sons.” [4, p. 278]

Reb Saunders, a cadik, the Hasidic spiritual leader, believes that there is a danger that the son's mind (*racio*) may take over the soul (*anima*), and therefore communicates with Danny, the successor of the Hasidic dynasty, through silence. According to his convictions, this develops the boy's axiological, moral and ethical values. Mr. Malter, Father Reuven, a modern-minded Talmudist scientist, on the other hand, prioritizes reason over the soul and lays down basic Jewish principles. Patterns of education are passed on to other generations, despite the possible negative consequences of the chosen pedagogical method. “Did he talk to you? Yes, Danny said quietly. We're already talking. There was a long, peaceful silence. An inaudibly cold breeze blew through the open living room windows. Then my father leaned forward in his chair. Danny, he said kindly when you have a son, will you raise him in silence? Danny didn't say anything for a long time. Then his right hand rose to his face, gently crying and pointing with the imaginary dog. Yes, he said. Unless I find another way.” [4, p. 279]

A similar form of education is explained in the relationship between Reb Saunders and Danny, his son. “We hated our silence, and it seemed inconceivable that Danny and his father didn't talk at all. The silence was disgusting, dark, peeking mischievously, crawling like cancer, it was like death. I hated him, and I hated Rebel Saunders for forcing him on me and his son.” [4, p. 229]

But Danny is aware of the benefits of his father's approach.

“Let's talk about my father. Do you want to know how I relate to him? I admire him. I don't know what he's watching with the strange silence he has established between us, but I admire him. I think he's a great man. I acknowledge him and admire him unconditionally, which I think is why I can live with his silence. I don't know why, but I trust him. And I'm sorry about him, too. He is trapped intellectually. He was born in a trap. I never want to be caught in the same trap as him. I want to breathe freely, I want to think what I want to think about, to say the things I want to say.” [4, p. 198]

The citation indicates another impulse for such an upbringing, namely the need to train another cadik, who is to take the place of his father: “Recently, it occurred to me that I wouldn't break the dynasty at all if I didn't take my father's place. My brother could take over. I thought I would disrupt the dynasty if I didn't take my father's place. I think I had to justify why I would have to become a cadik.” [4, p. 197]

Saunders' perception of the importance of Judaic texts for real life captures a passage from which the hierarchy of cadic values is evident: “For such a Rebel Saunders and others like him, it also meant any educated Jew who read Darwin, for example, did not wear a dog, or did not look fringed from his pants. Danny Saunders saw apikora in me despite my faith in God and the Torah, because I did not wear dogs and the school, I attended taught more English subjects than the required minimum, and Jewish subjects were taught in Hebrew instead of Yiddish. Both were unheard of sins for him. The first because there was less time left to study the Torah. The second is because Hebrew is a holy language and using it commonly in teaching meant desecrating the name of God.” [4, pp. 31–32]

Mr Malter takes a much more liberal stance on his son's future: “If you become a rabbi, your father said amiably, smiling. You meant when I became a rabbi. Father nodded, still smiling. You'd make a good university professor, he said. I would be happy if you became a university professor. But I have the impression that you have already decided. Am I right? Yes, I said.” [4, p. 215]

Danny and Reuven never decided to give up their faith, their Jewish identity; their approach to the practice of Judaism is linked by secular modernism, which Potok defines as *core-to-core*. Both Danny Saunders and Reuven Malter are beginning to realize that they are no longer part of one closed group (*we*) but are transforming *we* into a unified entity of both American and European Jews. This turn can be demonstrated by Danny's ostentatious shedding of the external characteristics of the Judaism: “Daniel, said Reb Saunders, almost in a whisper, when you leave to study, do you cut your beard and dogs? Danny stared at his father. His eyes were wet.” [4, p. 276]

3. Conclusions

In this paper, we have presented selected creative transformations in the literary depiction of Judaism in the work of Chaim Potok, *The Chosen*, because the given narrative forms a certain milestone in the given area. The author withdraws from strict adherence to the depiction of Judaism in order to preserve the legacy of this religion for future generations, emphasize the contribution of Jewish people who somehow realized in public space or approach the suffering of people of Jewish nationality during World War II, and vice versa in his novel debut. Potok does not preclude the thematization of certain disputes that existed and certainly continue to exist between the various Jewish communities. The story emphasizes the influence of the orthodox branch of Judaism on the upbringing of children and its reflection on the concept of life and views on global or societal events.

We have divided the changes in the literary depiction of the topic, which were foreshadowed by the publication of *The Chosen*, into four main areas. The first, Freud versus Orthodox Judaism, deals with the conflict between the teachings of the Talmud and the Torah and Freud's psychoanalysis. At the heart of the second split, changes in the perception of the Jewish people, is the confrontation of diametrically opposed views on the creation of Israel. The third, different perception of values, means a confrontation between Western secular humanism and religious orthodoxy. The last-mentioned schism, the critique of religious orthodoxy and its projection into education, is, in our opinion, a fundamental aspect of why Potok's novel is perceived as a certain milestone in the approach to the literary treatment of Judaism. We perceive the defined divisions in terms of changing the creative way and goals of the work of American Jewish writers on Judaism. That changes in the presentation of a given topic cannot be affected based on an analysis of one artistic narrative. Nevertheless, we are convinced that for the reasons we have outlined in the article, the book *The Chosen* occupies a pivotal position in the given area, mainly due to the thematization of a relatively open confrontation of two Jewish communities and due to the comparison of the influence of life representatives of their representatives on the upbringing of children.

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References

- [1] Bhabha, Homi, K, *The Location of Culture*, London, Routledge, 1994, 440 p.
- [2] Devir, Nathan, Paul, *Archetypes and Avatars: A Case Study of the Cultural Variables of Modern Judaic Discourse Through the Selected Literary Works of A. B. Yehoshua, Chaim Potok, and Chochana Boukhobza*, Ann Arbor, ProQuest, 2010, 397 p.
- [3] Jyothsna, DSilva, *Integration and disintegration of Jewish tradition in the selected novels of Chaim Potok*, *Research Journal of English Language and Literature*, Vol. 1, No. 1, pp. 156–160, 2013.
- [4] Potok, Chaim, *The Chosen [Vyvoleni]*, Praha, Odeon, 1993, 284 p.
- [5] Singh, Kamna, Ilui: Depiction of the Jewish Genius in Select Works of American-Jewish Fiction, *The Criterion: An International Journal in English*, Vol. 8, No. 4, pp. 691–697, 2017.
- [6] Zirzotti, Emanuela, Between Longing and Rejection: Antonio Lobo Antunes nad Chaim Potok, *The Wenshan Review of Literature and Culture*, Vol. 10, No. 2, pp. 93–109, 2017.

ALCOHOL ADDICTION OF AN INDIVIDUAL IN RELATION TO FAMILY ENVIRONMENT DURING HIS CHILDHOOD (CASE STUDY OF A PATIENT WHO IS DIAGNOSED WITH ALCOHOL ADDICTION)

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Abstract: *There are many factors that influence the development of alcohol addiction, among the most important we could include factors that are related to the family environment in which the individual grew up during his/her childhood. If the child's parents have the wrong parenting style, if the child does not form a secure attachment style and if he/she had traumatic experiences within the family during childhood, all this can contribute to the child's inability to integration and functioning within the society, and this can lead to the development of addictive behaviour. In this paper we present the most important family factors during childhood that can lead to the later development of alcoholism in the individual and we present a case study of a patient who is diagnosed with alcohol addiction, in which we focused on these factors.*

Keywords: *alcohol addiction, family environment, parenting style, attachment style, traumatic experiences during childhood*

1. Introduction

The family and its environment in which the child grows up is very important. If there is any pathology in this system immediately, it can be very much reflected by the child [15].

Kudrle (2003) talks about the complexity of the causes involved in development of alcoholism. Kalina (2003) emphasizes social and family factors (mental development in childhood and adolescence), which may also be strongly related to the later development of alcoholism in individual.

Early childhood of an individual is very important, during this period, children are most vulnerable to traumatic experiences. During childhood, traumatic experiences are most often caused by the person who is supposed to be close to the child and protect him (mother, father). The most common types of traumatic experiences are emotional and physical neglect, abuse, and deprivation. The child's reaction to this is to withdraw, we can see in the child signs of physical failure, stereotypical movements used for self-stimulation and self-harming behaviour may also appear, where we can include even addictions [6]. Alcohol addiction of one of the parents can also be a traumatic experience for a child and this may lead to a subconscious urge to repeat such behaviour, as the child inherits behaviour patterns from his or her parents during first years of life [16]. One of the parents' alcoholism is also related to the individual's genetic predisposition to this addiction. This predisposition can manifest itself at the level of metabolism of the addictive substance and at the level of its action on brain neurons [16]. According to Edenberg and Foroud (2013) two genes involved in alcohol metabolism are the most important in the later development of alcoholism- ADH1B and ALDH2 genes. The GABRA2, CHRM2, KCNJ6 and AUTS2 genes can also have a very significant effect on alcoholism development. Dopamine release is also very important

factor in development of addictions. Research from Oberlin et al. (2013) came to conclusion that individuals who grew up in a family with alcohol addicted family member, showed much more pronounced and massive dopamine excretion after drinking alcohol beverage than other individuals, they also found out that the incidence of alcoholism in the family doubled the risk of later development of alcoholism in an individual who grew up in such a family.

The way in which parents raise their child (parenting style) is also very important in terms of family factors. According to Rojková and Popelková (2010), the consistency of parenting styles is very important, if parents are inconsistent in their parenting styles, it can be a risk factor for the later development of addiction. According to Visser et al. (2013) and Martínez-Loredo et al. (2016) people addicted to alcohol were exposed in their childhood to a hyper protective and refusal parenting styles. On the basis of such upbringing, the child is unable to create a secure attachment, as such a child does not feel confidence, does not feel safe and accepted. This is confirmed by research of DeRick and Vanhuele (2009) and Wyrzykowska and Mickiewicz (2014) who claim that secure attachment is rare in people addicted to alcohol. According to DeRick and Vanhuele (2009) we can mostly observe uncertain types of attachment in people addicted to alcohol.

Research objectives and research questions

As part of the research, we set the following objectives:

- to identify what type of parenting style was present in family where respondent was raised and if parenting style of father and parenting style of mother were consistent
- to identify attachment style of a respondent
- to identify whether the respondent experienced traumatic experiences during his childhood and

whether there was alcohol addiction present in his parents

- compare findings from case study of our respondent with findings of other authors.

In connection with the research objectives and on the basis of theoretical background, we determine the following research questions:

RQ1: What parenting styles did the respondent's parents have?

RQ2: Were the respondent's parents consistent in their parenting styles?

RQ3: What style of attachment does the respondent have?

RQ4: Did respondent experience trauma during his childhood?

RQ5: Did alcoholism occur during at least in one of his parents during the respondent's childhood?

2 Methods

2.1 Research sample

The research sample consists of a patient who has been diagnosed with alcohol addiction. The patient was treated at the time of the research in psychiatric clinic, where we performed internships, on the basis of which we contacted this patient. Further information about the patient is given directly in the case study.

2.2 Research materials and equipment

Within the research, we had a structured interview with the respondent, which we compiled based on literature and research, which focused on the issue of alcoholism in connection with family factors. As part of the triangulation of methods, we also administered following questionnaires to the respondent:

s-E.M.B.U. [14] – by this questionnaire we were able to capture the parenting style of respondent's parents. The questionnaire consists of 23 statements, which can be evaluated on a 4-point scale, where 1-no, never and 4-yes, mostly. The statements are separate for the father and separate for the mother, so it is possible to determine the consistency of parenting styles. Examples of statements: "My parents praised me"; "My parents severely punished me." By using this questionnaire, it is possible to determine how *hyper protective*, *emotionally warm* or *refusal* the parenting style was.

ECR-R – this questionnaire was used to find out the attachment style of respondent. The questionnaire was revised in 2009, consists of 36 statements and is divided into 2 parts. The respondent evaluates statements on a 7-point scale, where 1 - strongly disagree and 7 – strongly agree. Examples of statements: "I am afraid of losing my partner's love", "It is difficult for me to rely on a partner", "I discuss various things with my partner" [2].

CTQ (Childhood Trauma Questionnaire) - for capturing any trauma experienced by the respondent during his childhood [7]. This questionnaire contains 28 items. Examples: "I didn't get enough food.", "I felt loved.",

"Someone sexually abused / harassed me." The respondent evaluates statements here on a 5-point scale from "never" to "very often". The authors distinguish 5 subscales within this questionnaire: *sexual abuse* (sexual contact between a child under the age of 17 and an adult), *physical abuse* (physical attacks on a child from an adult or an older person, which could result in serious injuries), *emotional abuse* (verbal attacks by an adult against child, which have a devastating effect on the child and endanger his or her self-esteem or emotional well-being), *physical neglect* (failure of caregiver (parents) provide and meet the child's basic physical needs), *emotional neglect* (failure of the caregiver (parents) to meet the child's basic emotional and psychological needs). The remaining 3 items are called additional items (we refer to them as the denial scale) [9].

CAST (Children of Alcoholics Screening Test) This scale consists of 30 self-evaluating items that focus on the attitudes, feelings, perceptions, and experiences of an individual with parents who have consumed alcohol. 30 points is maximum that one can have. The score when we can characterize an individual as a child who grew up in a family where alcoholism occurred is 6 points [10]. We took the Slovak version of the questionnaire from Vnučková (2012).

3. Case study

In order to maintain anonymity, we have assigned to the respondent name Jack for the purposes of this case study. All data are valid at the time the research was realized (November 2020).

Personal and medical history:

Jack is 28 years old; he is currently single and lives with his friend. He has no children. Jack has graduated high school (field: waiter). He reports no health problems, except alcohol addiction, which had been diagnosed to him in 2016, after a few sessions he paused and failed in abstinence. From 2019, he visits psychiatric clinic because of treatment of this addiction again. He takes medicines to suppress alcohol cravings. He is also regularly monitored by a psychologist and attends meetings of anonymous alcoholics.

Alcohol addiction history:

Jack consumed alcohol sporadically before reaching the age of 18, what is age limit in Slovakia for legal alcohol consumption. After reaching the age of 18, he started drinking alcohol regularly once a week. In the course of several months, he drank alcohol several times a week. The turning point came in the 22nd year of his life, when he broke up with his girlfriend, he started even more arguing with his father and he was forced to leave home and began to dwell with his friends who also drank alcohol. Over the course of two years, Jack began drinking alcohol every day and since he was working in gastronomy, he started to consume alcohol even during working hours. He sought help only with urgency of his then employer, but he did not remain in abstinence, at

present he tries to recover from addiction and again abstain.

Family history:

Jack grew up in a complete family with his mother and father. He is the only child. According to his answers in the interview („*My father is an alcoholic.*“) and according to the results of the CAST scale (19 points), we state that his father was an alcoholic during Jack's childhood. His father was aggressive after alcohol consumption. Jack's mother, often apologized for his father and she did not take his addiction seriously. Jack was often physically punished by his father; he also defended his mother (statement from interview: „*Father beats my mother when he got very drunk. He also beats me regularly.*“), but during the period of adolescence he did not even have a good relationship with her.

In the interview, Jack stated: „*When I was a small child my mother was very attentive to me. My father didn't drink so much back then, so she had time for me, but over the years, his alcoholism worsened, and when he got drunk, he was aggressive. My mother tried to keep him happy, she apologized for him, but I did not feel support from her.*“

Atmosphere in the family, parenting style and attachment style:

Jack does not characterize his childhood as joyful. The respondent's father's alcohol consumption had a large effect on the atmosphere in the family. When Jack's father drank alcohol, he was aggressive and violent, and he blamed his anger on the respondent. Atmosphere in the home of respondent was very tense (statement from interview: „*The atmosphere was very tense. We never knew the condition of my father returning home. More or less, we knew, but we wanted him to come sober and in a normal mood. Mostly it was not the case.*“). Jack did not feel safe in the presence of his father. Jack did not feel the closeness and care from his parents. He did not suffer materially, but all responsibilities in the household remained with his mother and him (statement from the interview: „*I was in charge of shopping, and since we lived in the house, I was also in charge of all the work around the house, my father didn't do anything in the household.*“).

According to the results of the s-E.M.B.U. questionnaire, we conclude that the father's parenting style could be mostly characterized as refusal. The mother achieved the highest score in emotional warmth, but the score was too low for us to clearly consider her parenting style to be emotionally warm. The mother showed a certain emotional affection for Jack, but only until she did not have to deal with a drunken father, and she often preferred the needs of her husband to the needs of her son, which largely marked their relationship. Over time, Jack gradually moved emotionally away from her.

According to the results of the ECR-R questionnaire, we can state that Jack has formed disorganized attachment style, it was almost impossible for him to form a secure

attachment, because as he himself stated in the interview, he did not feel safe in his family, he did not feel support, love and the fulfilment of his needs (statement from the interview: „*My parents did not give me enough time, love, and care. In the presence of my father, I never felt safe.*“).

Traumatic experiences in the family during childhood: (here we present the findings, which we gained through the interview and the CTQ questionnaire)

In the dimension of physical neglect, we found out from the answers that parents took care about Jack materially, he always had something to eat, and he had clean clothes. However, his parents did not care about him otherwise, they did not protect and support him.

In the dimension of emotional abuse, we found out according to the results that the respondent was during childhood emotionally abused. He often felt that someone in the family hated him, he was often attacked with insults. (statement from the interview: „*For us, it has always been mainly about the physical attacks. But I was afraid to go home from school, I didn't like spending time there, so I also suffered mentally.*“)

In the emotional neglect dimension, we found that the respondent did not have a person in the family who would let him know that he was loved and important. The members of the Jack's family were not emotionally close and were not a source of support for him.

In the physical abuse dimension, we found that the respondent was physically abused. His father often physically attacked him which caused him bruises. Jack was often punished by his father with objects such as a belt (statement from the interview: „*I had bruises, but we never went to the doctor. I never had anything broken.*“).

From the answers to the questions that are included in the dimension of sexual abuse, it is clear that sexual abuse never occurred to Jack during his childhood.

The answers of the respondent show that the respondent suffers from childhood trauma, especially as a result of physical and emotional abuse. In the interview he stated that the most traumatic experience for him during his childhood was seeing his father physically attacking his mother: „*The most traumatic experience I can remember was seeing my father attacking my mother, I was used to get hit from him, but when I had seen that he hit her, I knew no one would help us anymore, not even her.*“

4. Discussion

Based on presented case study, we see that family factors may be a major contributor to the later development of alcohol addiction. We decided to focus on parenting style, attachment style and traumatic experiences during childhood.

RQ1: What parenting styles did the respondent's parents have? + RQ2: Were the respondent's parents consistent in their parenting styles?

From our case study we can conclude that refusal parenting style could be a risk factor for the later development of alcoholism. This is also confirmed by research from Visser et al. (2013) and Martínez-Loredo et al. (2016). They also came to conclusion that a hyper protective and refusal parenting style can be a risk factor for the later development of alcoholism in an individual. Risk factor for the development of alcoholism could also be inconsistency of parenting styles of one's parents [15]. We see this in case of Jack, too. His mother's and father's parenting styles were inconsistent. His mother showed a certain emotional warmth in her parenting style toward Jack, and on the contrary, his father's parenting style was dominated by refusal.

RQ3: What style of attachment does the respondent have?

In Jack's case, we captured a disorganized attachment style. Brennan and Shaver (1995) point out that alcohol consumption correlates significantly with insecure types of attachment and secure attachment style is, on the contrary, a protective factor for the later development of alcoholism. This is confirmed also by Wyrzykowska and Mickiewicz (2014), who concluded that secure type of attachment is very rare in people addicted to alcohol, and most often we can observe an insecure types of attachment in those people.

RQ4: Did respondent experience trauma during his childhood?

We found traumatic experiences during childhood in four subscales out of five (physical abuse, emotional abuse, physical neglect, emotional neglect) in Jack's case. We did not confirm sexual abuse during Jack's childhood. Childhood traumas are relatively common in people with alcohol addiction. Hašto (2005) and Adamove (2017) state that the most vulnerable period in terms of trauma is precisely the period of childhood. Hašto (2005) states that in childhood, trauma is most often caused by emotional and physical neglect and deprivation. This can have a very negative effect on an individual even during the period of adulthood and it can lead to self-harming behaviour, to which we can certainly include dependence on dangerous and addictive substances, such as alcohol.

RQ5: Did alcoholism occur during at least in one of his parents during the respondent's childhood?

Traumatizing for a child can also be the fact that he or she grows up in a family where one of the parents is an alcoholic. Oberlin et al. (2013) with their findings point out that the incidence of alcoholism in the family can double the risk of later development of alcoholism in the individual. Also, Dager et al. (2014) state that alcoholism in the family can be a very risk factor for the later development of alcoholism in individual who grew up in such a family.

4.1 Limits of the research, contribution to practice and suggestions for further research

From our point of view, the biggest limit of our research was the need to conduct an online interview and not interview in person, due to the lockdown in connection with COVID-19. It is not possible to establish such close contact during the online interview, which may affect the respondent's openness to talk about sensitive topics. Another limitation that occurs often in case studies is the possible subjectivity of the researcher, which we tried to eliminate through triangulation of methods.

This study could help to better understand how an early childhood may play an important role in the later development of alcoholism. This can be useful for psychological counselling that works with addicted clients, but also for the general public and especially for parents who are raising the next generation. Through this case, they have the opportunity to realize how important family factors and the family environment, in which the child grows up, are for his future functioning in society. As part of further research, we propose a quantitative study of the issue, where the sample would be expanded, and generally valid conclusions could be drawn.

References

- [1] ADAMOVE, J. Vzťahová väzba v detstve a v dospelosti.. Bratislava: Vydavateľstvo F, Pro mente sana. 2017
- [2] BIEŠČAD, M., HAŠTO, J. Dotazník na typológiu vzťahovej väzby (attachment) v dospelosti. Trenčín: Vydavateľstvo F. 2009
- [3] DAGER, A. D. et al. Influence of alcohol use and family history of alcoholism on neural response to alcohol cues in college drinkers. In *Alcoholism: Clinical & Experimental Research*. 2013, vol. 37, no. 1.
- [4] DE RICK, A., VANHUELE, S. (2009). Alcohol Addiction and the Attachment System: An Empirical Study of Attachment Style, Alexithymia, and Psychiatric Disorders in Alcoholic Inpatients. In *Substance Use and Misuse*. 2009, vol. 44, no.1.
- [5] EDENBERG, H. J., FOROUD, T. Genetics and alcoholism. In: *Nature Reviewsn Gastroenterology & Hepatology*. 2013, vol. 10, no.8.
- [6] HAŠTO, J. *Vzťahová väzba, ku koreňom lásky a úzkosti*. Trenčín: Vydavateľstvo F, Pro mente sana s.r.o, 2005
- [7] HAŠTO, J., VOJTOVÁ, H. Posttraumatická stresová porucha, bio-psycho-sociálne aspekty. Olomouc: Univerzita Palackého. 2012
- [8] KALINA, K. *Drogy a drogové závislosti, medzioborový prístup*. Praha: Úrad vlády České republiky. 2003
- [9] KAŠČÁKOVÁ, N., FRUSTOVÁ, J., POLÁČKOVÁ ŠOLCOVÁ, I., BIEŠČAD, M., HAŠTO, J., TAVEL, P. Psychometrická analýza českej verzie dotazníka trauma z detstvá (CTQ) so sociodemografickými rozdielmi v traumatizácii dospelých obyvateľov Českej republiky. 2018.
- [10] KELLY, V., & MYERS, J. E. Parental Alcoholism and Coping: A Comparison of Female Children of

Alcoholics With Female Children of Nonalcoholics. In *Journal of Counseling and Development*. 1996, vol. 74, no. 5.

[11] KUDRLE, S. Úvod do bio-psycho-socio-spirituálního modelu závislosti In: *Drogy a drogové závislosti - Mezioborový přístup*. Praha: Úřad vlády České republiky. 2003

[12] MARTÍNEZ-LOREDO, V. et al. Parenting styles and alcohol use among adolescents: A longitudinal study. In *European Journal of Investigation in Health and Education*. 2016, vol. 6, no.1.

[13] OBERLIN, B. et al. Beer Flavor Provokes Striatal Dopamine Release in Male Drinkers: Mediation by Family History of Alcoholism. In *Neuropsychopharmacology*. 2013, vol. 38

[14] POLIAKOVÁ, M., MOJŽIŠOVÁ, V., HAŠTO, J. Skrátený dotazník zapamätaného rodičovského správania ako výskumný a klinický nástroj s-E.M.B.U. In *Psychiatria Psychoterapia-Psychosomatika*. 2007, vol. 38

[15] ROJKOVÁ, Z., POPELKOVÁ, M. *Vzťahy medzi rodinnými, osobnostnými a situačnomotivačnými faktormi z perspektívy alkoholovej závislosti*. Nitra: Univerzita Konštantína Filozofa. 2010.

[16] RUČKOVÁ, G. Závislosti na psychoaktívnych látkach a možný doliečovací proces v resocializačných zariadeniach. In *Mladá veda*. 2018, vol. 6, no. 1.

[17] VISSER, L. et al. The impact of parenting styles on adolescent alcohol use: The TRAILS study. In *European Addiction Research*. 2013, vol. 19, no. 4,

[18] VNUČKOVÁ, L. *Copingové stratégie dospelých detí alkoholikov*. Trnava: Univerzita sv. Cyrila a Metoda v Trnave, 2012.

[19] WYRZYKOWSKA, E & MICKIEWICZ, K. Attachment relationships among alcohol dependant persons. In *Alcoholism and Drug Addiction*. 2014, vol. 27, no. 2.

Session: History, Sociology

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SLOW MEDIA MANIFESTO, DIGITAL MINIMALISM AND DIGITAL DETOX AS IMPORTANT NOTIONS OF THE 21ST CENTURY

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Abstract: *Our study highlights the importance of slow media and digital minimalism, which are more than important in today's world. The main aim of the paper is to comprehensively explain the philosophy of slow media and digital minimalism, that show a moderate approach towards digital technology and media. They have become part of everyday life for most people. With the help of the Internet, digital technologies and platforms people are able to facilitate many activities, such as sending free messages, searching for information, sharing photos, videos and so on. At the same time, however, they rob us of the most precious thing of all – time. Disconnecting from the digital world can be unimaginable for some people. Awareness of such technologies and online activities are valuable. We clarify what positive impact disconnecting from technology and media for a certain period of time can have on our social life; how to adopt the ideas of slow media and digital minimalism and apply them to the pace of a fast-paced society based on the rapid consumption of media content and technology. We analyse the philosophy of slow media and digital minimalism in the context of communication and compare Slovak and foreign initiatives aimed at disengaging from digital technologies and new media.*

Keywords: *Digital detox. Digital minimalism. Media. Slow media. Technologies.*

1. Introduction

The Internet and digital technologies that have firmly entered our lives have greatly influenced the mindset, quality of life and leisure activities of people all around the world. Traditional forms of communication, information-seeking, leisure and so on have largely been replaced by the new forms offered by the Internet and digital technologies. Correspondence and face-to-face communication is gradually disappearing and is being replaced by text messages and messages on social networks. In addition to messaging, a number of social media offer users more advanced tools, namely video chat. Many offline activities, such as playing board games, have moved to the online world. We search for information using the Internet search engines like Google. We consider media and technology as great helpers and cannot imagine life without them. However, we do not think how much time we spend every day with our mobile phones in our hands, watching television or reading the news on the Internet. This unregulated use of digital media and technology leads to distracted attention, superficial reading and a lack of deeper reflection on media content. For this reason, it is necessary to promote responsible use of digital media and to discover what is valuable and positively formative in them. The philosophy of slow media and digital minimalism points to this problem. These are notions that do not reject but acknowledge digital technologies and address the idea of responsible use of digital media and technologies. The main aim of the paper is to provide a comprehensive explanation of the philosophy of slow media and digital minimalism, which point at a moderate approach to digital technologies and media.

1.1 Theoretical background and definition of basic terms

Recent research shows that users not only spend more than seven hours a day with their smartphone; moreover, they spend most of their time on social networks and playing games [5]. The dread of losing out on social contact, a new experience, or any other gratifying event is linked to frequent monitoring of social networking sites such as Facebook, Instagram, and the like. "Fear of missing out" (also known as FOMO) is described as a need to be constantly connected to what others are doing [3]. FOMO is common among young people in a range of settings and places, even those that are not influenced by social media [15]. In addition to heightened emotions of dissatisfaction, FOMO can lead to more hazardous behaviors, and in some circumstances, death, since FOMO is linked to inattentive driving, for example [9]. Another new media issue is the "fear of being offline" (hereafter referred to as FOBO). It refers to the anxiety that a person experiences when they don't have access to their phone, when their battery runs out, when the Internet is unavailable, and so on. Adults are concerned about being isolated from work connections, just as teens are concerned about missing out on social interaction [6]. FOMO and FOBO are a very topical issue of the 21st century. The pandemic due to the COVID-19 disease has caused students to switch to distance learning and a lot of staff to home office. Because of this, they have been spending a lot more time with digital technology.

These are the proponents of minimalism who agree that FOMO and FOBO are the real reasons to take a break from digital technology and apply the practices of digital minimalism, digital detox or the idea of Slow Media.

Digital minimalism is a notion popularized by Cal Newport, a professor of computer science at Georgetown

University [4], who defines digital minimalism as “*a philosophy of technology use in which you focus your online time on a small number of carefully selected and optimized activities that strongly support things you value, and then happily miss out on everything else.*” It is this minimalist philosophy that is in stark contrast to the maximalist philosophy that is typical of the majority of the population – a mindset in which any potential benefit of technology is enough to get a person to start using it [4]. Introducing digital minimalism into your life has some simple but important benefits. These benefits also have implications for improving a person's experience in even broader areas. Boswell defines several benefits of digital minimalism – taking control of one's time and making technology more useful [2]. We support the idea that one should responsibly and thoughtfully choose media content that has value and informs to the core and not be absorbed by the digital world. At the same time, it is a call for media content creators to apply the slow media philosophy and start creating durable media content.

Another notion is the Slow Media Manifesto. Slow Media, according to Rauch, is a “*philosophy and a practice: First, it represents an appreciation or re-appraisal of “heirloom” forms of media, such as print or analog, and questions popular desire for ever-more information and ever-faster communication.*” It also supports a 'slowness' in media production and consumption, which shifts usage away from digital networks and technology and toward slower mediated activities, frequently momentarily or by limiting time spent with them. Slow media and Slow Food are philosophically related notions. The public and the press became increasingly aware of the notion in 2010. It gradually received international recognition. In terms of institutional structures, public broadcasters have traditionally been the news providers who have paid the greatest attention to the Slow Media subculture. In the United States, National Public Radio aired a landmark report on sluggish media; in Germany, Zweites Deutsches Fernsehen published a major online piece on slow media; and in Australia, the Australian Broadcasting Corporation showed a substantial program on slow media [12]. We discovered only one article about slow media in the Slovak Republic, which was published by Forbes in 2021 [8].

Slow Media is concerned with the notion of spending time with the media in a slow and thoughtful manner. Spending less time reading worthless media information and more time creating media content that is important and relevant to humans [13].

2. Quality over quantity in news production and consumption

The discussion of slow media is linked to the transitional period and significant changes in society as a result of technology advancements. Focus, discourse, attachment, sociality, and quality are all integrally tied to digital change and the demands of a post-digital society, as a recent study by the authors of the Slow Media Manifesto claims on Slow Skills and Slow Lifestyles [16].

In 2008, the Columbia Journalism Review published an article titled "Overload!" that addressed news fatigue in an "age of too much information." As Facebook, Google and other technology platforms have monopolized our digital lives, news organizations have had to take on a supporting role and rely on traffic to these sites. Luo claims, that this reliance has a strong influence, on which stories are pursued, how they are presented, and at what speed and volume they are released. Advertising costs have decreased as a result of the expansion of Facebook and Google, but even with lower costs, we discover that social media is fueling a lot of sad modern media phenomena, such as clickbait headlines and quickly produced "fresh news" items. This is because news organizations are pursuing the same hot news to avoid missing out on the traffic it would generate. Any piece of content that may drive clicks on Facebook or Google and is relatively inexpensive to develop has the potential to earn cash [14].

3. Applying digital decluttering and digital detox practices

Newport in his book Digital Minimalism examines different developments that might radically alter the human connection with technology. In one's opinion as Newport, the most effective approach to embrace this lifestyle is through quick transformation – making significant changes in a short amount of time with adequate conviction, while a gradual shift in habits may not be beneficial. This is known as a digital cleansing and it entails removing all the optional technologies from your life for thirty days. During these thirty days without technology, a person should rediscover activities and behavior that are meaningful to them. At the end of this pause, he or she will reintroduce technology into his or her life and determine what value the technology has for his or her life and how specifically he or she will use it to maximize that value. In order to avoid failure, it is necessary to define the rules of technology use at the beginning of the thirty-day pause. The first step is to figure out which of your personal technologies fall into the optional category. These are technologies that will not dramatically affect your job or personal life on a daily basis. This is a collection of modern technologies, such as applications, websites, mobile phones, and so on, according to Newport. It does not include technologies such as the microwave oven or electric toothbrush. The second step is a thirty-day break. The goal is to spark a lasting transformation of digital life. It's not merely a thirty-day tech-free period. As a result, Newport refuses to use the terms "digital decluttering" and "digital detox" interchangeably. He sees detox as an essential stage in the change process. Before reinstating technology into one's life, one must first determine which leisure activities are essential to them and what they enjoy outside of the world of constant connectivity [4]. Based on the above, we can say that digital minimalism is not just about removing technology for a certain period of time, but an important step is just to think about the value and potential of the

technologies that are becoming part of people's everyday lives.

A digital detox, as previously discussed, is another technique to minimize your usage of digital technology. A digital detox is a period of time during which a person refrains from using electronic devices such as telephones in order to reduce stress or focus on social interaction in the real world [18]. If done thoughtfully, a digital detox can help a person release some of the negative buildup from technology use and give them the break they need to make better decisions in the future. Dr. Jantz recommends several digital detox practices:

- planning – similar to the process of digital minimalism, planning is the first and important step in the digital detox process. One must think through what technologies one will give up, for what reason, and for how long. Then he or she creates a plan;
- take a little break – start the digital detox gradually. For example, Jantz recommends leaving your smartphone in the car when going to the cinema, and thus spending a few hours concentrating on just watching the film. If you're constantly checking your email, he recommends setting a time interval, such as checking your smartphone every hour;
- substitute technology – time spent with technology but choosing to limit it needs to be filled with something positive, healthy and valuable. For example, a person decides to check Facebook every other day. On those days that he or she doesn't check Facebook, he or she can arrange a personal meeting with friends, go for a walk in the woods or with the dog, and so on. It is important to fill the offline time with worthwhile activities;
- defining goals – in this step it is important to specify the reasons why one is doing a digital detox. It is recommended to write down the goals and later reduce them to short, easy-to-remember phrases;
- setting the rules – the key is to set specific rules, but also the consequences in case of non-compliance. The less specific the rules, the easier they will be to follow. When planning a digital detox, it's also important to account for failure. A person needs to determine in advance how they will reset if they break a rule, such as taking their phone with them to the movies;
- use what one has learned – one of the goals of a detox technology should be to learn that one can actually live without it. One should also try to use digital detox to learn more about oneself and how one interacts with technology in all aspects of one's being. Jantz claims that the whole person can be characterized emotionally, relationally, physically, and spiritually. By paying attention to each of these areas during a digital detox, a person can discover how technology is helpful and how it can actually harm them in each area;
- the next step – the final step – is to apply what one has learned during the digital detox. Use the knowledge gained and gradually move towards a more positive

and healthy integration of technology into one's life [10].

Hadjiosif recommends a few tips to lighten up your online space and reduce screen time. He finds important to change the mindset and the way one thinks about technology. For example, when practicing digital minimalism, one should monitor time spent in the online space and with technology, turn off notifications, delete unnecessary photos, use storage, remove apps that are little or not used at all, tidy up folders on the desktop, name documents, install updates, clean up the email inbox, unsubscribe from newsletters, unfollow sites on social media platforms, tidy up one's contact list, use technology only for things that make life better, and so on [17].

4. Conversation-focused communication

In his publication, Newport offers practical advice, dealing with issues of leisure, social interaction and communication. It is with the advent of the internet that human interaction and the way people communicate today has changed [4].

It is the Internet and social networking that have brought new ways of communicating and are slowly displacing face-to-face communication in the real world. It was our brains and mindsets that evolved in the era when communication was done in an offline way. Offline interactions are valuable because they require our brains to process large amounts of information, such as body language, tone of voice, and the like. It is just that many digital communication tools offer limited communication. As a result, the value of a Facebook comment is lower than the value of a real-world interaction. People prefer to converse via social media messaging or texting because online contact is more convenient and easy. It requires less energy in the short term. We write a comment, a message instead of meeting someone in person. Another problem is the decreasing quality of valuable interactions. The importance of the person in the room with us and the person who sent us a fresh message is difficult for our analog brain to discern. Checking our phones, perusing websites, and clicking on things all the time deprives us of real-world encounters, leaving considerably less time for slower conversations. In one's opinion Newport, we need to strike a balance between conversation and connecting in a way that makes sense. Conversation-focused communication may be the solution. This is a worldview that accepts digital technology as long as it is utilized to enhance real-world social interactions. A user who applies conversation-focused communication can still use social networks. He or she should not, however, make it a habit to post on a regular basis, leave comments, react to his or her friends' postings, and so on. With this in mind, having these applications on your phone is no longer a good idea. Instead, they'll be more beneficial on a computer, where they'll be used just once in a while and for specialized objectives [4]. From the above, it is clear that despite the benefits that social networking and the Internet provide us, human interaction and communication in the real world is

irreplaceable. It is important to spend more time talking to a person face-to-face and less time in the online world.

5. Initiatives that apply the idea of slow media, digital minimalism and digital detox

There are several organisations in the field of journalism and media production that promote the idea of slow media and digital minimalism.

Nieman Journalism Lab is an institution that seeks to help journalism find its place in the Internet era. They deal with the idea of slow journalism as we are in a time where we are exposed to a huge amount of information. It is important to focus on quality and not quantity. The news media need to adopt a slow pace in order to remain relevant. News outlets should focus on producing the educational information that audiences need to make decisions and understand a complicated world. This is impossible without context [11].

Investigative and ad-free journalism is the foundation of The Probe's independent news media platform. They are part of the global Slow Journalism movement and advocate for slow journalism. Slow Journalism is a global movement for slower news reporting. They strive to inform and empower its audience by providing them with pieces of news that add value to the reader's life. Their goal is to develop solutions that will have a positive impact on social issues [1]. The philosophy of Slow Journalism is absent in Slovakia. Editors are still "competing" with each other and their goal is to publish the information first and get the most readers and interaction. Often such reports are shallow, contain very little information and are of minimal value to the reader.

School of Slow Media is another organization that connects the idea of slow media and digital detox. School of Slow Media is a global leadership program for creatives, changemakers, and everyday leaders who are interested in learning more about mindfulness, collaboration, and creativity. Participants in the Remix training program offered by School of Slow Media create a documentary that includes planning, logistics, interviews, filming, and editing. By documenting the creative process from start to finish, participants put design thinking into practice. The goal of the training program is to simulate the hectic pace and lack of time that most people experience in everyday life and turn it into a digital detox. This digital detox allows people to slow down and to be more people-oriented and to value one another [19].

International Mobile-Free Day and International Day without the Internet are among the most famous international days related to new media. Also in the Slovak Republic, organisations, influencers, primary and secondary schools are joining the challenge and spreading digital detox awareness.

Another campaign is the Digital Detox Day. The goal is to spend 24 hours away from the world of the Internet and

always-on screens. This day is being held in conjunction with another campaign called #IAMWHOLE, launched by Zoella, which encourages people to reach out and change small things in their lives to improve their mental health [7].

6. Conclusion

We believe it is important for today's society to reflect on the impact of technology and to be aware of the impact of new media on the quality of life. Such reflection can make people who spend a lot of time in the online world start thinking about the purpose and the way they use the internet and technology. We consider learning the practical advice and ideas of digital minimalism, slow media and digital detox as a great way to turn passive interaction with technology into free time in the physical world filled with worthwhile activities. Activities that one finds important and make one happy become valuable. The key to lasting transformation is slow changes and planning, such as turning off notifications on your phone, taking a break from social media, reading news summaries only at the end of the week, and so on. The goal is not to give up on digital technology, but to learn to use it wisely and in moderation. The best way to use digital devices is to use them less.

References

- [1] *About us.* [online]. [2022-01-26]. Available at: <<https://theprobe.in/about-us/>>.
- [2] Alexander, Boswell, *Why You Should Practice Digital Minimalism.* [online]. [2022-01-19]. Available at: <<https://medium.com/mind-cafe/why-you-should-practice-digital-minimalism-787aee663493>>.
- [3] Aarif, Alutaybi, Emily, Arden-Close, John, McAlaney, Angelos, Stefanidis, Keith Phalp, Raian, Ali, *How Can Social Networks Design Trigger Fear of Missing Out?* [online]. [2022-01-18]. Available at: <<https://core.ac.uk/download/pdf/222829028.pdf>>.
- [4] Cal, Newport, *Digital Minimalism: Choosing a Focused Life in a Noisy World,* New York, Portfolio, 2019, 304 p.
- [5] Chadwick, Jonathan, *Time to put down the smartphone? People spend nearly a THIRD of their waking hours on mobiles by averaging 4.8 hours a day on apps, research shows.* [online]. [2022-01-18]. Available at: <<https://www.dailymail.co.uk/sciencetech/article-10394221/People-spend-4-8-hours-day-mobile-apps-research-shows.html>>.
- [6] Claire, Sutton, *FOBO: Fear of Being Offline – Claire Sutton, Vancouver Life Coaching.* [online]. [2022-01-18]. Available at: <<https://www.claresutton.com/fear-of-being-offline/>>.
- [7] *Digital Detox Day: Can you ditch your devices? Here's how!* [online]. [2022-01-26]. Available at: <<https://www.bbc.co.uk/newsround/53990676>>.
- [8] *Držte krok s médiami ekologickejšie. Je v poriadku čítať tlačené noviny a časopisy?* [online]. [2022-01-26]. Available at: <<https://www.forbes.sk/drzte-krok-s-media-mi-ekologickejsie-je-v-poriadku-citat-tlacene-noviny-a-casopisy/>>.

- [9] Elizabeth, Scott, *How to Deal With FOMO in Your Life*. [online]. [2022-01-18]. Available at: <<https://www.verywellmind.com/how-to-cope-with-fomo-4174664>>.
- [10] Gregory, Jantz, *7 Tips for a Technology Detox*. [online]. [2022-01-22]. Available at: <<https://www.psychologytoday.com/us/blog/hope-relationships/201403/7-tips-technology-detox>>.
- [11] Imaeyen, Ibanga, *Let's take it slow*. [online]. [2022-01-26]. Available at: <<https://www.niemanlab.org/2019/12/lets-take-it-slow/>>.
- [12] Jennifer, Rauch, *The Origin of Slow Media: Early Diffusion of a Cultural Innovation through Popular and Press Discourse, 2002-2010*, No. 20, 2011.
- [13] Mark, Abouzeid, *Sustainable slow media*. [online]. [2022-01-19]. Available at: <https://www.academia.edu/31856172/Sustainable_slow_media>.
- [14] Michael, Luo, *The Urgent Quest for Slower, Better News*. [online]. [2022-01-21]. Available at: <<http://www.acta.sapientia.ro/acta-social/C5-1/social51-08.pdf>>.
- [15] Milyavskaya, Marina, Saffran, Mark, Hope, Nora, Richard, Koestner, *Fear of missing out: prevalence, dynamics, and consequences of experiencing FOMO*, No. 42, pp. 725-737, 2018.
- [16] Sabria, David, *The Slow Media Manifesto and Its Impact on Different Countries, Cultures, and Disciplines*, Vol. 5, No. 1, pp. 107-112, 2015.
- [17] Sofia, Hadjosif, *Digital Minimalism: 25 Tips To Simplify*. [online]. [2022-01-23]. Available at: <<https://www.terramovement.com/digital-minimalism-25-tips-to-simplify/>>.
- [18] Theda, Radtke, Theres,a Apel, Konstantin, Schenkel, Jan, Keller, Eike, von Lindern, *Digital detox: An effective solution in the smartphone era? A systematic literature review*, pp. 1-25, 2021.
- [19] Thuy Ái, Vuong, *Is it possible to create 'slow media' in 3 days?* [online]. [2022-01-26]. Available at: <<https://schoolofslowmedia.com/news/slow-media-in-3-days>>.

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