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Storytelling as a marketing communication tool New Trends in Sports Marketing example Hungarian Basketball Champion - FALCO KC

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Abstract: We examined the storytelling strategy of a four-time Hungarian champion basketball team through a case study. Today's consumers have an infinite amount of information at their disposal. One of the reasons for this is the proliferation of smart devices that allow you to enter the online world from anywhere, at any time. The reason for this is social media, which allows users to produce their content and decide what and who they want to "follow". Sports companies need to keep up with these changes as they compete for consumers' money and time as part of the entertainment industry. The team we studied launched a new series last season, with storytelling as its main motif. During the period under review, the team's YouTube subscribers doubled, and thanks to content distribution, they used the content they produced on all three other social media platforms. The core content was viewed by 90% of the 18-34 age group and it should be highlighted that 97% of the content was consumed by men.

Keywords: sports marketing, marketing communication, fan engagement

1 Introduction

Marketing and economic trends in recent years have shown that, in addition to a social media presence, sports clubs are increasingly focusing on content production and analysis [6]; [7]; [18]. Researchers justify the energy invested by sports clubs in building digital engagement with the acceleration of digitization caused by the COVID-19 pandemic and the economic impact of the Russian-Ukrainian war, as the current situation calls for new solutions [16]; [17]; [18]. In recent years, the relationship between consumers and sponsors has become more valuable, the latter is no longer satisfied with a visual presence on match days and wants to gain more advantage from the cooperation [5]; [12]; [16].

Social media encompasses a wide range of digital tools, so characterizing it's overall impact on young people remains a challenge [5]; [8]; [13]; [16]. In addition, it's critical to identify how social media specifically affect young people's behavior [2]; [3]; [5]; [8]; [10]; [13]. Social media is a recent form of media with several characteristics and attributes, as illustrated in Figure 1.

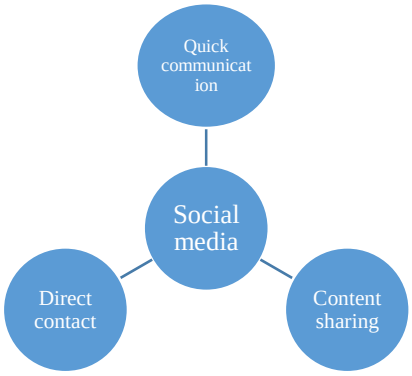

Figure 1
Why social media is so trendy?

2 Literature review

Storytelling as a marketing tool is nothing new in the world of marketing [10]; [12]. Storytelling aims to challenge consumers' liking, evoke empathy, and personalize the consumer-seller relationship [1], [9]; [10]; [15]. In line with Pan and Chan's study, a business needs to understand how the story is interpreted and understood by its audience to develop more persuasive storytelling strategies [11]; [14] It is important to know the consumer's perspective because you are telling your story to them, not to yourself [9]; [11]! Kakroo (2015) defined storytelling as emotional packaging that can motivate consumers to take action [12]; [15]. The phenomenon

was narrowly termed 'story', while the process of describing the phenomenon was termed 'narrative' [1]; [11]; [14]. In parallel with the gradual focus on the experience economy, businesses have based their business models on creating customer love [12]; [15]. Jeong and Koo (2015) argued that storytelling as a tool can bridge the gap between expectation and authenticity, to show more 'credibility' [11]; [14].

Today, the same goals are still on the list for companies. Sports companies and professional sports clubs are no exception [6]; [7]. The revenue structure of a business-based sports club is built on 5 main pillars [4]. Digital engagement and storytelling can be used to help teams' revenue structure both directly and indirectly. We can assume that the number of social media followers of a team is an indicator of the team's potential fan base [6]. The higher this number, the more fans a team has, and therefore the more valuable the club's product [4]. Because of the supply-demand relationship, it can be assumed that the more consumer interest, the more expensive the club can sell its service [4]; [7]; [18]. The same parallel can be drawn for the merchandise market, as the more people in the fan base, the greater the chance of selling fan trinkets, and therefore the demand-supply price increase may also be present. The principle is similar to the TV market. A sports team helps to strengthen the relationship between the team and the fan base through active storytelling, and storytelling also provides an opportunity for new consumers to join the team's fan base. The more interest there is, the more valuable the sports club and the event or league will be for TV [4]; [9]. Seemingly, social media may not have much impact on the player market, even though in today's world, players are just as attentive to the opportunities their team gives them to appear "off the field". The professionalism of a team's social media presence now means a lot to players. We have left the effects of digital engagement on the sponsorship market at the end of our list because the latter is boosted both directly and indirectly by an active, planned storytelling campaign [7]; [9]; [15]; [16] [17]. The size of the sponsorship market is related to the volume of consumers, so the indirect link is understandable [4]; [18]. The production of digital has, at the same time, allowed teams to market it and convert it into sponsored content [9]. If we consider this as a new pillar, the social media market has emerged, but in our opinion, there is a replacement for the classic sponsorship definition [4]; [17]; [19].

3 Method

Our research was carried out in a larger step. In the first stage, we carried out a document analysis on the following topics:

- digital engagement
- storytelling
- social media

In the second stage, we conducted a case study focusing on the impact of the storytelling campaign of Falco-Vulcano Energia KC, the four-time Hungarian champion basketball team. Specifically, we measured the impact of the team's "Off the Court" program on their YouTube channel.

4 Results

According to an article announcing the show, the team's main aim with the ’Pályán kívül’named series is to give a deeper insight into the players. As a means to this end, the in-depth interviews were conducted in a car rather than on or around the basketball court, as usual. Ho's study (2013) revealed that the 3 main goals of storytelling are:

- building trust between seller and buyer
- Building empathy, awakening empathy
- Empowerment and empowerment - Empowerment the customer to empathize, empathize and awaken the customer [15].

The question arises why a sports team, which is mostly judged by its performance on the pitch, should invest resources in a successful storytelling campaign. The answer is almost self-explanatory. By using storytelling, the team was able to take the players out of the jersey and present them as people to the fans. When you consider that in the two years before the show came out, fans were not even allowed to attend matches (Covid 19 rules), the answer is even more telling. Falco wanted to give. To give to the fans so that a deeper understanding could develop between the athletes and the fans. The team chose its YouTube channel to be the main platfrom of the show, as the average length of an in-depth interview is between 35 and 50 minutes. Of all the social media platforms presented above, YouTube is the best for content producers wishing to share longer videos.

In our study, we present and analyze the results of the first season. The 12-part series generated 21114 views, which also boosted the number of subscribers to the team's YouTube channel. Figure 2 shows the breakdown by episode and provides a summary of how the team in Szombathely used content distribution.

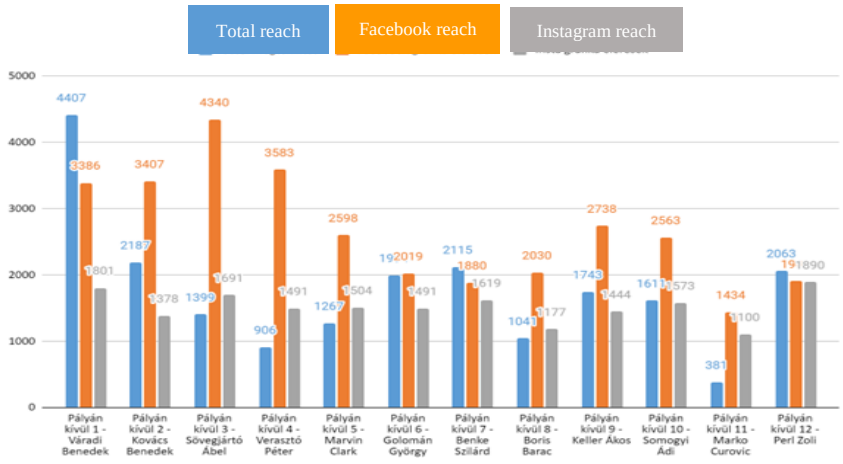

Figure 2.

The results of the content distribution

It's visible that there have been breakout results and views. This is mainly explained by the fact that fans were more willing to click on bigger names and content about home-grown players. Another recurring pattern to be discovered is that interviews in foreign languages generated fewer views. The difference can be interpreted in two ways. The first approach is that the majority of foreign players spend 1 season with the team so that not as much bonding and interest can develop between the fan and them. In contrast, players with local ties have been the backbone of the team for 3-5 years. The other explanation may come from content consumption. The subtitles for the foreign language content, on the other hand, may mean that the majority of fans have consumed and are consuming the Off the Field series rather than a podcast. Gender and age specificities were also detected in the analysis of the program, the former being illustrated in Figure 3.

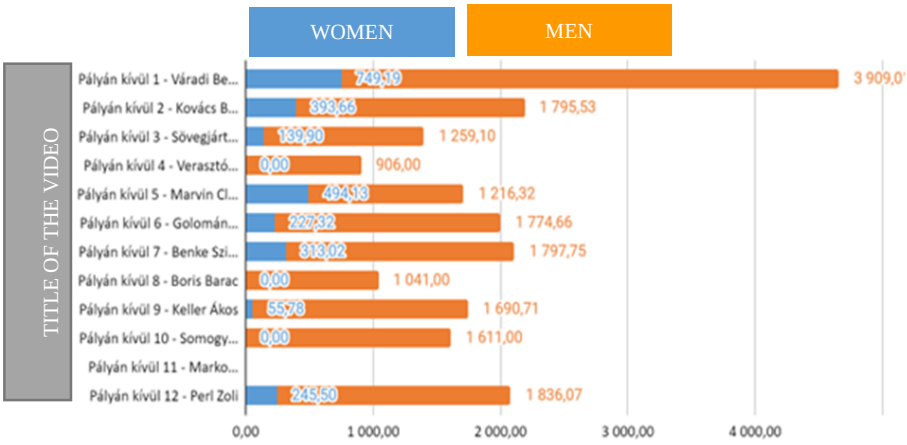

Figure 3.
Gender differences

Figure 3 clearly shows that the sex ratio is constant regardless of the player. The first season episodes were viewed by an average of 1,759 viewers, 13% of whom were female, while the YouTube creator studio measured that 87% of viewers were male. Knowing the sport and the club, it's not a big surprise that male consumers are in the majority, but the proportion is surprising. Especially considering that the gender breakdown of followers on the team's Facebook page is 44% female and 56% male. Again, the difference is worth looking at from several angles. On the one hand, it could be a distorting data point that although a family watches the video, they started the playback from the father's user profile. The other, and perhaps a better explanation, is that this type of content is primarily of interest to hardcore fans, who are shown to be mostly male.

The rise of digitalization has meant that the program has mainly reached young fans of the team. Taking all the videos into account, 89% of the viewers were in the 18-24 or 25-36 age group. Also, an interesting parallel is that the team's Facebook page does not show such a wide age gap, with a much healthier distribution. Based on current data, 15.8% of the team's Facebook page followers are in the 18-24 age group, 28.4% in the 25-34 age group; 23% in the 35-44 age group, 20.2% in the 45-54 age group, 6.8% in the 55-64 age group, and 5.8% in the over 65 age group. Given the digitalization of the world, the predominance of the younger age group is not surprising, but looking at content distribution, it is interesting and requires further measurement as to why the YouTube channel shows such a gap. Figure 4 shows the differences between the aging groups.

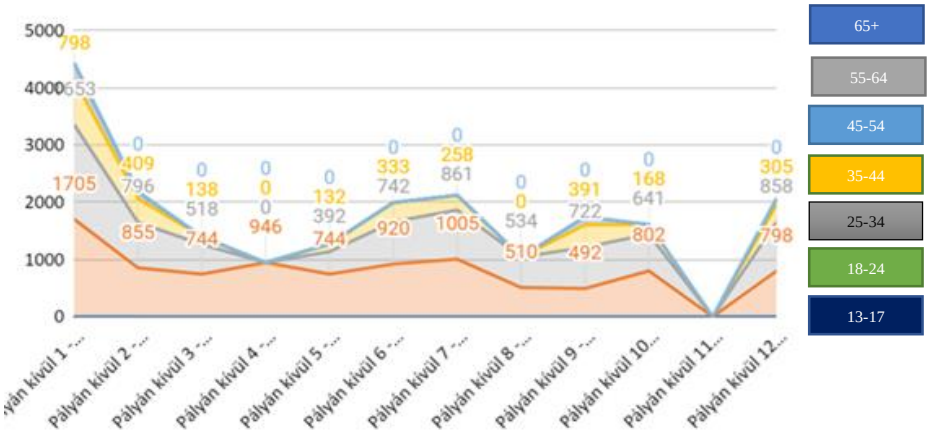

Figure 4.
Differences between age groups

5 Summary

All in all, the concepts of digital engagement, storytelling, social media, and their interpretation, analyzed in the initial stages of the research, have not only opened new doors in the world of content production, which is very much a dominant factor in the 21st century but have also paid great attention to meeting the needs of consumers as much and as widely as possible, helping business-based clubs to deepen their relationship with consumers. Social media is one of the most controversial topics of our time, with its speed, communication, and content sharing opportunities, the possibility for users to connect directly (just like sports clubs), but numerous studies have drawn attention to its negative effects on adolescents and young adults [2]; [3]; [5]; [8]; [13]; [16]. However, it also provides a great opportunity for sports clubs to connect with their followers and fans directly, through various visual or audiovisual content. This communication can also take place back there, as consumers can comment on and share the content. They have the freedom to express their opinions. Storytelling is a marketing strategy that focuses on gaining the empathy of the consumer. It aims to inspire love and a propensity to bond in consumers to develop a deeper relationship. However, to be successful, it is essential to know your consumers, as this sets the framework and the limits of how you tell the story and what you want to achieve. At the same time, great attention must be paid to credibility, as this is one of the main pillars of storytelling. As mentioned above, the 3 main pillars of storytelling are plot, character, and aesthetics. In the second phase, a case study was conducted, focusing on the impact of the storytelling campaign of Falco-Vulcano Energia KC, the four-time Hungarian champion basketball team. We measured the exact impact on the

YouTube channel of the team's 'Pályán kívül' show. The series was launched to give fans a deeper insight into the lives of the team's players, taking them out of the jersey (the in-depth interview was not conducted on the basketball court) and portraying them more humanly. The first season of 12 episodes has reached a total of 21114 views, which has also contributed to the number of new subscribers to the team's YouTube channel. From the views we have shown that videos with home-grown or bigger-name players generated higher viewership, and also a clear pattern that interviews in foreign languages (with Hungarian subtitles) had much lower viewership, the causal link is that the vast majority of foreign players spend only 1 season with the team, so they cannot develop a deeper bond with the fans. In terms of gender, 87% of our viewers were male, and by age group, the highest number of clicks were from the 18-24 and 25-36 age groups.

Conclusion

The primary conclusion of our study is that effective storytelling as a marketing tool can make the club more valuable to the consumer and, by extension, have a positive impact on the overall perception of the club. Storytelling provides consumers with an insight into the life of the club, which leads to a new and much stronger relationship and bond between the parties. This relationship can later be measured in economic terms for the club, where the bond that is formed can lead to the 'ordinary' fan becoming a fanatic, a ticket buyer becoming a season ticket holder, or a fan becoming more proud of their team and buying club merchandise. The conclusions are straightforward: if storytelling is used correctly, a larger club can be built, with a larger and more loyal fan base than at the outset. Building stronger loyalty is an essential aspect for any club, as engaged supporters can be relied on more securely and it’s harder to fall into the traps of overpricing or overbuilding a built event or project while the club's fan and consumer base is not regular. Strongly loyal supporters stick with the club and are strong support either in terms of attendance figures or team product pricing, and this can also strengthen the club's negotiating position in some cases, for example with sponsors, as season ticket holders provide stronger support against ticket buyers.

A further conclusion is that storytelling can also help to build a larger fan base, as this method is currently a major novelty, - especially in the Hungarian sports marketing market - which means that even fans of neutral or other teams are interested in watching the material produced on this topic, which can lead to an increase in the club's fan base. Nevertheless, the spread of the method does not mean that it is without interest, as example, the presentation of the private sphere of the team and players, even during the COVID-19 period, could bring the club closer to the fans in a way that cannot be experienced even with a match experience. The impact of this content is already measurable and from this, we have drawn our conclusions that the method has had the effect of increasing overall fan interest in the club's content, in other words, it has had an impact and been effective.

It is also important to stress that the marketing activities of clubs are not only directed toward consumers. Players are a constant presence on teams' social media platforms, seeking to maximize their reach and promote themselves in a positive way, which means that a club with a larger following and a wider, more extensive marketing activity is more interesting for professional players, and can therefore be a factor in their transfer or retention/extension decision process. The potential impact of this decision could result in a stronger roster and therefore a stronger team, partly due to the club having a stronger permanent marketing activity in a rival club.

However, storytelling also needs to take into account the composition of the particular follower base. To do this, we can use data on followers from social media platforms to determine their composition, either by gender or age. This is a particularly important issue, as different age groups consume different content, have different interests and there are differences in the duration and length of videos and the resulting viewership, as younger generations have grown up in a faster-paced world that prefers shorter videos, as opposed to older generations. Understanding generational differences is an important consideration, especially when different generations have different consumption habits but the same interest in the person of the sports club. The importance of knowing the composition of the fan base proves the need for professionals who can effectively analyze and identify it. It is worth mentioning that there is already a fan-engagement manager at foreign sporting events whose primary role is to ensure a positive fan experience, which further proves that the relationship between fans and their relationship is worth investigating and is a real phenomenon. The rise of young people on social media is also noticeable, as today's children are without exception growing up in a world of the internet and smartphones, essentially socialized on social media, which means new consumers and a whole new trend reversal. The rise of the young is bringing a new wave of children who are being exposed to social media for the first time - and at a very young and younger age - and this is also an opportunity for clubs to engage them, but also a huge responsibility to try to present the sport in a positive, educational way in their posts and stories, because using social media for education can be a key issue for educating the generation that will grow up in it, and sports teams must be part of that. Ideas for educational content could include images and videos of school visits or highlighting the importance of physical education and foreign language skills on such occasions, choosing the right way to communicate in the accompanying text of posts, choosing the right context for textual content, and promoting the spirit of fair play.

References

[1] Adams, C: How 3 Big Brands Use Storytelling to Make Everyday Products Exciting. 2014 Retrieved from http://www.bruceclay.com/ (2023.04.20)

[2] Anderson M & Jiang J: Teens, Social Media, & Technology. Pew Research Center 2020

[3] Anderson, M. & Jiang, J: Teens' Social Media Habits and Experiences. Pew Research Center 2020

[4] András, K: A hivatalos labdarúgás piacai --- Its title in English: The markets of professional football. Műhelytanulmány (working paper). Vállalatgazdaságtan Tanszék, Budapest. 2004

[5] Chauhan, V., Shah, M. & Purakala, H.: An Empirical Analysis into Sentiments, Media Consumption Habits, and Consumer Behavior during the Coronavirus (COVID-19) Outbreak. UGC Care Journal. 31(20), 2020. DOI: 10.13140/RG.2.2.32269.15846

[6] Cvijikj, P., & Michahelles, F.: Online engagement factors on Facebook brand pages. Social Network Analysis and Mining, 3(4), 2013 pp. 843-861. doi:10.1007/s13278-013-0098-8

[7] Dagoberto, H., Gabriel, V. & Rodríguez-Aceves, L.: Digital Engagement and Socal Identity of Sports Fans: The Case of Premier League Teams on Facebook. Revista Iberoamericana de Psicología del Ejercicio y el Deporte, vol. 13, núm. 1, 2019, pp. 59-69

[8] Falmann, T.: „A Z generáció digitális identitása a közösségi médiában", Marketing & Menedzsment, 49(1), 2015, pp. 18–29. https://journals.lib.pte.hu/index.php/mm/article/view/1015

[9] Garcia del Barrio, P.: Measuring empathy feelings in football through media value. Revista de Psicología del Deporte, 25(3), 2016, pp. 37-42

[10] Győrbíró, A., Cs.: The Role Of Social Media influencers In The Hungarian Consumption Habits In The Covid-19 Period. Paths of Communication in Postmodernity. 2020

[11] Jeong H-J, Koo D-M.: Combined Effects of Valence and Attributes of e-WOM on Consumer Judgment for Message and Product: The Moderating Effect of Brand Community Type. Internet Research, 25(1), 2015, pp. 2-29

[12] Kakroo, U. 5 Ways to Use Storytelling in Your Social Media Marketing. 2015.

[13] Nesi, J.: The Impact of Social Media on Youth Mental Health: Challenges and Opportunities. ncmedicaljournal 82(2). 2020, pp. 116-121

[14] Pan, L-Y. & Chen, K-H.: A Study on the Effect of Storytelling Marketing on Brand Image, Perceived Quality, and Purchase Intention in Ecotourism Ekoloji 28(107), 2019, pp. 705-712

[15] Ho H-Y, Lu M-H, Lin P-C.: The diverse perceived qualities and perceived values on the app E-Book and app EMagazine. Pak. J. Statist, 29(6), 2013, pp. 1029–1048

[16] Ráthonyi, G. & Márton, Sz. Sportfogyasztás, rajongói elköteleződés, sportstatisztika – Posztspecifikus passzolási jellemzők a labdarúgásban. International Journal of Engeering and Managment Scinces 7(1) 2022

[17] Tóth, D., Z.: Marketing Practices of a Sports organization – The marketing value of Falco – Vulcano KC Szombathely Basketball Team, Management, Enterprise, and Benchmarking in the 21st Century; Budapest 2020, pp. 212-220

[18] Tóth, D.Z. & Dancs, H.: A szurkolói elköteleződés kérdésköre a sportmarketing területén. Magyar Sporttudományi Szemle 23(99), 2022, pp. 41-42

[19] https://net.jogtar.hu/jogszabaly?docid=a0400001.tv

Information Technology Acceptance: Indonesian Company Case

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Abstract: Digital transformation involves digital capabilities and technology to add value to business processes and customer experience. To support the digital transformation, companies need to make efforts so that technology can be accepted and used by employees in operational activities. This study aimed to measure employee acceptance of information technology facilities provided by the company. A survey was conducted based on technology acceptance theories and an online questionnaire was distributed online. Employees participated through the Google form website. Two thousand six hundred six employees participated in the information technology acceptance survey from 2610 targeted employees (99%). Purpose, daily use, and acceptance represented the overall information technology acceptance (71.1%). Management, Perceived Usefulness, Participation, and Purpose significantly influenced IT Acceptance. The research findings provided insight into the approval of technologies to drive digital transformation. The company must optimize technology utilization and continuously improve its performance and reliability. In addition, companies need to review technology investment needs and optimize employee involvement in technology identification and selection.

Keywords: information technology acceptance, digital transformation, technology optimization

1 Introduction

After COVID-19 and the Russia-Ukraine war, the steel industry still faces challenges, especially in Indonesia. The excess global production capacity in 2022 of 563 million tons will make Indonesia flooded with imported products, especially from China, Russia, and Eastern Europe [13]. Meanwhile, Indonesia has already

invested heavily in developing the national steel industry [13]. However, Indonesia needs to address this challenge more optimistically because the projected growth in national steel consumption will reach 6% in 2023, in line with the recovery of the national economy, especially strategic projects in the infrastructure and energy sectors [7].

Therefore, digitalization has been implemented in Indonesia through the commitment of the Ministry of Industry and the Ministry of State-Owned Enterprises to transform towards Industry 4.0 through the Indonesia Industry 4.0 Readiness Index (INDI 4.0) assessment which 326 companies, including steel companies, attended [15]. The assessment is based on five pillars: management and organization, people and culture, products and services, technology, and plant operations [8].

Through well-established strategic planning, digitalization is carried out to increase efficiency, innovation, and competitiveness in the steel industry [9]. Steel industries can also collaborate with stakeholders to produce successful digital transformation initiatives [3]. Digital transformation involves digital capabilities and technology to add value to business processes and customer experience. To support the digital transformation, companies need to make efforts so that technology can be accepted and used by employees in operational activities. Adopting information technology is essential in driving efficiency [12], profitability [14], customer experience [11], and business sustainability [2].

It is beneficial to measure employee acceptance of information technology facilities provided by the company. In this sense, an online survey was conducted and analyzed with statistical methods. This paper is organized as follows: Section 2 describes the factors of information technology acceptance. Section 3 gives the detail of the research methodology. The results of the applied survey are presented in Section 4, and Section 5 explains the conclusion or summary.

2 Information Technology Acceptance

The Technology Acceptance Model (TAM) is a widely used theory to describe the user experience of adopting new technology (Figure 1). TAM can identify factors that influence user acceptance of new technologies and assist developers in designing information systems that are more easily accepted by users [5]. TAM explains that there is a strong influence of perceived usefulness and ease on technology users' attitudes and behavior, where respondents are measured for their perception that technology will help work and can be used easily [6]. Attitudes toward use are a function of perceived usefulness and perceived ease of use. Perceived ease of use has a chain reaction on perceived usefulness. The capability of designing technology can influence perceived ease of use [4]. The most important reason for developing a technology acceptance model is to create a system where

users can experience the benefits and conveniences of technology users can accept it more [16]. Innovation can thrive when an application development team follows the technology acceptance model [19].

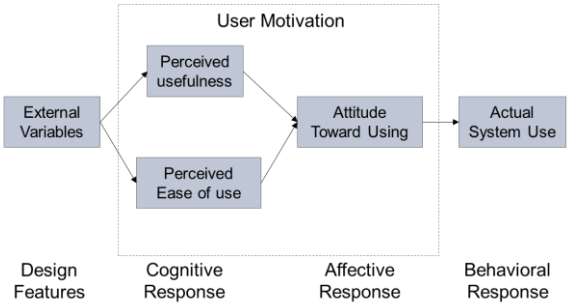

Figure 1
Technology Acceptance Model
Source: Davis, F.D. (1985)

3 Methodology

The survey, adapted from the TAM model, consists of 6 variables (Table 1), specific questions about IT acceptance and demographic questions on a unipolar and bipolar scale. The IT acceptance result will be categorized into one of three levels: Fully Accepted (70%-100%), Quite Accepted (50%-70%), and Not Accepted (0%-50%). An online questionnaire made by Google Form was distributed via email and WhatsApp. Employee demography consisted of 2,606 employees (99%) have participated in the IT acceptance survey from 2,610 targeted employees.

Name	Variable	Notes
Level	-	Multiple choice
Age	-	Multiple choice
Years of service	-	Multiple choice
Management	Independent	Multiple choice
Perceived usefulness	Independent	Multiple choice
Participation (perceived ease of use)	Independent	Yes/ No
Purpose (behavioral intention to use)	Independent	Yes/ No
Perception	Independent	Multiple choice
Acceptance (actual system use)	Dependent	Multiple choice
Technology type	-	Multiple choice

Table 1.
Survey Variables

The majority of respondents (Figure 2) were Operator (42.13%), between 25-30 years old (31.62%), and had 5-10 years of service (30.12%).

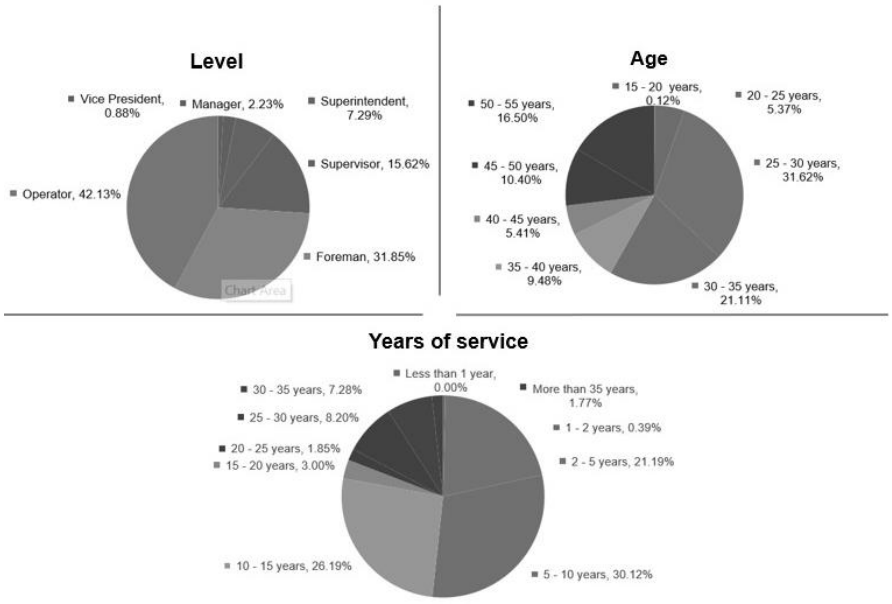

Figure 2
Respondent Demography

To carry out the analysis, 6 hypotheses were proposed as below:

H1: Management is partially affecting the IT acceptance.

H2: Perceived usefulness is partially affecting the IT acceptance.

H3: Participation is partially affecting the IT acceptance.

H4: Purpose is partially affecting the acceptance of IT.

H5: Perception is partially affecting the IT acceptance.

H6: Management, perceived usefulness, participation, purpose, and perception are simultaneously affecting the IT acceptance.

Data analysis regarding variables related to survey answers was carried out with SPSS through Multiple Regression Analysis testing.

4 Results and Discussion

The IT Acceptance Survey results stated that 71.1% of employees accepted the technology facilities implemented in the company (Fully Accepted). The survey results are significant facts that will determine the company's strategy as we advance based on the 8 specific questions.

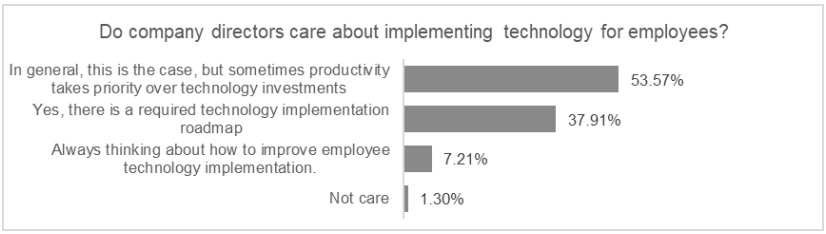

Figure 3
Management question results

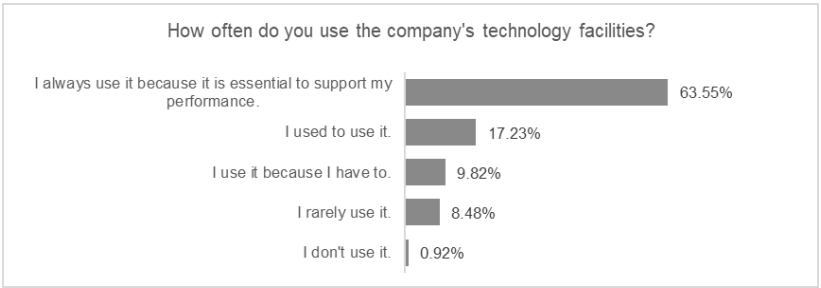

Figure 4
Perceived usefulness question results

Figure 5

Participation results

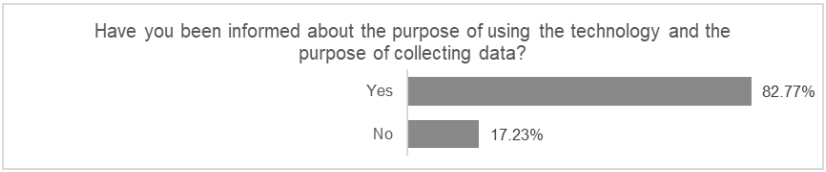

Figure 6

Purpose question results

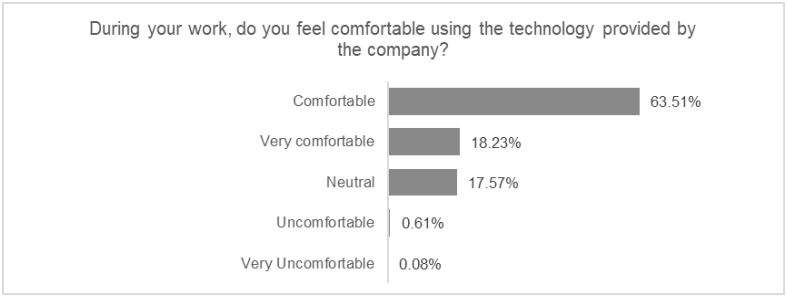

Figure 7

Acceptance question results

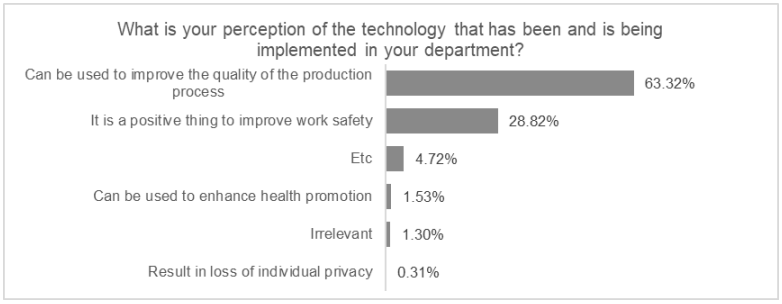

Figure 8

Perception question results

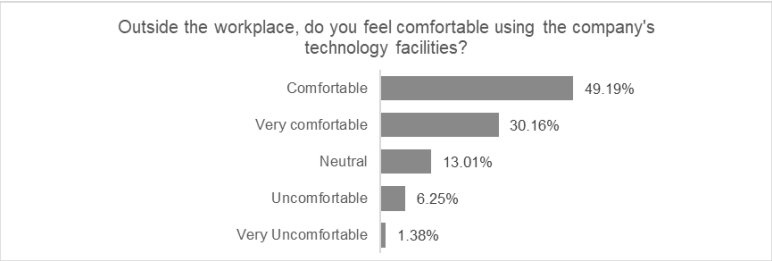

Figure 9

Outside acceptance question results

Based on the T-Test Result (Table 2), H1, H2, H3, and H4 was accepted, but H5 was denied. Management, perceived usefulness, participation, and purpose had partially affected the IT acceptance while perception was not significant. Simultaniously, Table 3 showed that IT acceptance was affected by management, perceived usefulness, participation, and purpose. Independent variables had 22.4% influence over the IT acceptance (Table 4).

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.469	.016		29.932	.000
	MANAGEMENT	.116	.009	.243	13.485	.000
	PERCEIVED USEFULNESS	.125	.011	.218	11.870	.000
	PARTICIPATION	.038	.006	.121	6.372	.000
	PURPOSE	.054	.008	.132	6.873	.000
	PERCEPTION	-.003	.014	-.003	-.192	.848

a. Dependent Variable: ACCEPTANCE

Table 2.

T-Test Result

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13.875	5	2.775	150.524	,000[b]
	Residual	47.934	2600	.018		
	Total	61.809	2605			

a. Dependent Variable: ACCEPTANCE

b. Predictors: (Constant), PERCEPTION, PARTICIPATION, MANAGEMENT, PERCEIVED USEFULNESS,

Table 3.

F-Test Result

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,474[a]	.224	.223	.13578

a. Predictors: (Constant), PERCEPTION, PARTICIPATION,

Table 4.

Determination Coefficient

Respondents' answers showed that the company had informed the purpose of using technology (82.77%) and employees continuously optimized the technology facilities (63.55%). Employees also felt significant comfort while working (63.51%). However, employees felt less involved in technology selection (61.28%), management is considered less concerned about technology implementation (53.57%), and employees are less comfortable using company technology facilities outside their work environment (49.19%).

In fact, the acceptance of information technology and the use of technology depend on a variety of factors, including individual and organizational characteristics, the design of the technology, and the broader socio-cultural context Older workers tend to be reluctant to use technology compared to younger employees [10]. People with higher levels of education tend to use technology more effectively than those with lower levels of education [5]. Men are more likely to adopt technology than women [17]. A supportive organizational culture also can encourage technology adoption to be accepted and used to get work done [1]. Societal norms also impact technology adoptions [18]. While management, perceived usefulness, participation, and purpose significantly influence IT acceptance, companies must improve technology reliability by involving employees in choosing technology that supports performance. In addition, companies need to review the need for investment in technology while maintaining and increasing productivity.

Conclusions

The Indonesian steel industry must be optimistic about meeting national steel needs, especially strategic projects in the infrastructure and energy sectors, by continuing to promote digitalization and information technology acceptance to boost productivity and efficiency. The survey was carried out to 2,606 online using the Technology Acceptance Model to identify the factors influencing user acceptance of new technologies. The IT Acceptance Survey results stated that 71.1% of employees accepted the technology facilities implemented in the company (Fully Accepted). Respondents' answers showed that the company had informed the purpose of using the technology. Employees continuously optimize the technical facilities and feel comfortable while working. These factors are also significant in building technology acceptance among employees: management, perceived usefulness, participation, and purpose. However, the company must involve the

employees in choosing technology. Companies also need to review the need for investment in technology while maintaining and increasing productivity.

References

[1] Ahmad Trawnih, A. et al. (2023) "Investigating the adoption of Social Commerce: A case study of smes in Jordan," Interdisciplinary Journal of Information, Knowledge, and Management, 18, pp. 031–058. Available at: https://doi.org/10.28945/5071.

[2] Bican, P.M. and Brem, A. (2020) "Digital Business Model, Digital Transformation, Digital Entrepreneurship: Is there a sustainable 'digital'?," Sustainability, 12(13), pp. 5239. Available at: https://doi.org/10.3390/su12135239.

[3] Branca, T.A. et al. (2020) "The challenge of digitalization in the steel sector," Metals, 10(2), p. 288. Available at: https://doi.org/10.3390/met10020288.

[4] Davis, F.D. (1985) A technology acceptance model for empirically testing new end-user Information Systems, Researchgate.net. Available at: https://www.researchgate.net/publication/35465050_A_Technology_Acceptance_Model_for_Empirically_Testing_New_End-User_Information_Systems (Accessed: February 28, 2023).

[5] Davis, F.D. (1989) "Perceived usefulness, perceived ease of use, and user acceptance of Information Technology," MIS Quarterly, 13(3), pp. 319. Available at: https://doi.org/10.2307/249008.

[6] Diamond, L. et al. (2018) "Using technology acceptance models for product development," Proceedings of the 20th International Conference on Human-Computer Interaction with Mobile Devices and Services Adjunct [Preprint]. Available at: https://doi.org/10.1145/3236112.3236175.

[7] Islamiati, W. (2023) "IISIA Proyeksi Konsumsi Baja Nasional Naik 6 Persen, Ini Alasannya," Bisnis.com, 9 January. Available at: https://ekonomi.bisnis.com/read/20230109/257/1616459/iisia-proyeksi-konsumsi-baja-nasional-naik-6-persen-ini-alasannya (Accessed: February 28, 2023).

[8] Kemenperin RI. (2018) Indonesia Industry 4.0 Readiness Index – INDI 4.0. rep. Available at: https://sindi4.kemenperin.go.id/assets/content/INDI4.0_Full_v1.pdf (Accessed: February 28, 2023).

[9] Nadkarni, S. and Prügl, R. (2020) "Digital Transformation: A review, synthesis and opportunities for future research," Management Review Quarterly, 71(2), pp. 233–341. Available at: https://doi.org/10.1007/s11301-020-00185-7.

[10] Naicker, V. and Van Der Merwe, D.B. (2018) "Managers' perception of mobile technology adoption in the life insurance industry," Information Technology & People, 31(2), pp. 507–526. Available at: https://doi.org/10.1108/itp-09-2016-0212.

[11] Nowicka, K. (2020) "Customer experience as the driving force for Supply Chains Digital Transformation," European Journal of Economics and Business Studies, 6(1), pp. 6. Available at: https://doi.org/10.26417/ejes.v6i1.p6-15.

[12] Regan, E.A. (2022) "Changing the research paradigm for digital transformation in healthcare delivery," Frontiers in Digital Health, 4. Available at: https://doi.org/10.3389/fdgth.2022.911634.

[13] Sandi, F. (2023) "Tangkis Serbuan Baja Impor, Pemerintah Selidiki Baja China," CNBC Indonesia, 14 February. Available at: https://www.cnbcindonesia.com/news/20230214160952-4-413778/tangkis-serbuan-baja-impor-pemerintah-selidiki-baja-china (Accessed: February 28, 2023).

[14] Shanti, R., Avianto, W. and Wibowo, W.A. (2022) "A systematic review on Banking Digital Transformation," Jurnal Ad'ministrare, 9(2), pp. 543. Available at: https://doi.org/10.26858/ja.v9i2.40584.

[15] Sukmana, Y. (2019) "Pemerintah Luncurkan INDI 4.0, Apa Itu?," Kompas.com, 15 April. Available at: https://money.kompas.com/read/2019/04/15/12075 8026/pemerintah-luncurkan-indi-40-apa-itu (Accessed: February 28, 2023).

[16] Tabe Bordbar, F., Kamani, S.M. and Yekta, M. (2015) "Explain the causal model of the use of internet technology by employees of the National Bank of Shiraz, according to subjective norms, governmental and institutional support," Interdisciplinary Journal of Virtual Learning in Medical Sciences, 6(4). Available at: https://doi.org/10.5812/ijvlms.11995.

[17] Wahid, F. (2007) "Using the technology adoption model to analyze internet adoption and use among men and women in Indonesia," The Electronic Journal of Information Systems in Developing Countries, 32(1), pp. 1–8. Available at: https://doi.org/10.1002/j.1681-4835.2007.tb00225.x.

[18] van Alphen, K. et al. (2007) "Societal acceptance of carbon capture and Storage Technologies," Energy Policy, 35(8), pp. 4368–4380. Available at: https://doi.org/10.1016/j.enpol.2007.03.006.

[19] Yin, B., Yu, Y. and Xu, X. (2021) "Recent advances in consumer behavior theory: Shocks from the COVID-19 pandemic," Behavioral Sciences, 11(12), p. 171. Available at: https://doi.org/10.3390/bs11120171.

Actual Managing and AI Problems of Healthcare Supply Chains

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Abstract: Problems of supply chains can be very diverse; the goal of this article is to explore the issues and the solutions provided by AI. Artificial Intelligence is already present in many areas of our lives and affects it. In this article we are not only investigating how it reduces uncertainty in the supply chain, but also the potential pitfalls of using artificial intelligence should be explored.What impact it will have on the results of the supply chain in the healthcare sector? The opportunities provided by this ever-developing technology must be used in the most efficient way.The research reveals how we achieve most effective satisfaction of the customer including AI technologies in our processes, also highligting some important issues related to the use of AI. In today's world, being in possession of information is the greatest capital, a lot of information has to be processed every day, but the winner will be the one who has it all and is able to process it.We are examinig a post-covid period, during this examinationAI software was introduced to a customer service team, also we took into account the advantages and disadvantages.

Keywords: Artificial Intelligence, Supply Chain Management

1 Introduction

The COVID pandemic drew attention to the shortcomings and weaknesses of healthcare supply chains and thus pointed out possible directions for development. [1] What challenges did they face? Among other things, lack of foresight, high demand for products, medical equipment, ensuring accurate delivery and minimizing costs. COVID period pushed companies to search for new innovative solutions to survive these extremely difficult times.

In our case study an AI driven software was implemented to a customer service team of a healthcare supply chain. The company is one of the leading multinational companies in the healthcare sector. Deals with the manufacture and sale of medical equipments, accessories and related devices, also handles installation and maintenance. In our case study, we were focused on the customer service team, which sells medical equipments and accessories.

In the supply chain we can face multiple problems on a daily baisis, in the following we examine the most common problems that occur according to five aspects, which are:

1. Lead time;
2. Communication (external, internal);
3. Product shortages;
4. Delivery issues;
5. Lack of information.

We've highlighted the most crucial problems which we try and potentially can be solved by implementing an AI driven software to the customer service team.

Managing Supply Chains can lead to competitive advantages, in addition traditional, more time-consuming processes can be remplaced by new technologies, which can save considerable time and manpower. Software-based, physical artificial intelligence is already part of our everyday lives. Our smartphones, smart watches, digital assistants, industrial robots, self-driving cars, autopilot functions etc. all work with AI softwers. Also, AI plays an important role in the healthcare industry as well, AI driven softwares and applications can help doctors to analyze patients images (X-ray, MRI, etc.). The purchase of these softwares is becoming more and more available for larger companies, if they want to gain a competitive advantage over competitors in this post-COVID situation, they must take this step and be open to technologies that sometimes require big changes.

2 Artificial Intelligence and understanding its importance

Today's modern information technology provides the approptiate tools, for example Internet enables global real-time communication. However, we cannot stop here since we can talk about the creation of AI technologies from around the 1950s, when Alan Turing raised the following question: "Can machines think?". Turing proposes a machine intelligence test, he believes that if a machine can make people think it is human, then it has intelligence, actually Turing test is a method to determine the intelligence of a machine. [2] Even today, the test is an integral element of AI research.

The term Artificial Intelligence was first coined in 1955 in a mathematics course by Professor Jonh McCarthy at Darthmouth University as follows: "Artificial Intelligence is the science and engineering of making intelligent machines". AI aims to reproduce mental activities with the help of machines. These activities include for example, perception, understanding and decision-making. [3]

2.1 Supply Chain Challenges solved by AI

At the beginning of the article, we mentioned a couple of challenges caused by the COVID pandemic, which pointed out some of the most critical points in the chain. Now we want to help solve these problems by embedding AI software.

2.1.1 Interpretation of the definition of supply chain

The first definition of Supply Chain was determined by the Supply Chain Council in 1997: "SCM encompasses the planning & management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners including suppliers, intermediaries, third-party service provides, and customers. In essence, SCM integrates supply and demand management within and across companies." We differentiate both material and information processes, include the flow of the product from the supplier to the final consumer, as well as the reverse product flow. The coordinated operation of logistics processes is essential for the smooth operation of companies participating in the supply chain. [4] The number of chain members may differ from company to company it may be simpler or more complex. In order to achieve effective supply chain management, coordination of activities, mutual trust, and unhindered cooperation are necessary. Information is the basis for establishing a relationship, and its rapid flow is a condition for efficient operation.

2.2 How AI works

John R. Searle american philosopher studied the behavior of AI, based on this, we distinguish weak and strong AI. Weak AI reproduces or imitates a special behavior, even able to recognize and solve problems but the machine does not understand the reason of act. In contrast, strong AI not only acts rationally, but also has emotions, it has its own thought processes and consciousness. [2] Today, strong AI exists at the level of plans for the time being, research has already begun and progressing rapidly worldwide. For the rest of this paper, we will consider the existing AI – i.e. weak AI.

AI softwares are using the following AI-driven technologies:

1. OCR - Optical character recognition: text recognition technology responsible for reading documents;

2. First-time recognition: extracting information from documents seen for the first time using deep learning technologies;

3. Automatic learning: machine learning technology that increases recognition rates by learning from user corrections.

2.2.1 Deep learning

Deep learning is a part of a variety of machine learning methods, which gives the ability to AI to produce similar activities as the human brain's neural network. [5]

Deep learning opportunites have already benefited the healthcare industry, for example image recognition applications can support doctors analyze images.

Why not use these technologies at other members of the chain?

2.2.2 Increasing efficiency of supply chains with AI

Why is it beneficial for us? First, the AI-driven software is ERP-compatible. In addition, using artificial intelligence, not only data scientists can perform business analysis, but also people with knowledge of the business field. [6] Several functions are available on a single platform: reports and results all contribute to planning. We will know, for example, what stocks we have to count on from the expected more accurate forecasts, we strive to achieve the optimal stock level, since holding unnecessary stocks is a cost, so this will also decrease. At the same time, elimination and prevention of shortage problems. [7]

Secondly, it offers more profitable marketing strategies, which helps determine the customer needs, and it communicates well about product development. Not least thanks to cloud-based solutions, it positively influences sustainable development. [8]

Errors caused by human inattention can be completely eliminated with the help of artificial intelligence. Automate, improve and simplify ordering processes as a single task. Humans can make several mistakes, such as misspelling important identification numbers and product numbers, but the software does not make such mistakes, it is more accurate. AI software increases the speed of document processing, up to five times faster order processing is available, thus reducing reaction time. This saves time for other important tasks: customer calls, customer inquiries, handling complaints. Finding customers is one of the most important tasks that must be focused on, since the customer is the key figure in the supply chain, without whom businesses cannot continue.

2.3 Regulation of principled issues related to the use of AI

Confidentiality issues arise in connection with the use of AI, but there are regulations to protect people and business information. [9] On April 21, 2021, the European Comission published its draw regulation on Artificial Intelligence in

Brussels, the main goal of which is to comprehensively regulate AI for the first time in the world: "In order to accelerate, act and align to seize opportunities of AI technologies and to facilitate the European approach to AI, that is human-centric, trustworthy, secure, sustainable and inclusive AI, in full respect of our core European values, this review of the Coordinated Plan puts forward four key sets of proposals for the European Union and the Member States:

• Set enabling conditions for AI development and uptake in the EU

• Make the EU the place where excellence thrives from the lab to the market

• Ensure that AI works for people and is a force for good in society

• Build strategic leadership in high-impact sectors" (European Commission, Brussels, 21.4.2021, COM(2021) 205 final)

Primarily, increasing the competitiveness achieved with AI and exploiting economic and social benefits. On the other hand, the minimization of risks and disadvantages, in order to ensure the human rights and EU core values are not violated. [9] The European Commission would also like to increase people's sense of security and trust, at the same time giving free space to technological development.

Should the employee be afraid of losing his job with the introduction of AI? In the near future I would say no, since humans train and control AI and not the other way around. However, globally millions of people have already lost their jobs as a result of the incredible fast development of robotics. [10] Another question arises: Are humans or AI doing the job better? Originally, the introduction of AI software was not introduced to completely replace human labor, but to facilitate their work and increase efficiency, but probably the rapidly developing artificial intelligence will revolutionize the labor market. [11]

3 Obstacles of implementing AI into the supply chain

We distinguish problems arising from the use of AI according to whether they violate principled reasons or whether we encounter technical obstacles.

We saw the principle problems in the previous chapter, so in the following we present technical problems that occured during practice and testing.

After a lot of planning, the problems really become apparent in practice. Before we start using a software live, it is preceded by a test period. What technical obstacles do we encounter during testing?

Technical problems can be approached from several perspectives, in this article we examine two sectors: data and human.

First of all, there are various data problems. AI works and learns from data, so if the data is insufficient or incomplete, the software will not have enough examples to draw conclusions. For example, not all AI softwares can read handwritten texts and documents, due to its uniqueness it is difficult to identify individual characters. Secondly, data quality can also be a problem. We can have a lot of data, but it should not be inconsistent and unbalanced, this would lead to over represent data of a group and would give us false results. Data privacyand security it is a highly important factor, because there are a lot of risks involved: loss of data can lead to the loss of reputaion, loss of customers and loss of money. The data of the company and their customers has to be safe and protected from cyber attacks. Therefore, it can be said that both the quality and quantity of the data must be adequate for the problem-free operation of the AI software.

Human factor is one of the most important to review when investigating problems. For example, deep learning is only possible with continous training, humans need to correctly plant the data and teach the software, and then test the software to see what did it learn from the trainings. I would mention two problems with learning, first it is a very time-consuming task, both from human and AI side. For humans it requires a lot of attention and time to teach AI recognize the information. Also, AI learns slowly, sometimes we have to teach the same task several times. Today, there are service providers on the market that try to simulate human work and try to teach AI programs. However, these researches are not yet fully successful, for now humans are the most thriving in teaching AI. [12]

4 Using AI software to solve Customer Service problems

The focus of the examination was an artificial intelligence software implemented on the customer service department of a healthcare company. Why Customer Service problems are so important to be solved? What roles the Customer Service play in the chain?

Many companies do not realize the importance of customer service even though it affects many things beyond the customer: for example, logistics, delivery, invoicing, product availability and planning.

Customer service can be seen as a bridge between logistics and marketing, its success determines the company's long-term viability and effective customer service can be one of the best ways to gain a competitive advantage. To achieve this, it is important to continuously monitor and regulate customer service and evaluate customer service levels. Customer service is an integral part of your company's strategy, and a strong, effective customer service ensures satisfied customers.

Customers can contact us through a number of platforms (phone, email, social media), whether to ask questions, inquiry about an order or make a complaint. Even if we manage to collect all the useful data, we may not be able to meet the challenge of making sense of it. Also, the preparation of the reports can take a lot of time, and the managers can also lose their trust in their team, thus the lack of supervision can also result in the lack of responsibility of the team.

The software is able to help us in two important areas, which are Order Management and Customer Inquiries Management.

4.1 Experiences of testing AI, as a customer service problem-solving tool

In the following the circumstances of the research will be presented. The case study was actually prepared at one of the biggest healthcare multinational companies, where we examined the potential effects of using AI at the customer service team on the most important chain member, the customer. In our case, the customer service team was in our center, as the research was corroborated with depth interviews within the team. The questions were carefully structured and composed as follows: what challenges do we face on a daily baisis for which we would like to find a solution, then they were asked about the advantages and disadvantages of the software, and what they think about the effect it will have on customer satisfaction. Last but not least, we asked them questions about the future of AI, and its danger on our jobs.

Information was collected from different sources during the case study, as we were using the depth interviews, as well as internal company documents.

Now we would like to introduce the practical research, which we obtained during software testing. Before the new software goes live, it has to be preceded by a test phase. Why testing is necessary? The testing period is important from several points of view, on the one hand, the employees get a first impression of the new interface. On the other hand, they can assess the problems that arise in time,generally testing provides visibility on both strong and weak points.The test environment consists of an artificial intelligence-controlled process automation software.

In the test environment Customer Service Representative teach AI where the location of the information is, and AI will remember from where the information was taken.During testing several problems were highlighted concerning the handling of documents, such as purchase orders:

- errors due to inadequate administration, important identification numbers were missing, which hindered the processing of documents, it automatically ran to an error;
- the software was not taught to read handwritten text, so it could not read them;
- the software could not read the correct data from the document;

- customers sent their requests with incomplete data, it was unidentifiable for the software.

Part of the listed problems is a data administration problem, since the data from the company's ERP system was not correctly transferred to the new system, therefore a synchronization error occurred, and as a result of the incomplete data, we were unable to approve the order registration where essential information was missing. Also, as the software cannot read handwritten text, special characters or blurred fax, the customer service employees must ask and educate customers to send their documents in a readable format for us, thereby facilitating the processing of their orders.

The second major workstream for the customer service team is handling customer inquiries. It envolves complex tasks, such as tracking the status of orders, answering emails, customer calls, handling customer complaints.The software not only enables communication with both internal and external customers, but we reach a platform where we are ableto answer and solve all type of customer requests in the shortest possible time. All information, history, previous request can be reachable though one platform, thanks to a simple IT environment. During testing, we did not mesure any problems regarding the customer inquires handling.

We don't have to work harder, we have to work smarter. It is necessary to create the settings that support the work of the employees, so that we can achieve greater efficiency with fewer measures.

At the moment, the development of the software is not yet at the point where it does not require human supervision, for example for certain processes the software needs human approval.

5 Suggestions based on case study

While artificial intelligence becomes a tool infiltrating the lives of all companies and organizations, it will inevitably transform our economy and society as well.

Companies in the healthcare sector, hospitals, public health institutions have invaluable data, they will most likely use the advantages of AI technologies. Data is key to the effective application of AI, and the first step necessary to develop an AI strategy is to focus on the construction of data collection and data management systems, this is essential as AI softwares work with huge amounts of data. [13]

Based on implementation experience, to introduce AI in the supply chain I recommend using the following flowchart:

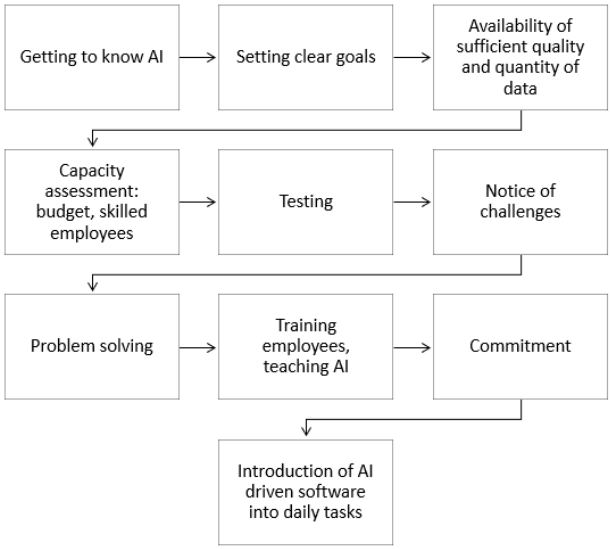

Figure 1.

AI strategy

source: own editing

By developing the right AI strategy, all problems can be prevented, thereby making the difficulties and challenges associated with change smoother.

It can be stated that the introduction and use of AI software have more advantages than disadvantages. The first and most important advantage is that the manual order entry activities will be automated, thus the order processing will be faster and the lead time will be reduced. The customer will receive the order sooner, thus there will be fewer complaints about delivery delays. Also, one of the biggest problems we deal with every day is the lack of products, with the help of the new software, planning will be much easier, but there is a short-term disadvantage which is the change management. The results of the research clearly proved that it has a positive effect on customer satisfaction. Since the software can record an order up to 5x faster than an employee, the processing time of orders is reduced. The customers will receive their package sooner, thus they will be satisfied. Post-correction will also be reduced, as the software reduces errors resulting from human inattention (recording a misspelled order number, recording the wrong quantity, recording the wrong phone number).

Overall, the customer can enjoy a more positive, problem-free customer service. And a happy customer will be a returning customer, which is essential for the company's success.

In the following table, we can see the comparison of benefits and potential pitfalls of implementing and using AI driven software:

Benefits	Potential pitfalls
✓ Increases speed and accuracy of document processing	× Data errors due to insufficient amount of data
✓ Errors due to human inattention are reduced	× Data errors due to inadequate data quality
✓ Real-time tracking of orders, customer inquires	× Time management – AI learns slowly
✓ Simplified IT environment	× Time management - Employee needs to spend time on teaching the AI
✓ Immediate analysis results, statistics	× Does not recognize special character recognition characters, or handwritten text
✓ E-archiving	× There will still be manual tasks to do, the system will not be completely independent

Despite many positive aspects we can experience through this innovation we can we face potential pitfalls too. However with the availability-, and right implementation of data, as well as continuous, correct teaching of AI, we can achieve excellent results.

To achieve even better results and reduce problems in other areas of our chain, it would be worthwhile to introduce AI-driven software to all other supply chain members that work with larger data sets, for example invoicing, warehousing. Automation is the future, so it is likely that innovation will soon be necessary for other members of our chain as well.

Conclusion

In summary, based on the case study and the experiences we gained during the use of the AI driven software, we can state that the company can experience much greater customer satisfaction thanks to the integration of AI software as it takes over tasks from human, but still remains under the control of humans throughout. However, as we saw in the article, several questions arise when using AI. From my perspective, the future of AI in healthcare supply chains is promising. As our future holds more and more automation, AI will help to reduce risks and make the change smoother, most importantly will help the company stay competitive. What will happen to the relationship between humans and AI? Human intelligence should be augmented by AI, as humans should teach artificial intelligence. We hope that we cannot teach AI enough to be smarter than us and that the final decisions and power remain in the hands of humans.

References

[1] Rana, J., Daultani, Y. Mapping the Role and Impact of Artificial Intelligence and Machine Learning Applications in Supply Chain Digital Transformation: A Bibliometric Analysis. Oper Manag Res (2022). https://doi.org/10.1007/s12063-022-00335-y Date of downloading: 3 April 2023

[2] Lexcellent, Christian: Emberi agy kontra mesterséges intelligencia : Meghekkelhető az ember ? Háttér Kiadó, 2020

[3] Lennox, John C.: A mesterséges intelligencia és az emberiség jövője, Harmat, Budapest, 2021

[4] Szegedi, Zoltán: Ellátásilánc-menedzsment, Kossuth Kiadó, 2012

[5] Sarker, I.H.: Deep Learning: A Comprehensive Overview on Techniques, Taxonomy, Applications and Research Directions. SN COMPUT. SCI. 2, 420 (2021). https://doi.org/10.1007/s42979-021-00815-1 Date of downloading: 24 April 2023

[6] Fehér, K., Dr. Kökényesi-Bartosi, A., Bártfai, B. : Mesterséges intelligencia avagy Pandora digitális szelencéje, BBS-Info Kft, Budapest, 2020

[7] Mohsen, Baha M.: Impact of Artificial Intelligence on Supply Chain Management Performance, pp. 44-58.(2023) Date of downloading: 23 March 2023; https://doi.org/10.4236/jssm.2023.161004

[8] Kaj-Fu, Li, Csiu-Fan, Csen: Mesterséges Intelligencia 2024, HVG Könyvek, Budapest, 2022

[9] Török, B., Ződi, Zs.: A mesterséges intelligencia szabályozási kihívásai, Ludovika Kiadó, Budapest, 2021

[10] Ford, Martin: Jövőnk a robotok korában: Hogyan alakítja a mesterséges intelligencia az életünket?, HVG Könyvek, Budapest, 2022

[11] Ball, Matthew: Metaverzum: Így forradalmasítja valóságunkat a virtuális világ, HVG Könyvek, Budapest, 2022

[12] Tai, Michael Cheng-Tek: The impact of artificial intelligence on human society and bioethics. Tzu Chi Medical Journal 32(4), pp. 339-343, Oct–Dec 2020. | DOI: 10.4103/tcmj.tcmj_71_20 Date of downloading: 24 April 2023

[13] Min, Hokey: Artificial intelligence in supply chain management: theory and applications, pp. 13-39, https://doi.org/10.1080/13675560902736537, 2009; Date of downloading: 16 April 2023

Exploring the challenges and opportunities for green supply chain menegement in angolan firms: a case study of three angolan companies

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Abstract: In today's world, businesses are increasingly aware of the negative consequences of disregarding the environment. Therefore, promoting social and environmental responsibility has become an essential organizational strategy. Green Supply Chain Management (GSCM) is rapidly gaining momentum in Africa as a viable solution to achieving sustainability goals. However, it is crucial to address the unique challenges and opportunities that are specific to developing countries like Angola when implementing this approach. To this end, a qualitative exploratory study was conducted to investigate the challenges and opportunities for GSCM in Angolan firms. The study involved in-depth interviews with three Angolan Small and Medium-Sized Enterprises (SMEs). The results indicate that waste management, green procurement, energy management, water management, eco-design, and pollution management are the most common types of GSCM practices in Angolan firms. However, the study also revealed that companies in Angola often face challenges such as high implementation costs, lack of knowledge, absence of policies, and lack of incentives when attempting to implement green practices. Despite these challenges, the implementation of GSCM practices in Angolan firms has significant benefits. The study further highlights the need for increased awareness among suppliers and consumers about GSCM practices, particularly among SMEs. Additionally, more programs should be made available to the general population to improve awareness. Furthermore, new policies should be developed to address the environmental damage caused by human activities in the country. This study provides a basis for future research to evaluate the implementation of GSCM practices in Angola. Overall, promoting social and environmental responsibility is a crucial organizational strategy, and GSCM offers a promising solution to achieving sustainability goals in developing countries such as Angola.

Keywords: Green supply chain management; Challenges and Opportunities; Angola Sustainable supply chain management

1 Introduction

As the demand for sustainable products steadily rises, environmental issues have become central to worldwide discussions within industrial and non-industrial forums. Green supply chain management is a crucial approach to address the environmental impact of business operations. It focuses on mitigating the environmental effect on the supply chain, which can have far-reaching implications for the well-being of our planet. However, achieving sustainable goals calls for a significant paradigm shift in the mindset and strategies of organizations, with a greater emphasis on the adoption of new and innovative methodologies that promote environmentally-friendly practices.

Green Supply Chain Management (GSCM) can be regarded as an innovative and solution-driven approach encompassing various elements that enhance different supply chain and supply chain management operations while minimizing the likelihood of damaging the environment.

In Angola, the implementation of green supply chain management is a new concept that presents a range of challenges and opportunities for companies. The country is rapidly industrializing and urbanizing, leading to various environmental problems like deforestation, pollution, and waste generation. Given the fact that Angola's economic growth depends heavily on natural resources, it is crucial to find a balance between environmental concerns and the country's economic development goals. Early efforts have been compromised by the Covid-19 Pandemic, which has caused financial difficulties that have hindered efforts to adopt sustainable practices by both the government and organizations.

This study aims to conduct a thorough analysis of three Angolan companies and their practices related to GSCM. The study aims to identify challenges and opportunities in this area and is the first of its kind to address the topic in Angola. The ultimate goal is to bridge the gap in the existing literature. The study focuses on a specific topic, and the following research questions have been formulated accordingly:

RQ1: What are the opportunities and challenges that Angolan firms face in implementing green supply chain management practices, and how can these challenges be addressed?

RQ2: Which green supply chain management practices are most commonly implemented by enterprises in Angola?

This study is organized into five distinct sections, each serving a specific purpose in exploring the topic of green supply chain management in Angola. Section 1 offers an introductory overview of the study's aims, objectives, and research questions. Section 2 discusses the theoretical background of green supply chain management both globally and in Angola. Section 3 outlines the adopted methodology. Section

4 presents and discusses the results of the three case studies. Lastly, Section 5 includes the conclusion, limitations, and suggestions for future work.

2 Theoretical Background

This section aims to provide a comprehensive overview of the important aspects of green supply chain management literature. Firstly, we outline the general concept of green supply chain management by summarizing relevant studies on the subject. Following this, we explore the current literature on the implementation of "green" practices in Angola.

2.1 Green Supply Chain Management

Green supply chain management is based on the principles of supply chain and supply chain management. The latter involves efficiently coordinating a complex system of operations to deliver a fully completed product to the end consumer or user [1]. As defined by Srivastava [2, p. 54], green supply chain management consists of "integrating environmental thinking into supply chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final products to the consumers, and end-of-life management of the product after its useful life." According to Shahriarpour and Tabriz [3], the primary goals of supply chain management are customer satisfaction, demand fulfillment, and profitability. Therefore, adopting green supply chain management practices is crucial for organizations looking to meet their sustainability goals and demonstrate their commitment to protecting the environment. This management approach aims to optimize business operations to mitigate environmental impacts and reduce damages and has garnered considerable interest among professionals and scholars across various industries. In recent years, it has become one of the most desired strategies by organizations to reduce the negative impact of their business activities on the environment.

Global events such as wars, financial crises, and pandemics can inflict severe damage on our planet. The COVID-19 Pandemic, for instance, has had a significant impact on the healthcare and economic systems worldwide and has also notably influenced the implementation of GSCM. In addition, the pandemic has led to the disintegration of traditional supply chains, the demise of countless small and medium enterprises, reduced consumer demand, and fostered the development of new markets, with some being displaced along the way [4]–[6].

2.3 Green Practices in Angola

Despite the large number of studies conducted on green supply chain management implementation, opportunities, and challenges in regions such as Asia [7]–[10] and Europe [11]–[13], there are very few studies that focus on green supply chain management in Africa. For instance, Angola is a country with currently little to no research publications available on GSCM challenges and opportunities, making the implementation process of sustainable practices more difficult.

Like many other developing nations, Angola faces various environmental difficulties, including deforestation, soil erosion, water contamination, and air pollution. Nonetheless, the most pressing climate predicament at the moment is the drought in the country's southern provinces, which is adversely affecting agriculture and the well-being of the people living in the region [14]. This was worsened by the current economic situation in Angola, which has been affecting the growth of local companies, especially in the wake of the COVID-19 pandemic. As a result, adopting green practices has become a challenge, mainly due to financial limitations. Furthermore, the environmental problems in Angola arise due to factors such as rapid population growth, urbanization, unsustainable farming practices, poor waste management, and inadequate implementation of environmental policies. For instance, Angola has experienced a significant increase in CO2 emissions, as shown in Fig 1

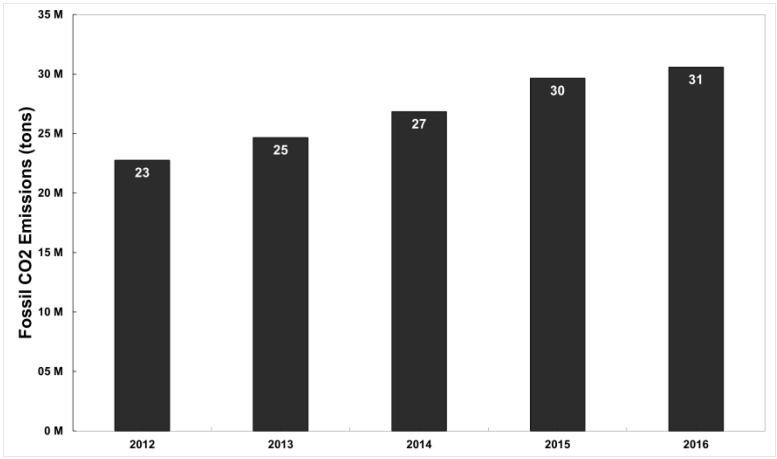

Figure 1.

Emission of CO2 in Angola, 2012-2016

Source: Authors, based on Worldometer [15].

The absence of solid climate policies in Angola always posed a burden in tackling the numerous climate problems that affect the country. However, the Angolan government has set in place a framework to tackle environmental concerns through Article 39 of The Constitution of the Republic of Angola from 2010, which ensures that it has the right to live in a healthy and unpolluted environment and the duty to

defend and preserve it. Moreover, this legal framework demonstrates Angola's commitment to sustainable development. Angola relies heavily on oil and gas for its public revenue. Unfortunately, these resources have become a major focus for both local and global environmental activists. Therefore the country needs to explore new and creative ways to expand its economy, focusing on environmentally sustainable options.

3 Methodology and Data Collection

This study employs an exploratory multiple-case study strategy to explore the participant experiences, uncovering unexplored challenges and opportunities in green supply chain management in Angolan firms. The research was conducted according to the recommendations of Yin [16]. Therefore, to address the study objectives, we conducted semi-structured interviews with three respondents: the CEO and two Senior Managers of the three selected companies. According to Grossoehme [17], case study research with semi-structured interviews allows researchers to ask follow-up questions and investigate the phenomenon in greater detail. Therefore, this approach was preferred for the present study.

This research is based on multiple case studies with three small Angolan companies operating in different sectors and locations. To gather data, we utilized a combination of primary and secondary sources. In the field of social sciences, it is imperative to practice triangulation, which involves using multiple data collection methods to enhance the validity and reliability of the research [18], [19]. Therefore, we collected primary data by conducting in-depth interviews with representatives of all three companies. In addition, we analyzed technical documents, reports, and articles from various internal and external sources to gather secondary data. Due to mobility restrictions, the interviews were held online through Zoom. Furthermore, the restricted number of interviews resulted from limitations in volunteers' availability and time constraints, although the obtained data was sufficient to proceed with the research.

In pursuit of a comprehensive understanding of GSCM in Angola, we engaged companies operating in distinct locations and with distinct business models. One company was based in the country's capital, Luanda, while the others were located in the second and third most populous cities, Benguela and Huambo. To ensure confidentiality and protect the participants' anonymity, all interview data were anonymized, and each company was assigned a code (CP1, CP2, CP3) for reference, as shown in Table 1.

The research conducted has some limitations. Firstly, the number of companies interviewed may not give a complete view of the current state of green supply chain management across the entire country. Secondly, the study only focused on Small

and Medium Enterprises (SMEs), so further research on larger corporations may highlight additional practices that have yet to be discussed.

Company ID	Industry	Respondent Designation
CP1	Retail	CEO
CP2	Environmental consulting	Manager
CP3	Construction	Manager

Table 1.
Characteristics of the firms
Source: Authors

To analyze the interview transcripts, we used the content analysis method with the assistance of software called Atlas.ti. This qualitative data analysis tool helps researchers analyze and code transcripts.

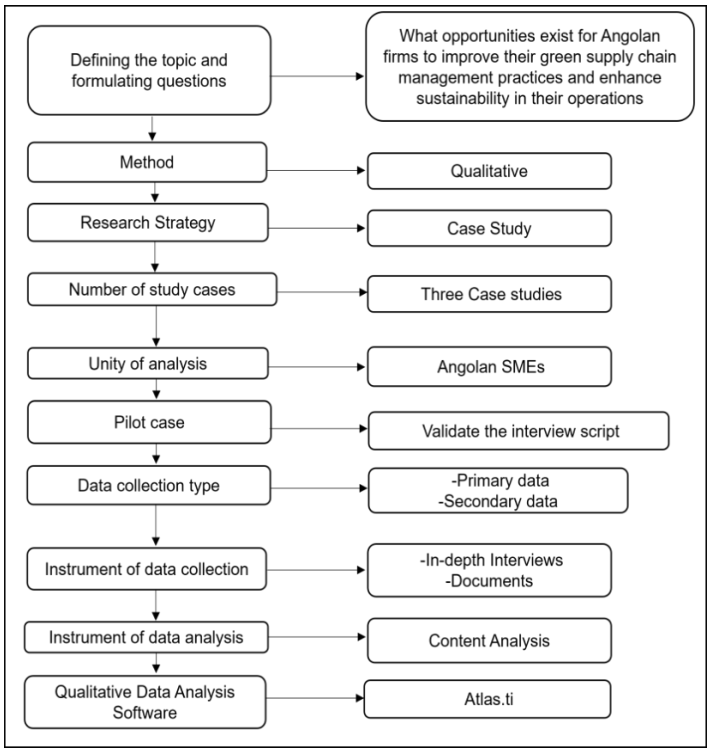

Figure 2.
Methodological steps
Source: Authors

The first step was to transcribe the interviews that we had conducted. We listened carefully to the recordings and transcribed them into a Word document. As the interviewees preferred Portuguese, we transcribed the interviews in that language and later translated them into English. The next stage involved analyzing the data for recurring themes and patterns, which we achieved by coding the textual material. We identified keywords and themes and then calculated the frequency with which they were mentioned. After segmenting the data and identifying themes and patterns, we were able to draw appropriate conclusions and recommendations by reassembling the data.

4 Results and Discussions

4.1 Case Studies

CP1 is a retail business that was established in 2015 by three Angolan entrepreneurs. It is situated in Benguela, which is the third most populated city in Angola and has a chain of stores across Benguela and Lobito. CP1 trades in a variety of products, such as clothing, electronics, and household goods. This year, the company expanded its operations to Bie, another city, as part of its long-term objective of expanding to all 18 provinces in Angola. After conducting interviews and analyzing documents, it was confirmed that the company has been actively implementing more environmentally-friendly practices in its business operations. This includes reducing electricity and water consumption, recycling, and green procurement. The interviews revealed that these practices have had a positive impact both internally and externally. However, the cost of implementing these practices has been a barrier to adopting more of them.

CP2 is a highly competent small and medium-sized enterprise founded in 2017 in Luanda, Angola's capital. Their expertise lies in providing top-notch environmental consulting services for engineering projects, which are innovative and secure and uphold ethical and technical standards. With their innovative solutions, CP2 strives to solve socio-environmental challenges while ensuring sustainable exploration. Furthermore, they prioritize delivering economically feasible solutions aligned with their unwavering sustainability commitment.

CP2 has gained significant recognition in the local market due to its extensive campaigns focusing on environmental issues. These campaigns have been broadcasted on public television and social media platforms. Additionally, the company offers its services across all cities within Angola. Upon analyzing the interview results and relevant documents, it was evident that CP2 is committed to implementing green practices and consistently engages in green marketing initiatives.

CP3 is a reputable construction services company founded in 2003. It is located in Huambo, the second most populous city in Angola, and is well-known for its top-notch services. The company's business model is designed to cater to low-income families, enabling them to access quality services at an affordable price. CP3 operates in three cities, including Bie and Lubango, and offers a wide range of construction and renovation services for residential and industrial projects.

In addition to providing excellent services, CP3 is committed to promoting sustainable practices in its daily operations. This includes waste, energy, and water management, as well as the use of fuel-efficient equipment. The interview and other documents provided confirm the company's commitment to sustainability.

Practices	Case Studies		
	CP1	CP2	CP3
Green Procurement	Little investment in the purchase and sale of sustainable goods	The company strategy revolves around the utilization of green products.	Little investment in sustainable materials.
Waste Management	Committed	Committed	Committed
Energy Management	Committed	Committed	Committed
Energy Management	Committed	Committed	Committed
Green Marketing	Lacking	Committed	Lacking.
Water Management	Committed	Committed	Committed
Eco-Design	Lacking	Committed	Committed
Pollution Management	Committed due to legislation	-Wide-scope actions regarding the use of eco-friendly products internally and externally. -Legislation obligations.	Committed to due to legislation

Table 2.

Summary of case studies

Source: Authors

After analyzing the data collected from interviews and documents, we found that all three companies have similar views on the opportunities presented by green supply chain management. Company CP2 sees sustainable practices as a way to repair the environmental damage caused by human activity. The company

emphasizes that adopting green practices can help organizations both economically and environmentally. CP1 and CP3 also view green supply chain management as an opportunity to improve their environmental impact and enhance their company's image and economic performance. All three companies confirm that implementing green practices has numerous benefits. For example, CP1 notes that some customers appreciate their green initiatives, such as providing recyclable materials in their stores, which sets them apart from other local shops. A study by Dhull and Narwal [20] reported similar results.

Although GSCM offers many benefits, companies often encounter obstacles that hinder the implementation of these practices. One such challenge is the need for more awareness and knowledge among both suppliers and buyers, making it difficult to adopt new approaches. The CEO of CP1 highlighted this issue: *"It is important to be aware of new market trends and developments as it helps to stay ahead of competitors. For a small company like us […], neglecting to stay informed can result in falling behind and missing out on opportunities for growth and success."*

The three corporate entities identified as CP1, CP2, and CP3 have reported other obstacles that hinder the implementation of GSCM practices. Among the factors are the cost of implementing certain practices, the lack of incentives, and the absence of local government policies that aim to standardize the implementation process. For example, the Manager of company CP3 stated: *"Without uniform policies, it becomes harder to implement it [implement sustainable practices]. We need policies that everyone can […] and should adhere to."*

According to the data presented in Table 2, it is evident that all three companies have implemented at least one Green Supply Chain Management (GSCM) practice. This observation suggests that GSCM is progressively gaining recognition among Angolan firms, despite its relatively early stage of development. Based on the collected data, Fig 2 displays the three companies' most commonly utilized green practices.

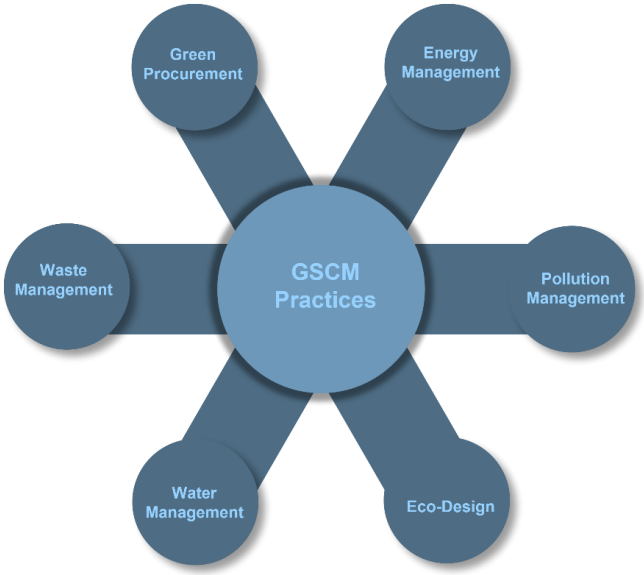

Figure 3.
Most implemented GSCM practices
Source: Authors

Conclusions

According to the research findings, green supply chain management is still in its early stages in Angola. Despite this, several companies are already adopting green practices in their operations to mitigate the impact on the environment.

The interviews also show that three selected companies utilize green practices, mainly to abide by local laws and regulations and to gain competitive advantage. We found that the three companies employ some GSCM practices, such as green procurement, energy management, water management, waste management, and eco-design, to improve customer satisfaction, comply with local environmental regulations and improve their economic performances. However, the degree of adoption varies among each enterprise. The interviews have also highlighted the importance of raising awareness about green supply chain management among both suppliers and consumers. Consequently, there is still a need for more local campaigns that aim at promoting sustainable practices in Angola.

The economic growth of local companies in Angola has been limited by the current economic situation, particularly in the aftermath of the COVID-19 pandemic. This has presented a challenge for the adoption of green supply chain management practices, mainly due to financial constraints. In addition, various other obstacles have been identified, such as the need for a robust policy structure for climate issues, the high cost of implementation, limited knowledge, and the absence of incentives.

These barriers pose significant implications for the implementation of this management strategy, requiring significant efforts to overcome them and enable companies to focus on achieving more sustainable objectives. To achieve sustainable goals in Angola, it is important for various stakeholders to be involved, such as the government, business owners, consumers, non-governmental organizations, and academic researchers. Each stakeholder's contribution is essential to successfully implementing sustainable practices. Therefore, collaboration among stakeholders is crucial to achieve the desired outcome. The government, in particular, plays a significant role in shaping the country's adoption of green supply chain management practices by proposing and implementing efficient policies and focusing on incentivizing the population to adhere to more sustainable practices.

Based on the findings of our interviews, it is strongly advised that more companies operating in Angola begin implementing sustainable and eco-friendly supply chain management practices. This is crucial in order to stay in line with the latest industry standards and expectations and to ensure long-term success in an ever-changing business environment.

To better understand how green supply chain management practices are implemented in Angola, we recommend increasing the sample size of future studies. We also suggest using a quantitative research approach to gain a deeper understanding of how these practices affect different companies. Based on our analysis of recent research, it is clear that additional studies are needed to comprehend and implement sustainable practices in Angola fully.

Acknowledgment

The participation of the companies and respondents in the research has been duly acknowledged and appreciated for its significant value and relevance. Their contribution has played a crucial role in facilitating the success of the project, and we are grateful for their support and cooperation.

References

[1] Hervani AA, Helms MM, Sarkis J: Performance measurement for green supply chain management, Benchmarking: An International Journal, Aug 1, 2005, 12(4):330–53.

[2] Srivastava SK: Green supply-chain management: A state-of-the-art literature review, Int J Management Reviews, Mar, 2007, 9(1), pp. 53–80.

[3] Shahriarpour M, Tabriz AA: The Importance of Green Supply Chain Management and its Role in Marketing Management, 2017, 7(3).

[4] Canhoto AI, Wei L: Stakeholders of the world, unite!: Hospitality in the time of COVID-19, International Journal of Hospitality Management, May, 2021 95:102922.

[5] Cankurtaran P, Beverland MB: Using design thinking to respond to crises: B2B lessons from the 2020 COVID-19 pandemic, Industrial Marketing Management, Jul, 2020, 88, pp. 255–60.

[6] Zhang Q, Gao B, Luqman A: Linking green supply chain management practices with competitiveness during covid 19: The role of big data analytics, Technology in Society, Aug, 2022, 70:102021.

[7] Tseng ML, Islam MS, Karia N, Fauzi FA, Afrin S: A literature review on green supply chain management: Trends and future challenges, Resources, Conservation and Recycling, Feb 2019, 14, pp. 145–62.

[8] Tseng ML, Chiu ASF: Evaluating firm's green supply chain management in linguistic preferences, Journal of Cleaner Production, Feb, 2013, 40, pp. 22–31.

[9] Wu GC, Ding JH, Chen PS: The effects of GSCM drivers and institutional pressures on GSCM practices in Taiwan's textile and apparel industry, International Journal of Production Economics, Feb, 2012, 135(2), pp. 618–36.

[10] Zhu Q, Sarkis J, Lai K hung. Initiatives and outcomes of green supply chain management implementation by Chinese manufacturers, Journal of Environmental Management, Oct, 2007, 85(1), pp. 179–89.

[11] Amann M, K. Roehrich J, Eßig M, Harland C: Driving sustainable supply chain management in the public sector: The importance of public procurement in the European Union, Stefan Schaltegger, Roger Burritt D, editor, Supply Chain Management: An International Journal, May 6, 2014, 19(3), pp. 351–66.

[12] Gábriel M: Green Supply Chain Management - Motivation, Methods and Expectations - in Hungarian Automotive Oems, Practice- Review of Business and Management, 2016; 12(1). Available from: http://tmp.gtk.uni-miskolc.hu/index.php?i=2490.

[13] Quintana-García C, Benavides-Chicón CG, Marchante-Lara M: Does a green supply chain improve corporate reputation? Empirical evidence from European manufacturing sectors, Industrial Marketing Management, Jan, 2021, 92, pp. 344–53.

[14] ACAPS: Angola Drought in South-West, ACAPS, 2022, Available from: https://www.acaps.org/country/angola/crisis/drought-in-south-west.

[15] Worldometer: CO2 Emissions by Country, [cited 2023 April 20], 2022, Available from: https://www.worldometers.info/co2-emissions/co2-emissions-by-country/).

[16] Yin RK: Case Study Research: Design and Methods, SAGE, 2009, 5, pp. 241.

[17] Grossoehme DH: Overview of Qualitative Research, Journal of Health Care Chaplaincy, Jul, 2014, 20(3), pp. 109–22.

[18] Denzin NK: The reflexive interview and a performative social science, Qualitative Research, Apr, 2001, 1(1), pp. 23–46.

[19] Oppermann M: Triangulation- A methodological discussion, International Journal of Tourism Research, 2000, 2(2), pp. 141–5.

[20] Dhull S, Narwal MS: Drivers and barriers in green supply chain management adaptation: A state-of-art review, Uncertain Supply Chain Management, 2016, pp. 61–76.

Examining the competitiveness of the US food trade during COVID-19

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Abstract: During COVID-19 a general decline in world food trade was also observed. One of the accepted measures of competitiveness is the Balassa index, which this research uses to see why the international competitiveness of US food products has been able to grow despite the general decline. Has the decline been less severe than in other countries? Or was government intervention more powerful? Or did other sectors of industry help out the food industry? Actually, all three, because the US food industry is so international that it has been able to come out of the crisis well compared to other major food exporters..

Keywords: COVID-19, food trade, US

1 Introduction

The COVID-19 outbreak affected most developed countries in the world, with a strong negative impact on international trade for both exporting and importing countries. The impact of COVID-19 on importing countries was significant until July 2020, and then declined thereafter, suggesting that the negative impact of COVID-19 on international trade has to some extent disappeared after the first wave of the pandemic. Different impacts are observed across different industries. The negative impacts on non-essential consumer durables have persisted for a long time in recent years, while the health trade sectors have experienced positive impacts (Hayakawa & Mukunoki, 2021).

Following the spread of COVID-19, trade intensity between countries has fallen dramatically and international relations have changed significantly. The structure of the trade network has changed dramatically. By December 2020, trade had fallen dramatically in most economies (Vidya & Prabheesh, 2020).

Agricultural production/trade markets reacted differently to events, as they were very resilient during the epidemic (Beckman & Countryman, 2021).

In the figure 1. increasing confirmed cases are seen from 2020 and 2022. In the aspect of cases the most critical year was 2022, but parallely in this year the restrections were withdrawn.

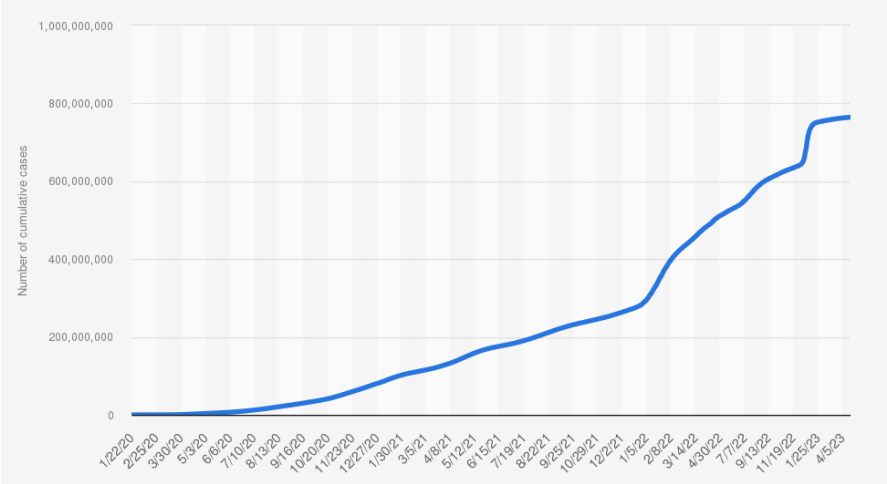

Figure 1

Cummulative confirmed COVID-19 cases Source: ourworldindata

After this brief general description, it can be seen that the United States has the highest number of cases in the world (data in Figure 2). As a welfare state, one would assume that it has a stronger public health system, care and a better population.

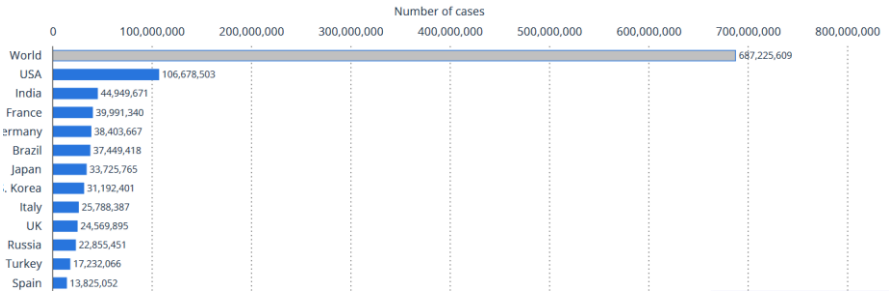

Figure 2

Number of coronavirus (COVID-19) cases worldwide as of May 2, 2023, by country or territory Source: worldometer

On the one hand, the distribution of cases (data in Figure 3) follows most countries in the world, with the difference that the peak appeared half a year later than in European countries (end of 2020). The significant peak in early 2022 did not follow international trends and was specific to the country. Eventually, the number of cases dropped significantly.

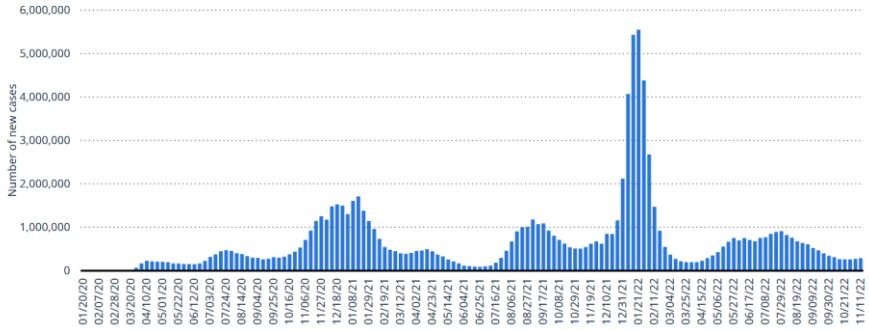

Figure 3

Number of new cases of coronavirus (COVID-19) in the United States from January 20, 2020 to November 11, 2022, by week Source: WHO

The effects of the 2020 crisis were still being felt in 2021. Afterwards, however, there was a decline in several parameters, i.e. the negative impact of the pandemic on the economy was reduced. This can be seen, for example, in the reduction of the unemployment rate by 2022 or increasing in the GDP (Statista, 2023).

2 Data and methodology

WITS Login - World Integrated Trade Solution (WITS) database data, 2017-2021. 2017-2019 pre-COVID-19, and during COVID-19 2020-2021. data were collected and used for research and calculations. The first 24 classes include food products.

The methodological basis of the study is the index of manifest comparative advantage defined by Balassa (1965). The index is based on the theory of trade based on Ricardo's theory of comparative advantage. The original index is calculated using the following formula:

$$B_{ij} = RCA_{ij} = \left(\frac{X_{ij}}{X_{it}} \right) \Big/ \left(\frac{X_{nj}}{X_{nt}} \right),$$

where X is the export, i is the country, j is the product, t is the group of products, and n is the reference country.

Competitiveness indices for the years before and including COVID-19 show only a status quo, but do not show whether and to what extent there has been a decline in competitiveness after COVID-19. I therefore used a trend function to calculate what the values would have been in the years 2020 and 2021 had there been no pandemic. The direction of the deviations shows whether there has been a decline in competitiveness or whether the competitiveness of the product group has increased.

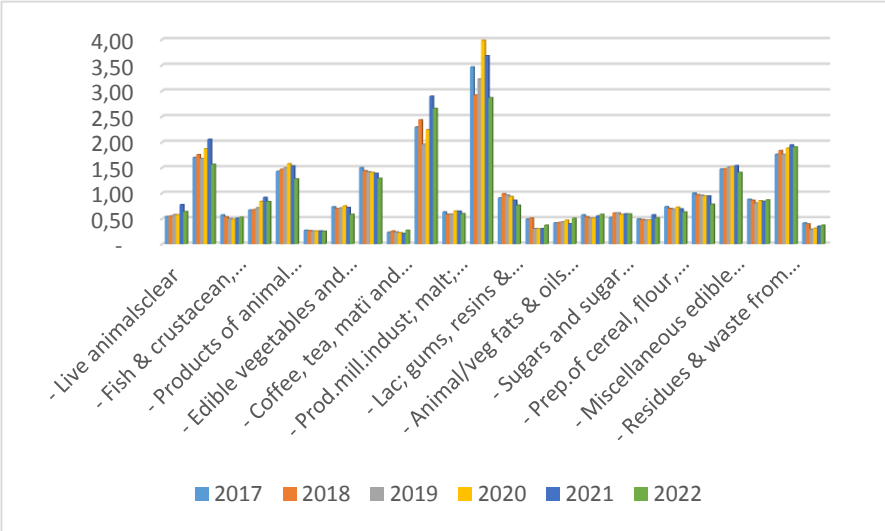

Figure 4
Output data in the main groups in US
Source: WITS, own edit

The 17 product areas of the usa are at a competitive disadvantage according to the Balssa index. This means in practice that it needs to import, or in other words, it is worth importing these products. The products with a small competitive advantage are:

- Residues & waste from the food indust; preprations
- Miscellaneous edible preparations
- Edible fruit and nuts; peel of citrus fruit
- Products of animal origin, nes or included
- Meat and edible meat offal

Products with middle level competitive advantage are:

- Oil seed, oleagi fruits; miscell grain, seed

There is no any product with large competitive advantage.

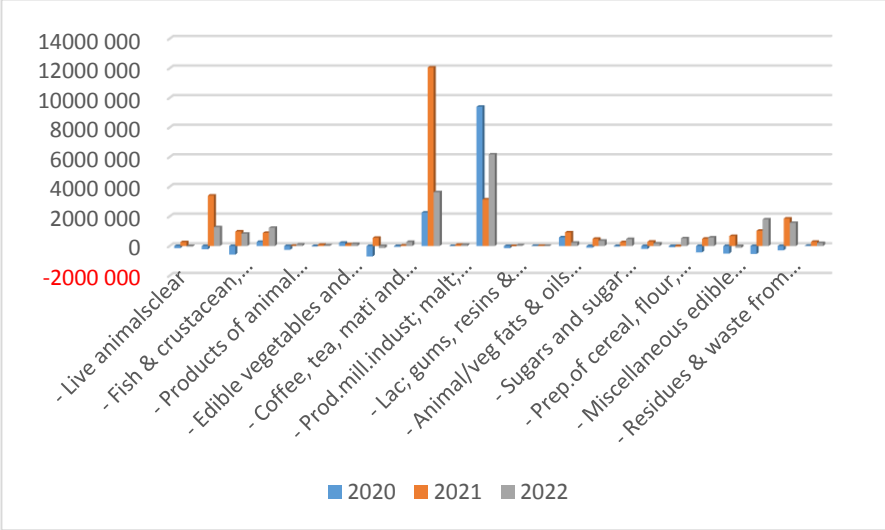

Figure 5
Main trends changes in main groups in US
Source: WITS, own edit

Looking at the changes in trends, we see that most product lines experienced a decline in 2020, followed by a correction in 2021-2022 for most product lines (Figure 5 data). Live animals, edible fruits, lac and gums, preparations of cereals, miscallenous eligible preparations are the producst where the decrease was durable.

products with increasing competitiveness	**products with stagnating competitiveness**	**products with declining competitiveness**
fish	Live animals	Products of animal origin
Live tree	meats	edible vegetables
cereals	dairy goods	oil seeds
vegetables	edible fruits	las, gums
meat preparations	coffee	sugars
beverages	mill products	
tobacco	fats	
	cocoa	
	cereal preparations	
	vegetable preparations	
	miscallenous	
	residues	

Table 1
Winners, loosers and neutral main groups in US
Source: WITS, own edit

A significant number of products have either stagnated or declined in competitiveness during COVID-19. A significant number of products have either stagnated or declined in competitiveness during COVID-19. However, basic foods, together with beverages, show increasing competitiveness. Its already competitive product range typically showed stagnation in the difference in competitiveness relative to the trend, which means that it could not strengthen further.

Conclusions

The following conclusions can be drawn from the analysis:

- For most product groups there was a decline compared to the trend function.
- Most US food products are not competitive, with the exception of
    - Residues & waste from the food indust; preprations
    - Miscellaneous edible preparations.clear
    - Edible fruit and nuts; peel of citrus fruit
    - Products of animal origin
    - Meat and edible meat
    - Oil seed, oleagi fruits; miscell grain, seed

- basic foods, together with beverages, show increasing competitiveness.
- Its already competitive product range typically showed stagnation in the difference in competitiveness relative to the trend, which means that it could not strengthen further.

Acknowledgement

I thank the leaders of the Faculty and my colleagues for making it possible for me to participate in the conference, and my friend Tamás Mizik for the methodological guidance.

References

[1] Balassa, B. (1965). Trade liberalisation and "revealed" comparative advantage 1. The manchester school, 33(2), pp. 99-123.

[2] Beckman, J., & Countryman, A. M. (2021). The importance of agriculture in the economy: impacts from COVID-19. American journal of agricultural economics, 103(5), pp. 1595-1611.

[3] Hayakawa, K., & Mukunoki, H. (2021). The impact of COVID-19 on international trade: Evidence from the first shock. Journal of the Japanese and International Economies, 60, 101135..

[4] Ourwordlindata (2023): Cummulative confirmed COVID-19 cases downloaded at o 05.24.2023

[5] Statista: Coronavirus (COVID-19) in the U.S. downloaded at study_id71515_coronavirus-disease-covid-19-in-the-us.pdf 22.05.23.

[6] Vidya, C. T., & Prabheesh, K. P. (2020). Implications of COVID-19 pandemic on the global trade networks. Emerging Markets Finance and Trade, 56(10), pp. 2408-2421

[7] WHO (2023). Statistics about COVID-19 download at https://covid19.who.int/ 22.05.23.Worldometer (2023): Coronavirus download at: https://www.worldometers.info/coronavirus/ 25.05.2023.

[8] WITS database. downloades at https://wits.worldbank.org/ 25.05.23.

Main changes in food trade in Europe and the world under COVID-19 restriction

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Abstract: The COVID-19 cuts have caused a general decline not only in international trade but also in world trade in food. One measure of competitiveness is the Balassa index, which this research uses to examine how these measures have evolved for China, one of the largest producers and exporters. A trend function constructed from data prior to COVID-19 predicted how these measures would have evolved in the absence of a downturn. In comparison, Chinese exports of foodstuffs have fallen significantly. So has its competitiveness. What happened? What is the background to this? Which areas have been more affected? What has been done to address this? The study looks at this.

Keywords: COVID-19, food trade, China

1 Introduction

The epidemic, known as COVID-19, has spread to many countries since 2020 and has affected societies, people and daily life in many areas of life.As of 2 May 2023, more than 687 million cases of COVID-19 have been reported across the globe, and almost 6.87 million people have died from the disease or its complications. The impacts have affected many areas, so the COVID-19 cuts have had a serious impact on the global economy and on the financial lives of individuals, the buck system. And the restrictions put in place to slow the spread of the disease have had a major and negative impact on the lives of billions of people (Elflein, 2023).

In the figure 1. increasing confirmed cases are seen from 2020 and 2022. Fortunately, from 2023 there is a deceaes cases number. In the aspect of cases the most critical year was 2022, but parallely in this year the restrections were withdrawn.

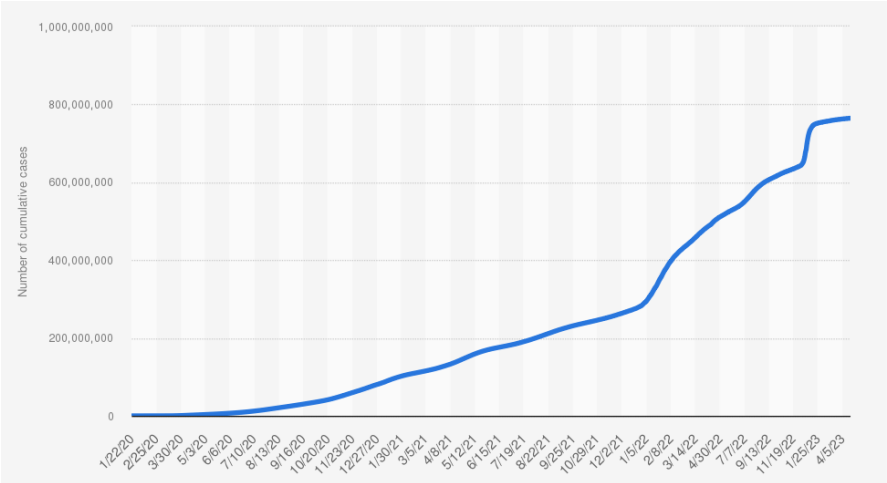

Figure 1

Cummulative confirmed COVID-19 cases Source: ourworldindata

After a brief general description, let's focus on China. The official case numbers in the country remained stagnant for a long time (Figure 2). This could be due to either the statistics not being realistic or to the fact that China's tightening restrictions were successful and then the case numbers increased significantly when the restrictions were lifted.

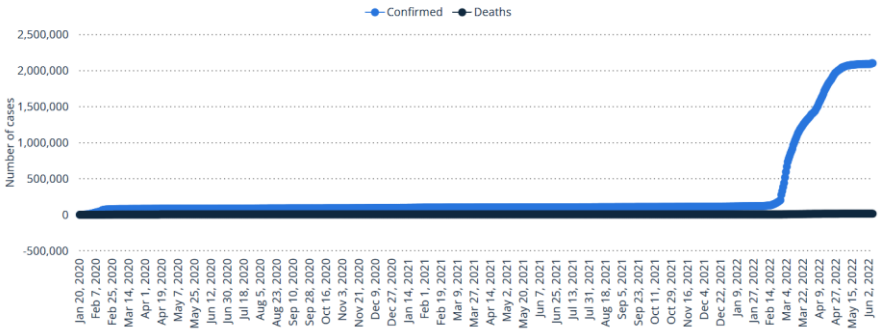

Figure 2

Cummulative confirmed COVID-19 cases in China Source: Chinese Center for Disease Control and Prevention

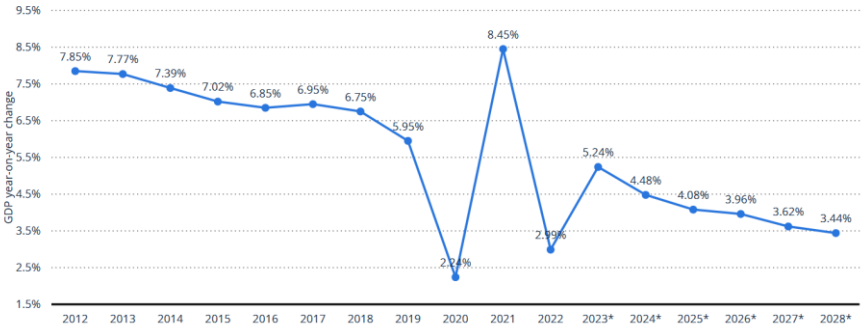

Figure 3

Growth rate of real gross domestic product (GDP) in China from 2012 to 2022 with forecasts until 2028

Source: Statista

Collected statistics show 2 low points during COVID-19. First was in 2020 like in the other parts of the world. Second one was in 2022 similsarly like in the US os in EU countries.

According to data from the Chinese Statistical Institute, agriculture and the food industry were less exposed to the negative effects of COVID-19 (National Bureau of Statistics of China, 2023).

2 Data and methodology

WITS Login - World Integrated Trade Solution (WITS) database data, 2017-2021. 2017-2019 pre-COVID-19, and during COVID-19 2020-2021. data were collected and used for research and calculations. The first 24 classes include food products.

The methodological basis of the study is the index of manifest comparative advantage defined by Balassa (1965). The index is based on the theory of trade based on Ricardo's theory of comparative advantage. The original index is calculated using the following formula:

$$B_{ij} = RCA_{ij} = \left(\frac{X_{ij}}{X_{it}} \right) \Big/ \left(\frac{X_{nj}}{X_{nt}} \right),$$

where X is the export, i is the country, j is the product, t is the group of products, and n is the reference country.

Competitiveness indices for the years before and including COVID-19 show only a status quo, but do not show whether and to what extent there has been a decline in competitiveness after COVID-19. I therefore used a trend function to calculate what

the values would have been in the years 2020 and 2021 had there been no pandemic. The direction of the deviations shows whether there has been a decline in competitiveness or whether the competitiveness of the product group has increased.

3 Results

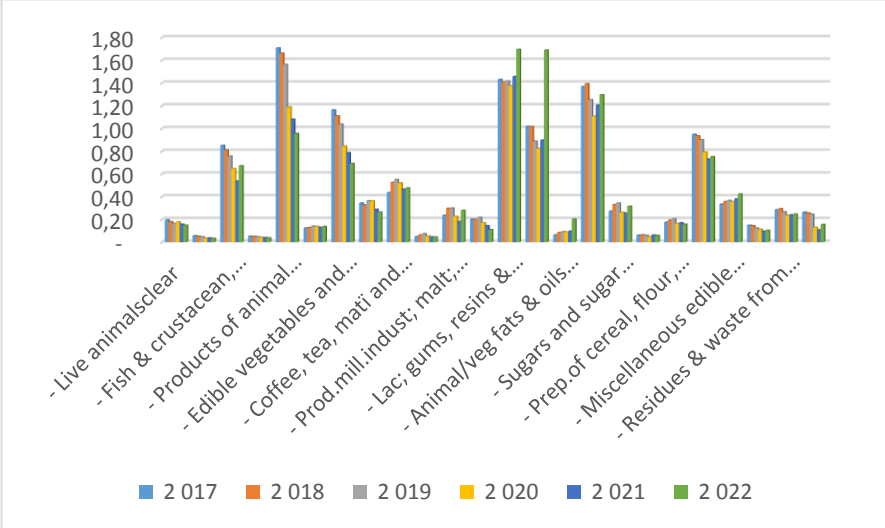

Figure 4
Output data in the main groups in China
Source: WITS, own edit

The 21 product areas of China are at a competitive disadvantage according to the Balssa index. This means in practice that it needs to import, or in other words, it is worth importing these products. The products with a small competitive advantage (1-2) are:

- preparations of meat
- vegetable products
- lac, gums
- Products of animal origin, nes or included

Products with middle (2-4) or large level competitive advantage (more than 4) do not exist in China.

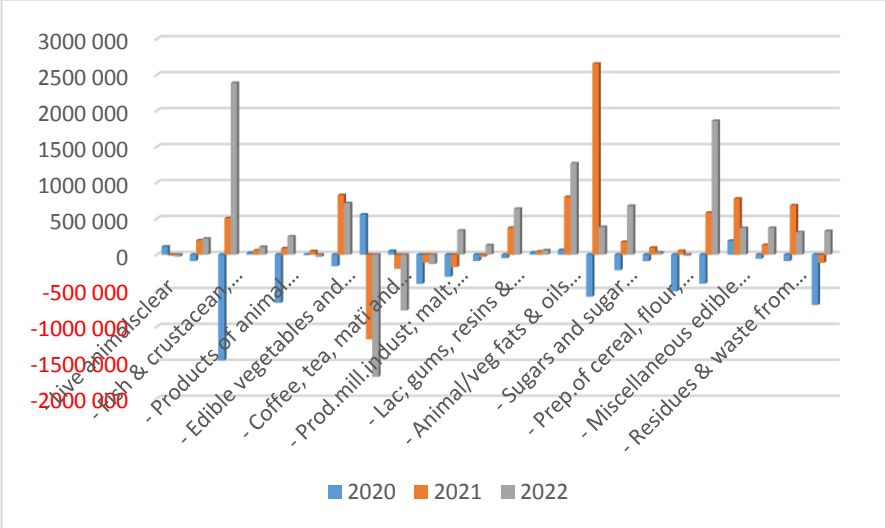

Figure 5

Main trends changes in main groups in China

Source: WITS, own edit

The data show a greater economic recession and decline for the Chinese food industry and agriculture, when Figure 5 shows that declines occur in more product areas than in the case of data from other countries, and these declines are large. So the impact of COVID-19 was absolutely significant on the Chinese food industry as well. Exceptions are dairy products, vegetables, animal fats, oils, miscellaneous edible preparations.

products with increasing competitiveness	**products with stagnating competitiveness**	**products with declining competitiveness**
vegetables	Live animals	edible vegetables
	meats	oil seeds
	dairy goods	lac, gums
	fish	sugars
	animal fats,	Live tree
	preparations of meat	Edible fruits
	cocoa	coffee, tea
	vegetable preparations	cereals
	miscallenous	mill products
	residues	cereals preparations
	Edible vegetables	
	bevarages	
	tobacco	

Table 1

Winners, loosers and neutral main groups in China

Source: WITS, own edit

According to data of Table 1. a significant number of products have either stagnated or declined in competitiveness during COVID-19. However, only vegetables shows increasing competitiveness. Its already competitive product range typically showed stagnation in the difference in competitiveness relative to the trend, which means that it could not strengthen furthe except vegetables, which is basic food.

Conclusions

The following conclusions can be drawn from the analysis:

- For most product groups there was a decline compared to the trend function.
- Most Chinese food products are not competitive, with the exception of
    - preparations of meat
    - vegetable products
    - lac, gums
    - Products of animal origin, nes or included

- Only vegetables shows increasing competitiveness. This does not mean a strong foundation in trade.
- Its already competitive product range typically showed stagnation in the difference in competitiveness relative to the trend, which means that it could not strengthen further.

The competitiveness of the Chinese economy, which is based on the size of resources and labor, has shown a decline in recent years under the COVID-19, which weakens the international positions of the Chinese economy. Decision-makers must definitely take this into account and take measures that can compensate for this.

Acknowledgement

I would like to thank the leaders of the Faculty and my colleagues for making it possible for me to participate in the conference, and my friend Tamás Mizik for the methodological guidance.

References

[1] Balassa, B. (1965). Trade liberalisation and "revealed" comparative advantage 1. The manchester school, 33(2), pp. 99-123.

[2] Chinese Center for Disease Control and Prevention (2023). COVID- 19 Clinical and Surveillance Data. downloaded at https://en.chinacdc.cn/ 05.24.2023.

[3] Elflein, J (2023): COVID-19 impact on mental health - statistics & facts in Statista database.

[4] National Bureau of Statistics of China. Downloaded at : http://www.stats.gov.cn/english/

[5] Ourwordlindata (2023): Cummulative confirmed COVID-19 cases downloaded at https://ourworldindata.org/explorers/coronavirus-data-explorer?zoomToSelection=true&time=2020-03-01..latest&facet=none&country=~OWID_WRL&pickerSort=asc&pickerMetric=location&hideControls=true&Metric=Confirmed+cases&Interval=Cumulative&Relative+to+Population=false&Color+by+test+positivity=false 05.24.2023

[6] Statista: Coronavirus: economic impactin China downloaded at study_id72133_coronavirus-economic-impact-in-china.pdf 20.05.23.

[7] WHO (2023). Statistics about COVID-19 download at https://covid19.who.int/ 22.05.23.Worldometer (2023): Coronavirus download at: https://www.worldometers.info/coronavirus/ 25.05.2023.

[8] WITS database. downloades at https://wits.worldbank.org/ 25.05.23.

The role of e-agriculture in promoting sustainable agricultural practices and rural development in Albania.

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Abstract: This paper discusses the potential benefits of using ICT in agriculture, known as e-agriculture, for promoting sustainable agricultural practices and enhancing rural development in Albania. It reviews existing literature and case studies, highlighting the challenges and opportunities of adopting e-agriculture technologies in rural areas. The paper concludes that e-agriculture can improve resource use efficiency, promote environmentally-friendly practices, and enhance market access for smallholder farmers. Finally, it calls for coordinated stakeholder activities to enable the adoption and spread of e-agriculture technology in rural regions. It also explores the policy implications of promoting e-agriculture for sustainable agricultural practices and rural development in Albania.

Keywords: E-agriculture, rural development, sustainable agriculture, policy implications, resource use efficiency

1 Introduction

Rural communities' economic growth and means of subsistence largely depend on agriculture. In recent years, Information and Communication Technology (ICT) in agriculture, also known as e-agriculture, has become a possible tool for promoting sustainable agricultural practices and enhancing rural development [1]. Implementing e-agriculture in rural areas offers benefits such as resource efficiency and market access, but challenges like limited internet access and low digital literacy must be overcome. In addition, past experiences emphasize the importance of supportive policies, stakeholder collaboration, and capacity-building efforts [2]–[7].

This paper aims to identify solutions for promoting sustainable agricultural practices and rural development in Albania by analyzing effective e-agriculture tools in various contexts. It encompasses a comparative analysis of the various e-agriculture initiatives implemented in different countries, considering technological feasibility, economic viability, and social acceptability, among other factors. In addition, a thorough case study analysis will examine specific examples of successful e-agriculture implementations and their potential transferability to theAlbanian agricultural sector.

2 Literature Review

E-agriculture, which refers to the use of ICT in agriculture, has gained significant attention for its potential to promote sustainable agricultural practices and drive rural development. As a result, extensive research and studies have explored the benefits and challenges of e-agriculture implementation across different regions worldwide. One of the critical advantages of e-agriculture is its ability to enhance resource-use efficacy. Using ICT solutions like precision farming, real-time monitoring, and data-driven decision-making, e-agriculture can optimize water, fertilizers, and pesticides [4]. Research by [8] has demonstrated that applying ICT-enabled precision agriculture technologies significantly improves resource efficiency and productivity in agricultural systems. In addition to improving resource utilization, e-agriculture provides opportunities to promote environmentally favorable practices. By facilitating targeted input applications and reducing wastage, ICT-based tools help mitigate the environmental impacts of agriculture [9]. For instance, remote surveillance and satellite imagery enable the early detection of pests and diseases, leading to timely interventions and reduced reliance on chemical treatments [10]. Enhancing market access for smallholder producers is another crucial aspect that e-agriculture can address. ICT tools connect producers to market information, prices, and consumers, enhancing their bargaining power and market opportunities [11]. In various contexts, mobile applications and online platforms have facilitated direct farmer-consumer links, reducing the involvement of intermediaries and increasing farmers' profitability [12].

The deployment of rural e-agriculture faces challenges such as limited internet connectivity and digital literacy among farmers [13], [14]. Overcoming these obstacles requires targeted strategies for infrastructure, connectivity, and digital skills [15]. In addition, cultural and societal factors like resistance to change and mistrust of new technology also impact adoption [16]. Therefore, understanding the socio-cultural context is crucial for successful implementation. Comparative analysis and case studies offer insights into effective strategies and technologies [13], [14], [17], [18]. Case studies examined are AgroCenta, eNAM, Esoko, Plantix, Digital Green, iCow, and CropX and their implications for e-agriculture adoption in Albania. These cases showcase the potential of e-agriculture to enhance market

access, disseminate information, and improve resource efficiency. Applying similar tools in Albania can enhance agricultural practices and promote rural development [19]–[25]

3 Methodology

This study examines the implementation of e-agriculture applications and their relevance in Albania through comparative and case study analysis. Comparative analysis of AgroCenta, eNAM, Esoko, Digital Green, iCow, CropX, and Plantix identifies common themes and lessons learned. A systematic review of existing literature highlights the benefits and limitations of these applications. Case studies analyze implementation strategies, technologies, and outcomes, focusing on sustainable practices, market access, resource efficiency, and rural development. These analyses aim to extract valuable insights and provide practical examples to guide the implementation of e-agriculture initiatives in Albania.

4 Results and Discussions

The study's findings emphasize the importance of e-agriculture in promoting sustainability and rural development in Albania. It includes the analysis of seven e-agriculture solutions, case studies, transferability options, and proposed implementation solutions. The results offer valuable insights into these tools' benefits, challenges, and transferability in Albania.

e-Agriculture Application	
AgroCenta	
App Features	Direct trade between farmers and buyers -Access to financial services and inputs - Inventory management -Farmer profiling and analytics
Innovation and Success Factors	AgroCenta's success is attributed to its ability to bridge the gap between farmers and buyers, ensuring fair pricing and reducing post-harvest losses. It also offers financial inclusion for farmers through access to credit and other financial services.
Constraints, Challenges, and Barriers	AgroCenta faces challenges related to limited digital infrastructure and low digital literacy among farmers. Therefore, it requires investment in infrastructure and farmer education to maximize its impact.

e-Agriculture Application	
eNAM	
App Features	Direct selling platform - Real-time price information - Logistics support - Electronic payment options

Innovation and Success Factors	eNAM's success stems from its ability to bring transparency to agricultural markets, improve farmers' bargaining power, and streamline the supply chain. It has led to better price realization for farmers and enhanced market efficiency.
Constraints, Challenges, and Barriers	eNAM faces challenges related to resistance from traditional market intermediaries, inadequate infrastructure, and limited awareness among farmers. Building trust among stakeholders and improving infrastructure are crucial for its effective implementation.

e-Agriculture Application

Plantix	
App Features	Crop disease diagnosis - Pest management solutions - Personalized recommendations - Image recognition technology
Innovation and Success Factors	Crop disease diagnosis - Pest management solutions - Personalized recommendations - Image recognition technology
Constraints, Challenges, and Barriers	Plantix faces challenges related to constant updates to the image recognition database, language limitations in localized versions, and access to smartphones and internet connectivity.
Assessment of Transferability	Plantix's transferability to Albania is promising, considering the importance of crop protection and sustainable farming practices. However, localization efforts, database updates, and ensuring accessibility to smartphones are key considerations.

e-Agriculture Application

Esoko	
App Features	Agricultural information and advice - Market prices and trends - Weather updates - Financial services - Communication and networking
Innovation and Success Factors	Esoko's success is attributed to its ability to provide timely and relevant information, empower farmers with market insights, and facilitate financial transactions. In addition, it promotes transparency and efficiency in agricultural markets.
Constraints, Challenges, and Barriers	Esoko faces challenges related to limited internet connectivity in rural areas, low digital literacy among farmers, and the need for continuous data updates. Overcoming these challenges is crucial for its widespread adoption.

e-Agriculture Application

Digital Green	
App Features	Locally produced Agricultural videos - Community-based approach - Farmer-to-Farmer knowledge sharing - Capacity building
Innovation and Success Factors	Digital Green's innovation lies in its participatory video approach, empowering farmers with relevant knowledge and facilitating peer learning. It strengthens social networks and enhances the adoption of sustainable agricultural practices.
Constraints, Challenges, and Barriers	Digital Green faces challenges related to the production and distribution of localized videos, ensuring the sustainability of the community-based

	model, and scalability to reach a larger number of farmers.
e-Agriculture Application	
iCow	
App Features	Animal health and breeding information - Feeding management guidance - Financial management tools - Access to veterinary services
Innovation and Success Factors	iCow's success is attributed to its comprehensive support for dairy farmers, addressing critical aspects of animal health, nutrition, and financial management. It empowers farmers to make informed decisions and improve productivity.
Constraints, Challenges, and Barriers	iCow faces challenges related to limited access to smartphones and internet connectivity, tailoring the content to local breed variations, and ensuring sustained user engagement. Overcoming these challenges is essential for its effective implementation.
e-Agriculture Application	
CropX	
App Features	Soil sensing devices for data collection - Cloud-based platform for data analysis - Precision irrigation recommendations - Nutrient management tools
Innovation and Success Factors	CropX's innovation lies in its ability to provide real-time soil data, enabling farmers to optimize irrigation and nutrient application based on crop needs. It promotes water and fertilizer use efficiency, resulting in improved crop yield and sustainability
Constraints, Challenges, and Barriers	CropX faces challenges related to the initial investment cost, calibration of sensors for local soil conditions, and user adoption of new technologies. Overcoming these barriers is crucial for its widespread implementation.

Table 1.

The transferability analysis assessed the feasibility and potential impact of implementing the identified e-agriculture solutions in Albania. It considered factors such as the digital infrastructure, internet penetration rates, mobile device usage, digital skills level, and alignment with national strategies. This analysis provided valuable insights into the suitability of these solutions for implementation in Albanian agriculture.

At the beginning of 2022, Albania had a 72.2% internet penetration rate. Studies conducted by INSTAT revealed that 82.6% of individuals aged 16 to 74 used the internet, with 91.6% using it multiple times daily. Mobile devices were the primary internet access for 99.9% of the population, while 96.5% of Albanian families were internet users. "Mobile broadband" was used by 99.2% of families to connect to the internet. Within the last year, 34.7% of individuals aged 16 to 74 made online purchases [26]. The Electronic and Postal Communications Authority reported 2 million active mobile internet subscribers with SIM cards, representing a 3% increase from the previous year. Smartphone internet usage accounted for 78% of

active mobile service subscribers. In 2021, over 77% of households had a broadband connection, and broadband internet traffic from fixed networks reached 952 million GB, indicating widespread usage for various services. Fixed broadband users also increased by 10% to reach 560,000 in 2021 [27]. In 2022, e-government usage in Albania saw significant growth across various categories, including electronic contacts with public authorities and access to public services. The most notable increase was observed in "Downloading/printing forms," which rose by 37.6 percentage points compared to the previous year. Additionally, "obtained information from websites or apps" increased by 19.3 percentage points. The e-government platform "E-Albania" offers 1,227 public electronic services, accounting for more than 90% of all public services provided in the country. According to the World Economic Forum Executive Opinion Survey, the level of digital skills among the active population in Albania is 4.67 on a scale of 7 [28].

Albania has established strategic plans and programs, such as the Digital Agenda, Strategy for Agriculture, Rural Development, and Fisheries, and the National Farmers Training Program, to support the implementation of ICT in agriculture. In addition, the launch of the farmer portal, AgroAlbania, provides valuable resources and services for farmers. The Ministry of Agriculture and Rural Development is also developing an eNAM platform, and EU-funded IPARD projects have improved farmers' access to finance in Albania. These initiatives demonstrate Albania's commitment to digitalization and the advancement of the agricultural sector [29], [30]. The transferability analysis was conducted to identify which applications can be implemented in Albania.

Transferability analysis			
E-agriculture application	**Transferability**	**Supportive Factors**	**Challenges**
AgroCenta	transferable	availability of a robust network infrastructure, high mobile internet usage	Ensuring farmer adoption and awareness of the platform, building trust among buyers and sellers, and addressing any language and literacy barriers
eNAM	can be created like India eNAM	existing infrastructure, digital skills level, the government's initiatives to promote ICT in agriculture	Ensuring the participation of farmers and buyers, building trust and transparency in the digital marketplace, and addressing any technical and logistical challenges
Plantix	transferable	The widespread use of mobile devices, high mobile internet usage, and network infrastructure availability, and digital skills	Adapting the app to the specific crop species and disease patterns in Albania, ensuring language compatibility, and addressing potential literacy and language barriers

Esoko	considered for implementation	The widespread use of mobile devices, availability of internet connectivity, and the government's focus on digitalization in agriculture	Ensuring accurate and up-to-date market information availability, addressing language barriers, and promoting widespread platform adoption among farmers and buyers
Icow	can be explored for implementation	The high mobile internet usage and availability of smartphones, existing digital infrastructure and increasing digital skills level	Adapting the app to the specific livestock farming practices and breeds in Albania, ensuring user adoption and engagement, and addressing any language and literacy barriers
CropX	can be considered for implementation	Albania's availability of internet connectivity, mobile devices, and digital skills, government focus,	Adapting the technology to the specific soil and crop conditions in Albania, ensuring farmer acceptance and understanding of the technology, and addressing potential cost constraints
Digital Green	can be explored for implementation	widespread availability of mobile internet connectivity, the high utilization of mobile devices, and the government's initiatives in agricultural training	Adapting the content and videos to the local context, ensuring language compatibility, addressing potential literacy and language barriers, and promoting farmer engagement and adoption

Table 2.

Based on the transferability analysis, the top three transferable applications for implementation in Albania would be: **AgroCenta**, **eNAM** and **Plantix.** These applications offer significant potential for improving agricultural practices, enhancing market access, and promoting sustainable development in Albania.

Conclusions and Recommendations

E-agriculture can use ICT solutions to promote sustainable agriculture and rural development in Albania. The literature review and case study analysis showed the benefits and drawbacks of e-agriculture in rural areas. According to a comparative analysis, AgroCenta, eNAM, Plantix, and other applications improved market access, resource usage, and knowledge diffusion in various agricultural contexts. Albania's good digital infrastructure, high internet penetration, and broad mobile device use make it suitable for e-agriculture tools implementation. Government agencies, farmers' associations, technology suppliers, and research institutions should collaborate to promote rural e-agriculture adoption. Digital literacy programs and training can improve farmers' e-agriculture skills. Localization should remove linguistic and geographical obstacles to make apps more user-friendly for Albanian farmers. Investing in digital infrastructure is essential for reliable and

broad e-agriculture tools. Financial support, tax incentives, and favorable regulatory regimes may also accelerate the use of e-agriculture tools.

References

[1] FAO and ITU, "E-AGRICULTURE STRATEGY GUIDE Piloted in Asia-Pacific countries," Bangkok, 2016.

[2] Stephenson J, Chellew T, Von Köckritzv L, Rose A, and Dinesh D, "Digital agriculture to enable adaptation: A supplement to the UNFCCC NAP Technical Guidelines.," Wageningen, 2021.

[3] Uwe Deichmann, Aparajita Goyal, and Deepak Mishra, "Will Digital Technologies Transform Agriculture in Developing Countries? ," 2016.

[4] M. Dhanaraju, P. Chenniappan, K. Ramalingam, S. Pazhanivelan, and R. Kaliaperumal, "Smart Farming: Internet of Things (IoT)-Based Sustainable Agriculture," Agriculture, 12(10) pp. 1745, Oct. 2022, doi: 10.3390/agriculture12101745.

[5] P. Tiwasing, B. Clark, and M. Gkartzios, "How can rural businesses thrive in the digital economy? A UK perspective," Heliyon, vol. 8(10), pp. e10745, Oct. 2022, doi: 10.1016/j.heliyon.2022.e10745.

[6] F. Awuor, G. Raburu, A. Onditi, and D. Rambim, "Building E-Agriculture Framework in Kenya," Journal of Agricultural Informatics, 7(1), Apr. 2016, doi: 10.17700/jai.2016.7.1.244.

[7] Y.-P. Lin et al., "Blockchain: The Evolutionary Next Step for ICT E-Agriculture," Environments, 4(3), pp. 50, Jul. 2017, doi: 10.3390/environments4030050.

[8] W. Liu, X.-F. Shao, C.-H. Wu, and P. Qiao, "A systematic literature review on applications of information and communication technologies and blockchain technologies for precision agriculture development," J Clean Prod, 298, pp. 126763, May 2021, doi: 10.1016/j.jclepro.2021.126763.

[9] H. El Bilali and M. S. Allahyari, "Transition towards sustainability in agriculture and food systems: Role of information and communication technologies," Information Processing in Agriculture, 5(4), pp. 456–464, Dec. 2018, doi: 10.1016/j.inpa.2018.06.006.

[10] J. Zhang et al., "Monitoring plant diseases and pests through remote sensing technology: A review," Comput Electron Agric, 165, pp. 104943, Oct. 2019, doi: 10.1016/j.compag.2019.104943.

[11] P. Courtois and J. Subervie, "Farmer Bargaining Power and Market Information Services," Am J Agric Econ, 97(3), pp. 953–977, Apr. 2015, doi: 10.1093/ajae/aau051.

[12] A. Maru et al., “Digital and Data-Driven Agriculture: Harnessing the Power of Data for Smallholders,” 2018.

[13] ITU and FAO, “Status of Digital Agriculture in 18 countries of Europe and Central Asia,” Geneva, Switzerland, 2020.

[14] G. Sylvester, E-agriculture in action: Blockchain for agriculture Challenges and opportunities. Bangkok, Thailand: FAO and ITU, 2019.

[15] E. M. Emeana, L. Trenchard, and K. Dehnen-Schmutz, “The Revolution of Mobile Phone-Enabled Services for Agricultural Development (m-Agri Services) in Africa: The Challenges for Sustainability,” Sustainability, vol. 12(2), pp. 485, Jan. 2020, doi: 10.3390/su12020485.

[16] M. Mwangi and S. Kariuki, “Factors determining adoption of new agricultural technology by smallholder farmers in developing countries,” Journal of Economics and Sustainable Development, 6(5), pp. 208–216, 2015.

[17] W. Liu, X.-F. Shao, C.-H. Wu, and P. Qiao, “A systematic literature review on applications of information and communication technologies and blockchain technologies for precision agriculture development,” J Clean Prod, 298, pp. 126763, May 2021, doi: 10.1016/j.jclepro.2021.126763.

[18] FAO and ITU, Status of digital agriculture in 47 sub-Saharan African countries. FAO; ITU;, 2022. doi: 10.4060/cb7943en.

[19] J. Bisen and R. Kumar, “Agricultural marketing reforms and e-national agricultural market (e-NAM) in India: a review,” Agricultural Economics Research Review, 31, no. conf, pp. 167, 2018, doi: 10.5958/0974-0279.2018.00032.0.

[20] M. Quayson, C. Bai, and V. Osei, “Digital Inclusion for Resilient Post-COVID-19 Supply Chains: Smallholder Farmer Perspectives,” IEEE Engineering Management Review, 48(3), pp. 104–110, Sep. 2020, doi: 10.1109/EMR.2020.3006259.

[21] D. Ayisi Nyarko and J. Kozári, “Information and communication technologies (ICTs) usage among agricultural extension officers and its impact on extension delivery in Ghana,” Journal of the Saudi Society of Agricultural Sciences, 20(3), pp. 164–172, Apr. 2021, doi: 10.1016/j.jssas.2021.01.002.

[22] F. Van Schalkwyk, A. Young, and S. Verhulst, “Esoko–Le, veling the Information Playing Field for Smallholder Farmers in Ghana.,” 2017.

[23] K. Pallassana, V. Singh, and A. Singh, “igital agriculture in India: A holistic approach to deliver value to small and Marginal Farmers in India. ,” Agricultural Engineering Today, 46(3), 2022.

[24] M. E. Marwa, J. Mburu, R. E. J. Oburu, O. Mwai, and S. Kahumbu, “Impact of ICT Based Extension Services on Dairy Production and Household

Welfare: The Case of iCow Service in Kenya," Journal of Agricultural Science, vol. 12(3), pp. 141, Feb. 2020, doi: 10.5539/jas.v12n3p141.

[25] S. Datta and T. Saleh, "Conserving Agricultural Water Resources in Oklahoma using Smart Technologies.," 2018.

[26] INSTAT, "Survey on Information and Communication Technologies (ICT) usage in Households and by Individuals in 2022," 2023. [Online]. Available: https://www.instat.gov.al/media/11169/ict-2022-english.pdf

[27] AKEP, "Activity Report of the Electronic and Postal Communications Authority for," Tirana, Albania, 2022.

[28] ITU, "Albania Digital Development Country Profile," 2022. [Online]. Available: https://albania.un.org/sites/default/files/2022-05/Digital%20Development%20Country%20Profile_Albania_final_02.22.pdf

[29] R. of A. Ministry of Infrastructure and Energy, NATIONAL PLAN FOR SUSTAINABLE DEVELOPMENT OF DIGITAL INFRASTRUCTURE, BROADBAND 2020-2025. Tirana, 2020.

[30] R. of A. Ministry of Agriculture and Rural Development, "Rural Development Programme 2021-2027," Tirana, 2021. [Online]. Available: https://bujqesia.gov.al/wp-content/uploads/2022/09/Programi-IPARD-III_2021-2027_English.pdf

The impact of digitalisation on older workers' job satisfaction. Case study Serbia

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Abstract: In recent years, digitalization totaly changed the way of work within companies because new business models evolve from digitalization processes. Most organizations are aware of the necessity of digitalization and its effect on employees' work. This paper aims at assessing the influence of digitalization on older workers'job satisfaction and their productivity. The study was conducted in the city of Bor (Serbia) and included 153 employees. Data regarding job satisfaction and level of digitalisation was collected using questionnaire

Keywords: digitalization, older worker, job satisfaction, productivity

1 Introduction

It is very obvious that new technologies affect almost all aspects of society today. The impact of digital transformation in organizations is particularly visible in the increase in efficiency and productivity, but also in the quality of work and working conditions of the employees themselves. Of course, looking at the bigger picture, digitalization is not only happening in the context of organizations. The widespread usage of digital tools and programs has an impact on every part of our life. The occurrence of COVID-19 pandemic only speed up the process of digitalization, forcing people to work from home and communicating online [1].

Most research regarding workplace digitalization focuses on its effects on business performance and employee productivity [2]. However, the effects of digitalization on personal factors such as employee satisfaction are very [3-6]. In addition, very low number of studies particularly examined the impact of digitalization on job satisfaction or job quality among older employees [7-9]. In that sense, it could be

said that this study contributes a lot to a very limited literature by trying to resolve the inconsistent findings on the relationship between digitalization of the workplace and older people' job satisfaction.

First it is necessary to define what the term 'older employee' means. Rožman et al. [10] summarise that statisticians tend to take the age of 45 as the demarcation between being a younger (24–44 years) or an older employee (45–64 years). Other authors [11-13] define older employees as those between 55 and 64 years of age. But, taking into consideration all these pension reforms across Europe, we will be free to say that older employees are those older than 55 until their retirement. Because of that, we can expect that the percentage of older employees will only increase in the years to come. Unfortunately, employers do not pay attention to the management of older employees. When it comes to transmitting knowledge and expertise, older employees are sometimes perceived as a barrier rather than as a chance that should be developed and taken advantage of [14].

Different studies have examined the reasons why people stay in work, even after reaching retirement age, and the reasons that influence their early retirement. As the main reason for staying at work they reported higher level of job satisfaction and commitment to the organization [15]. On the other hand, the factors which facilitate their departure are organizational changes [16], which most recently involve the digitalization process.

Digitalization can have both positive [17,18] and negative impact [19] on job satisfaction and, in general, on job quality.

In this study, we have analyzed relationship between digitalization and employee satisfaction with two moderating variables, gender and sector of employment. For that purpose we have defined two hypothesis and have designed theoretical model:

H1: Digitalization level of the organization has a positive effect on employee satisfaction

H2: Gender and sector of employment are mediator variables between digitalization and employee satisfaction

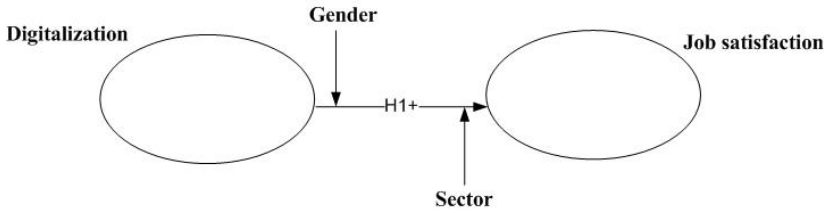

Figure 1
Theoretical model

2 Methodology

The main objective of this paper was to study the impact of workplace digitalization on older people' job satisfaction. The study sample were employees older than 55 in different organizations in the city of Bor, Serbia. Study was conducted between December 2022 and February 2023. Data were collected personally with the help of the questionnaire. The survey covered a total of 153 workers and all the questionnaires were properly completed. The demographic characteristics of the sample are described in Table 1: they were mostly females, with more than 30 years of work experience.

		Number	%
Gender	Male	70	45.8
	Female	83	54.2
Sector	Manufacturing	33	21.6
	Service	29	19.0
	Education	5	3.3
	Administration	30	9.6
	Other	56	36.6

Table 1.
Socio-demographic characteristics of the sample

The questionnaire is made up of two parts. The first part consists of 3 questions which lead to the socio-demographic data (gender. working experience in years and sector of employment). and the other part consists of 11 questions divided into 2 groups. digitalization and job satisfaction. Digitalization questions are taken from "Digital Transformation Readiness Survey Summary" by Center for Creative Leadership-Corporate Leaders. Employee Satisfaction questions are taken from "Thesis named "İşveren Markası ve İşveren Markasının Çalışan Memnuniyeti Üzerindeki Etkileri" by Meryem Demir. Bahçeşehir University (2014). Five-point Likert scale was used to assess the answers. where 1 means „I completely disagree". and 5 means „I completely agree".

The structural and measurement models are estimated using partial least squares structural equation modelling (PLS-SEM). an exploratory multivariate data analysis technique designed by Wold [20]. The structural models are assessed by examining coefficients of determination and the significance of the path models.

2.1 Measurement model

Measurement model assessment included establishing construct reliability and validity. Construct reliability was established through Cronbach's Alpha and Composite reliability (Table 2). The Cronbach alpha values for all the constructs

were higher than the recommended value of 0.700. For the assessment of convergent validity. the Average Variance Explained (AVE) was used. The data from Table 2 indicate that convergent validity is also achieved. taking into account that AVE for all constructs is above the threshold of 0.5 [21].

Indicator /Variable	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	AVE
Digitalization (WD)	0.896	0.902	0.895	0.633
Job satisfaction (JS)	0.901	0.914	0.900	0.607

Table 2.
Construct realiability and convergent validity

Hair et al. [22] argued that discriminant validity means that a construct measure is empirically distinctive and represents facts of interest that other measures in an SEM do not capture. A Fornell–Larcker criterion was used for discriminant validity. so the correlations among latent variables with the square root of AVE by each latent variable are presented in Table 3.

Variables	Digitalization	Job satisfaction
Digitalization (WD)	0.795	
Job satisfaction (JS)	0.644	0.779

Table 3.
Discriminant validity

The Fornell–Larcker criterion argues that the square root of AVE must be higher than the correlation of the construct with all other constructs in the structural model [21]. Table 3 indicates that the square root of AVE for all constructs is higher than the correlation among the considered constructs, indicating discriminant validity is achieved

SRMR and NFI are commonly used indicators for PLS-SEM in order to evaluate the appropriateness of the overall model. The range of the SRMR value is from 0 to 1. When SRMR is less than 0.08, it can be regarded as a good fit of the model. NFI is a non-statistical measure ranging from 0 (poor fit) to 1 (perfect fit). The higher the value of NFI indicator, the better the match. Good fitting is indicated by a value above 0.90 [23].The SRMR value of the model evaluation verification in this study is 0.063. Although the NFI value of 0.858 is less than 0.9, its value is somewhat below the threshold and it is assumed that it would increase with an increase in the number of respondents. Therefore, this indicator is acceptable in our model and the overall model is well-fitted in general

Indicators	Saturated model	Estimated model
SRMR	0.063	0.063
d_ULS	0.263	0.263
d_G	0.204	0.204
Chi-square	106.738	106.738
NFI	0.858	0.858

Table 4.
Model fit

2.2 Structural model

Since the validity and reliability of the constructs are empirically verified, the structural model can be evaluated. First, multi-collinearity was assessed using the Variance Inflation Factor (VIF). VIF values less than or equal to 5 [24] indicate no multicollinearity issues. With VIFs on the construct level ranging from 1.97 to 3.44, no collinearity issues bias the results (Table 5).

Item	VIF
JS1	3.440
JS2	2.955
JS3	2.173
JS4	2.295
JS5	1.961
JS6	1.834
WD1	2.360
WD2	2.743
WD3	2.565
WD4	2.585
WD5	2.809

Table 5.
VIF

The next step in structural model assessment is the evaluation of path coefficients, obtained via the bootstrapping procedure in SmartPLS 4 software (Ringle et al., 2022) and presented in Figure 2. The results show consistent significant positive coefficient between variables digitalization and job satisfaction. In that way hypothesis 1 was confirmed.

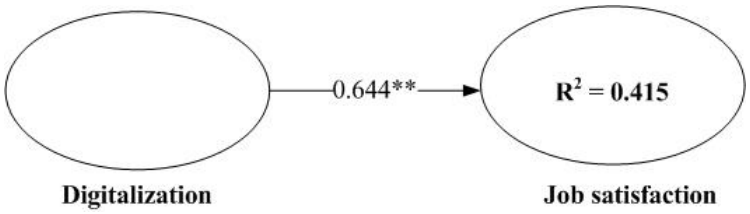

Figure 2.
The results of PLS-SEM

R^2 has been used to determine the explained variance of the latent dependent variable in relation to the overall variance. The cutoff R^2 values suggested by Chin (2009) are as follows: 0.190 weak, 0.333 moderate, and 0.670 substantial. According to the results in Figure 2, the overall model explained 41.5% of the variance in perceived satisfaction, so it can be said that some other factors have influence on this variable, but the model has a good predictive value.

3 Discussion

It is evident that there are certain stereotypes regarding older workers, who are thought to be less adaptable, less trainable, and less cost-effective than younger workers. On the other hand, according to the numerous studies older workers represent an educated, dependable, experienced, and stable workforce [27], so employeers should work harder in order to eliminate unfavorable age stereotypes [28].

The results obtained in this study indicate that workplace digitalization is predominantly beneficial: The higher the degree of digitalization, the higher is the older employee's job satisfaction. This results could seem surprising, since in the literature digitalization has been associated with increased efficiency, more multitasking, and less breaks, which as a result cause bigger pressure and stress [29,30]. One possible explanation is that older people do realize how digital tools actually help them to better organize job and save time and energy.

The relationship between technology use at work and employee satisfaction has been somewhat explored in the present literature, athough with inconsistent findings [6]. However, the obtained results are similar to [19,31,32} Unfortunately, further analysis didn't confirm the impact of gender and sector of employment as mediator variables, showing in that way that obtained results are not sensitive to respondents' gender or sector of employment.

This study confirmed that the usage of new technologies can increase job satisfaction and improve overall quality of work. However, the introduction of new technologies into workplace needs to accompanied by provision of training for all employees, especially older ones. The most recent data show that only 48.28% of

people aged 55–64 in Serbia are using computers [33], which is much lower compared to EU average (69.28%).

Conclusions

The purpose of this paper was to analyses the impact of workplace digitalization on older employees' job satisfaction. One of the main implications of this study is comprehension of the true value of older employees which could serve to employers to overcome the negative stereotypes about older workers and to see them us important resource.

Study also has some limitations. First one is that sample only included older employees from one country, hence partially restraining a generalization of the results. The other is that the questionnaire didn't include level of education of the employees, which could as moderator variable to some extent change obtained results. Future research aims to expand the sample to other countries and consider other variables, such as the level of education.

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References

[1] Fernando Almeida, Jose Duarte Santos, Jose Augusto Monteiro. (2020). The challenges and opportunities in thedigitalization of companies in a post-COVID-19 World. IEEE Engineering Management Review, 48(3), pp. 97-103.

[2] Anbreen Yasin, Sadia Hussain, Shafei Moiz Hali. (2022). Digitalization and firm performance: mediating role of smart technologies. Journal of Tianjin University Science and Technology, 55 (4).

[3] Sébastien Lechevalier, Malo Mofakhami. (2023). Analyzing the diverse impact of digital use on the job quality Comparing work organization and job satisfaction in Japan and France, Discussion Paper Series A, 740.

[4] Joerg Bueechl, Ralf-Christian Härting, Mara Schröder. (2021). Influence of Digitization on Employee Satisfaction in Small and Medium-sized Enterprises, 5th International Conference on Knowledge-Based and Intelligent Information & Engineering Systems, Procedia Computer Science 192, pp. 2753–2760.

[5] M. Dhanabhakyam, Emil Joseph. (2022). Digitalization and Perception of Employee Satisfaction during Pandemic with Special Reference to Selected Academic Institutions in Higher Education. Mediterranean Journal of Basic and Applied Sciences, 6 (1), pp. 51-63.

[6] Viswanath Venkatesh, Hillol Bala, Tracy Ann Sykes. (2010). Impacts of information and communication technology implementations on employees' jobs in service organizations in India: A multi-method longitudinal field study. Production and Operations Management, 19(5), pp. 591-613.

[7] Thomas W. H. Ng, Daniel C. Feldman. (2010). The relationships of age with job attitudes: A meta-analysis. Personnel Psychology, 63(3), pp. 677–718.

[8] Carolin Dietz, Pauline Bauermann, Hannes Zacher. (2022). Relationships between ICT Use for Task and Social Functions, Work Characteristics, and Employee Task Proficiency and Job Satisfaction: Does Age Matter? Merits,, 2, pp. 224-240.

[9] Lisa Katharina Kortmann, Julia Simonson, Claudia Vogel, Oliver Huxhold. (2022). Digitalisation and Employees' Subjective Job Quality in the Second Half of Working Life in Germany, Social Indicators Research, 162, pp. 577–597.

[10] Maja Rožman, Sonja Treven, Vesna Čančer, The impact of promoting intergenerational synergy on the work engagement of older employees in Slovenia, JEEMS, 25 (1) 2020, pp. 9 – 34.

[11] Dorien Kooij, Annet De Lange, Paul Jansen, Josje Dikkers. (2008). Older workers' motivation to continue to work: five meanings of age. A conceptual review'. Journal of Managerial Psychology, 23 (4), pp. 364– 394.

[12] Wendy Loretto, Phil White. (2006). Employers attitudes, practices and policies toward older workers. Human Resource Management Journal, 16 (3), pp. 313– 330.

[13] Deborah E. Rupp, Stephen J. Vondanovich, Marcus Crede. (2005). The multidimensional nature of ageism: construct validity and group differences. Journal of Social Psychology, 145 (3), pp. 335– 362.

[14] Sara Zaniboni, Donald Truxillo, Franco Fraccaroli, Elizabeth A. McCune, Marilena Bertolino. (2014). Who benefits from more tasks? Older versus younger workers. Journal of Managerial Psychology, 29 (5), pp. 523–508.

[15] Mark Visser, Jelle Lossbroek, Tanja Van der Lippe. (2021). The use of HR policies and job satisfaction of older workers", Work, Aging and Retirement, 7 (4), pp. 303-321.

[16] Jana Macken, J. (2019). Work stress among older employees in Germany: effects on health and retirement",PloS ONE, 14 (2), 0211487.

[17] Arla Day, Natasha Scott, Kevin E. Kelloway. (2010). Information and communication technology: implications for job stress and employee well-

being. In Perrewé, P.L. and Ganster, D.C. (Ed.) New Developments in Theoretical and Conceptual Approaches to Job Stress (Research in Occupational Stress and Well Being, Vol. 8), Emerald Group Publishing Limited, Bingley, pp. 317-350.

[18] Yam B. Limbu, Chinnappa Jayachandran, Barry J. Babin. (2014). Does information and communication technology improve job satisfaction? the moderating role of sales technology orientation. Industrial Marketing Management, 43(7), pp. 1236–1245.

[19] Thomas Bolli, Filippo Pusterla. (2022). Decomposing the Effects of Digitalization on Workers' Job Satisfaction. International Review of Economics, 69, pp. 263–300.

[20] Andreas H.O. Wold. (1982). Soft Modeling: The Basic Design and Some Extensions. In: Joreskog, K.G. and Wold, H.O.A., Eds., Systems under Indirect Observations: Part II, North-Holland, Amsterdam, 1-54.

[21] Claes Fornell, David F. Larcker. (1981). Evaluating structural equation models with unobservable variables and measurement error. Journal of Marketing Research, 18(1), pp.39–50.

[22] Joseph F. Hair Jr, Christian M. Ringle, C. M., Marko Sarstedt. (2011). PLS-SEM: Indeed a silver bullet. Journal of Marketing theory and Practice, 19(2), pp. 139-152.

[23] Luis Miguel Molina, Francisco Javier Llorens Montes, Ruiz Moreno. (2007). Relationship between quality management practices and knowledge transfer. Journal of Operations Management, 25, pp. 682–701.

[24] Joseph F. Hair Jr, G. Tomas M. Hult, Christiane M. Ringle, Marko Sarstedt, Nicholas P. Danks, Soumya Ray. (2021). Partial least squares structural equation modeling (PLS-SEM) using R: A workbook.

[25] Christian M. Ringle, Sven Wende, Jan-Michael Becker. (2022). SmartPLS 4. Oststeinbek: SmartPLS GmbH, http://www.smartpls.com.

[26] Wynne W. Chin. (2009). How to write up and report PLS analyses. In Handbook of partial least squares: Concepts, methods and applications , pp. 655-690. Berlin, Heidelberg: Springer Berlin Heidelberg

[27] Anselmo Ferreira Vasconcelos. (2015b). The contemporary experience of work: older workers' perceptions. Management Research Review, 38 (4), pp. 381–403.

[28] Steven Appelbaum, Richard Wenger, Carolina Pachon Buitrago, Ravneet Kaur. (2016). The effects of old-age stereotypes on organizational productivity (part three). Industrial and Commercial Training, 48(4), pp. 181–188

[29] Francis Green, Steven McIntosh. (2001). The intensification of work in Europe. Labour Economics, 8(2), pp. 291–308.

[30] Francis Green. (2004). Work intensification, discretion, and the decline in Well-being at work. Eastern Economic Journal, 30(4), pp. 615–625

[31] Rajnish Ratna, Kaur T. (2016). The impact of Information Technology on Job Related Factors like Health and Safety, Job Satisfaction, Performance, Productivity and Work Life Balance. Journal of Business and Financial Affairs, 5, pp. 171.

[32] Ludivine Martin, Nessrine Omrani. (2015). An Assessment of Trends in Technology Use, Innovative Work Practices and Employees' Attitudes in Europe'. Applied Economics, 47, pp. 623–638.

[33] Eurostat. (2023). Individuals' level of digital skills, accessed 15.04.2023.

The influence of age on digital literacy in Serbia

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Abstract: The development of information and communication technologies (ICT) has imposed the need for digital literacy and computer handling by employees at all organizational levels. Younger generations learn about ICT through formal and informal education, as well as through everyday activities. On the other hand, older employees have little or no experience with ICT technologies. Accordingly, improving their digital literacy, competencies, skills, and thinking is necessary. Only in this way will they be able to meet the needs of modern business.This study aims to investigate the level of use and knowledge of digital technology among Serbia's older population. The potential influence of age on people's digital literacy in Serbia was investigated. In addition, the PROMETHEE methodology was used in order to perform a comparative analysis of the different age groups of the population based on the level of ICT usage for different purposes in everyday life.

Keywords: digital literacy, age, digitalization, computer skills, Promethee methodology

1 Introduction

The main feature of the 21st century is rapidly growing digitalization. New technologies have significantly impacted the way of living and working. During the COVID-19 pandemics, the world faced with the intensive demand for Information-Communication Technologies (ICT) infrastructure and services. New circumstances created the need for a more intensive studies of the impact of socio-demographic characteristics on the population's digital literacy. Digital literacy includes a set of actions in order to reach the aim which is the acquisition of knowledge in the use of ICT – computers and Internet [1]. It refers to the skills required to live, learn, and work in a society where communication and information systems are fast changing due to digital technology. The abilities needed for

navigating a fragmented and complicated information system have been identified as digital skills [2].

A shortage of digital literacy and obstacles like difficult access to technology, telecommunications, information, and financial level are major contributors to an increasing multidimensional digital divide. The non-uses, or inefficient use of ICT, may lead to social exclusion. This fact must be considered in studies about how older people and marginal groups utilize new technologies [1].

ICT provides significant opportunities for all members of society, regardless of age. Digital technologies can help people gain new skills, live independently, and improve health and social care services for the elderly [3]. The ICT's enable this age group to access goods and services that otherwise would be more difficult to get: trips, services, online banking, online shopping, etc. Despite numerous benefits, there is still age-related digital divide. Senior citizens are still more reserved about adopting new technologies. The elderly still lags behind in using and benefiting from IT in general and the Internet in specific [4]. While the Internet is used by all or nearly all citizens from 25 to 34 years old, it is rare among the older generation in many European countries [5]. In the 28 countries of the European Union, 26 per cent of older adults (aged 65–74) use the Internet frequently compared to 88 per cent of people aged 16–24, 78 per cent of EU citizens, aged between 16 and 74, used the Internet for networking and information seeking [6]. This digital divide means that the elderly is prevented or disinterested to use and to exploit the potential of Internet usage and IT in general [7]. To address the digital demands of the elderly, a "multiage" society requires the design and creation of new areas of learning and communication.

Numerous studies have pointed to the existence of a link between the economic development of countries and the level of digital literacy, which is particularly noticeable when it comes to the elderly population and rural areas [8]. The digital gap affects many aspects of life in developing countries, limiting access to contemporary technologies but also preventing these countries from progressing further. Due to low digital literacy, many people in developing countries need more digital skills to utilize technology fully.

Republic of Serbia as the transition country is still under the process of digitalization. Digitalization is the most dynamic sector in the past ten years. Development of digital skills is defined by the Strategy of Digital Skills Development in the Republic of Serbia for the period 2020-2024, which implies the improvement of digital knowledge and skills of all citizens [9]. This is especially important for elderly if we take into account that the Republic of Serbia is characterized by the process of demographic aging of the population. Although the ICT sector is constantly growing, the communication infrastructure in the Republic of Serbia needs to be further improved, especially when it comes to the communication infrastructure in rural areas. Scientists in Serbia have begun to deal

more with the phenomena of digital literacy in the last decade, but the research is still rare and non-systematic.

This paper opens a particularly important topic – types of Internet usage among the age groups in Serbia. The authors specifically seek the answer to the question whether there are differences between younger and older population related the purpose of using the Internet. Thereby, two main objectives were specified: 1) to rank age groups according to their activities on the Internet and 2) to recognize Internet activities that should be affirmed and improved among older people.

2 Literature review

People of various ages, from teenagers to the elderly, use the Internet for various reasons, and their activities differ according to their interests. Teenagers are more engaged in online gaming, but those in their 20s and 30s use the Internet for social networking and searching for people. Older people use it to stay up to date on world events. However, little is known about the depth and breadth of technology use by older adults or whether it differs from younger adults' usage patterns [10].

Compared to other age groups, older persons are still less likely to use the Internet, and education is a major factor in Internet use among older adults [11]. Accordingly, the study of computer utilization by older people is growing since this demographic has considerably increased its use of information and communication technology (ICT) in everyday activities, personally and professionally [12]. Olson et al. (2011) conducted the research aimed to highlight age-related variances and similarities in technology usage and frequency [10]. Their findings provide insights into the technology-use behaviors of older and younger persons, giving an outline for expectations regarding knowledge differences. They concluded that younger persons employ a wider range of technology than older adults. In the literature, few reasons for age disparities in ICT literacy and learning could be find. First, there could be generational effects. Senior citizens did not grow up with digital technology. Therefore, they belong to a different technology generation than younger people [13]. Second, differences between young and old may be explained by factors other than changes in fluid intelligence. Individuals might have sensory and motor function issues as they age, which can harm ICT's learning process and user experience [14]. Finally, the physical and cognitive abilities of elderly persons vary.

According to Agudo et al. (2012), the elderly use ICT as a type of education that these generations of the elderly need and want to learn, and they consider this point in their lives as the appropriate time to approach ICT [15]. The elderly mostly utilizes the Internet to get information and to be familiar with news and current events (reading newspapers online). Russell et al. (2008) conducted an online

survey of older Australians (55+) [16]. They found that emailing improved satisfaction with family communication, enabling older adults to widen their close networks, and leading to in-person interactions. Other internet activities, such as browsing and online shopping, did not provide the same consequences as emailing. Except for utilizing the Internet for communication, the changes in social capital remained steady after a particular frequency of Internet use [17]. Barbosa et al. (2018) analyzed social capital and Internet use in old age and across age groups [18]. Older adults were less likely to have a high degree of social capital. Besides, frequent Internet users had higher levels than other users and non-users within this age range. The Internet appears to aid in preserving, accumulating, and mobilizing social capital. Proper training and support systems must be created based on seniors' aims, abilities, and experience to minimize computer anxiety and enhance motivation, particularly in the early stages of learning [19, 20].

3 Experimental

3.1 Data set

This analysis relies on the data from the report "Usage of Information and Communication Technologies in the Republic of Serbia, 2022", published by Statistical Office of the Republic of Serbia and online available [21]. This report contains the data of the extensive survey conducted among the population from RS. The focus of this study was on the question:

For which of the following activities did you use the Internet (including via apps) for private purposes, in the last three months?

The offered answers for this question were classified into five categories of internet activities: Communication (4 items), Access to information (2 items), Civic and political participation (2 items), Use of entertainment (5 items), E-health (4 items), Other online services (2 items) (Table 1). There were 6 age groups: a) 16-24, b) 25-34, c) 35-44, d) 45-54, e) 55-64, f) 65-74. The empirical analysis is based on the data for 2022.

ITEM	**Abbreviation**
Communication	
Sending/receiving e-mails	**COM1**
Telephoning over the Internet (via web cam) (using apps, such as Skype, Messenger, WhatsApp, FaceTime, Viber, Snapchat, Zoom, MS Teams, Webex)	**COM2**
Participating in social networks (creating user profile, posting messages	**COM3**

or other contributions on Facebook, Twitter, Instagram, Snapchat, etc.)	
Sending online messages via Skype, Messenger, WhatsApp, Viber, Snapchat	**COM4**
Access to information	
Finding information about goods and services	**INF1**
Reading online newspapers, magazines	**INF2**
Civic and political participation	
Posting opinions about civic or political issues via websites or social media (such as Facebook, Twitter, Instagram, Youtube)	**PART1**
Taking part in online consultations or voting to define civic or political issues (urban planning, signing petitions)	**PART2**
Use of entertainment	
Listening or downloading music (web radio, music streaming)	**ENT1**
Watching television program over the Internet from TV broadcasters	**ENT2**
Watching video on demand from commercial services (such as Netflix, HBO GO, Amazon Prime, Maxdome, Apple TV, etc.)	**ENT3**
Watching video content via sharing services (such as YouTube)	**ENT4**
Playing or downloading games	**ENT5**
E-health	
Seeking health-related information	**EHEA1**
Making an appointment with a doctor over website or app	**EHEA2**
Online access to own medical record	**EHEA3**
Using other medical services over website or app instead of going to hospital or doctor (such as obtaining prescription or online consultations)	**EHEA4**
Other online services	
Selling goods or services over website or app (such as eBay, Facebook, Marketplace)	**OTH1**
Internet banking (including mobile banking)	**OTH2**

Table 1

The offered answers and their abbreviations

3.2 Methodology

PROMETHEE method is one of the newest methods in multi-criteria analysis, and is known as one of the most effective and the simplest in this field. It was developed by Jean-Pierre Brans and Bertrand Mareschal. For the purpose of this study, PROMETHEE method was used in order to rank the age groups depending on the type of the internet activities that the respondents usually do. The analysis was performed using the Decision Lab software, as a sophisticated application of the PROMETHEE method.

4 Results and discussion

The initial step in this analysis was the use of the entropy method in order to determine the relevant weights for each indicator. On the basis of such allocation of weights and by using the PROMETHEE method, the order of age groups presented in Table 2 was obtained.

Rank	Age groups	Phi	Phi+	Phi-
1	25-34	0.551	0.776	0.225
2	16-24	0.292	0.642	0.350
3	45-54	0.214	0.607	0.393
4	35-44	0.112	0.556	0.444
5	55-64	-0.395	0.292	0.687
6	65-74	-0.775	0.107	0.881

Table 2

Ranking results

It can be seen that, on the first place are people from the 25-34 years old and on the last the oldest respondents. The members of the 25-34 age group use the internet very intensive and for all purposes (Figure 1). They are very active users and the only activities with negative are related to the E-health – (*Online access to own medical record*) and Access to information (*Reading online newspapers, magazines).* Young people, 16-24 years old are on the second rank, and the most interested in communication and entertainment (Figure 2).

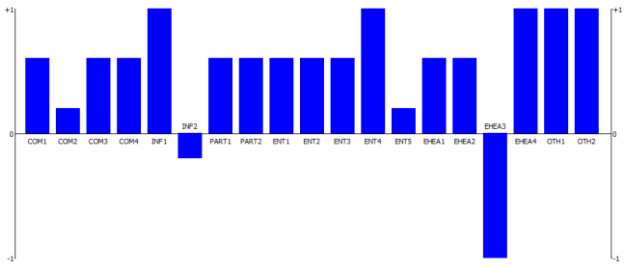

Figure 1

Profile for age group 25-34 years

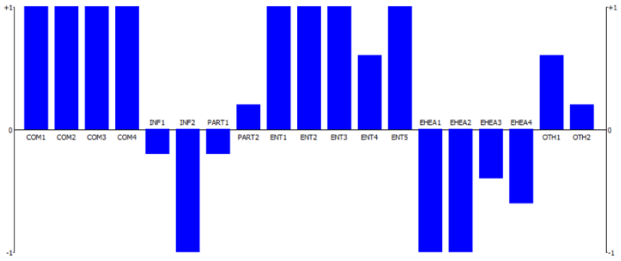

Figure 2

Profile for age group 16-24 years

Respondents in their 45-54 hardly use the Internet for the entertainment and communication. They are usually focused on the e-health. This group read the magazines and newspaper, make online consultations or vote (Figure 3). The next age group (respondents between 35 and 44 years) mostly use the internet for the following activities: gathering information about goods and services, reading the newspapers and magazines, posting opinions about civic or political issues, selling goods and services and usage of Internet banking (Figure 4).

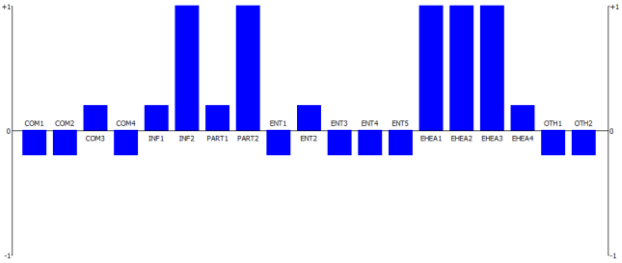

Figure 3

Profile for age group 45-54 years

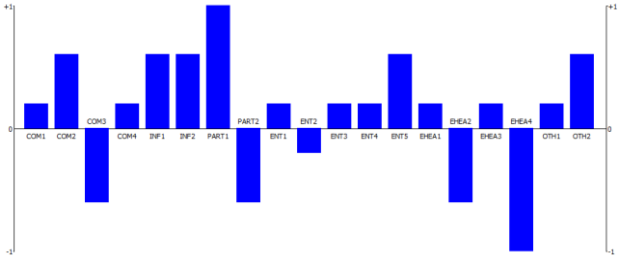

Figure 4

Profile for age group 35-44 years

Taking into account the negative Phi values, deficiencies in the Internet activities among 55+ age group have been proven. When it comes to the population 55-64

years old, all internet activities are characterized as negative except reading newspaper or magazines and using the medical services over website or app instead of going to hospital or doctor (Figure 5). The same is with the oldest who are just making appointments with a doctor over website or app and access to own medical record online (Figure 6). This opens the door to interventions that could give support to older adults' learning and Internet appropriation processes, getting them started on the web.

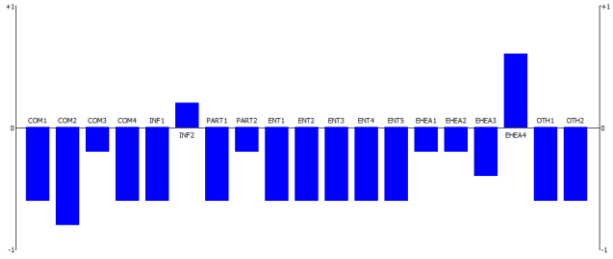

Figure 5
Profile for age group 55-64 years

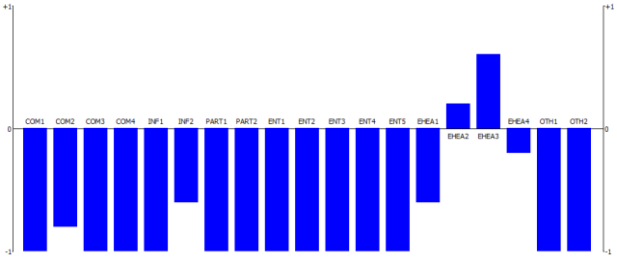

Figure 6
Profile for age group 65-74 years

The results given above talks about the nineteen different activities over the Internet, divided in five fields, for different age groups of people. In-depth information about various Internet activities revealed age inequalities. The adolescents and people of early 30's realize frequent and various Internet activities as the entrainment, gathering information, communication, online shopping etc. In the adolescent time everyone is eager to learn more. Individuals in their late 30's and early 50's are generally less active on the Internet, as most of them might be busy in their corporate life and personal life. Also, the purpose for using the Internet has been changed. They use the Internet much less for communication, entertainment, downloading and playing online games, but the product research, online banking and E-health is a bit more that in the case of individuals from the previous groups.

Finally, in this study, skill deficiencies for the older population have been highlighted. Older adults are still less likely to adopt the Internet when comparing to other age groups [11]. There is no clear definition of an older or senior citizens and existing studies use different thresholds for the empirical analysis. According to the extensive literature review conducted by Oh et al. (2021), most of the authors suggest the population 50+ [22]. Accordingly, we considered the age groups: 55–64, 65–74 and more than 75 as elderly. When it comes to these age groups, all internet activities are characterized as negative except reading newspaper or magazines and using the medical services over website or application instead of going to hospital or doctor. The same is with the oldest who are just making appointments with a doctor over website and access to own medical record online. Health care in particular is a domain in which older adults adopt the Internet as a useful tool [23]. They hardly use internet activities for communication, entertainment, civic and political participation, online shopping, etc.

Access to innovation and new technologies is vital for avoiding generational divides and ensuring that the elderly do not feel excluded from modern society [15]. Besides, there are many factors that affect the digital literacy of the older population. According to Ragnedda and Mutsvairo (2018), the ICT access depends on their purchasing power or management capacity [24]. Older adults are one of the least likely demographic groups to have a computer in their homes. Considering the low pensions in Serbia, Internet usage will be greater if they could buy computers and Internet packages for more favorable prices. Besides, social capital and level of education determine the frequency of Internet use [11, 18].

Previous studies indicated that the older population often shows an interest in learning about computers. Still, they are determining their ability to succeed, especially when using the Internet [25-27]. The process of learning something new differs between younger and older people [28]. This implies that specialized learning activities for senior adults should be devised. Training programs aimed at improving the ICT abilities of the elderly can help them overcome their skepticism about new technology. Accordingly, there is a need to support older persons' digital learning and adoption of Internet knowledge and get them started online.

Conclusions

Obtained results point to the conclusion that policymakers in Serbia should have in mind the age differences and adjust the policies to support education of the elderly in the field of digital knowledge. The bearers of economic policy and economic development policy in Serbia realized the importance of ICT late. They needed to be sufficiently aware of the challenges that arise for every economy from the growing global competitiveness of developed countries. The main problem is that there needs to be a necessary level of sophistication and awareness in the state

administration when it comes to institutionalizing the problem of the digital divide. In the absence of such institutionalization, any efforts to reduce the country's digital divide carry a huge risk of failure and ineffectiveness of the financial resources used. The experience of developed countries shows that the digital divide problem is challenging to fit into the general context of a country's economic policy. That is why it is simpler to treat this problem through a large number of local government bodies that cover the areas of education and economic development. In order to make progress in bridging the digital divide, economic policymakers must be well aware of the potential of information technologies.

Obtained empirical results lead to potentially important policy recommendations. Based on the results from previous research and this study, we argue that it is important to invest more in training, education, and support for older adults who face difficulties with ICT and to consider diverse learning preferences in the conception of technology trainings. Training programs designed to improve ICT skills of older population can in general help them to overcome concerns and doubts related to new technology. It is also necessary to accredit digital skills development programs for citizens, particularly taking into account vulnerable categories such as the elderly, persons with disabilities, poor citizens and persons in rural areas, with continual citizens' awareness-rising of the need to adopt digital skills.

Senior citizens should be trained as much as possible in basic digital skills, which include learning the basics of how smartphones and the Internet work together to deliver applications, information, and messages, including skills to set up new accounts and create passwords, research, search, download, and using online and mobile applications. This training could be implemented in premises such as retirement clubs, libraries, homes for the elderly, etc. Positive effects could also be achieved through peer education so that trained older persons carry out further training in basic digital skills.

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References

[1] Baigorri Artemio, Chaves Mar, (2005) The Digital Lireracy of older Citizens in Extremadura (Spain).

[2] Eshet Yoram, (2004) Digital literacy: A conceptual framework for survival skills in the digital era. Journal of Educational Multimedia and Hypermedia, 13(1), pp. 93–106

[3] UNECE - United Nations Economic Commission for Europe (2021) Guidelines for Mainstreaming Ageing. United Nations, Geneva

[4] Niehaves Björn, Ralf Plattfaut, (2014) Internet adoption by the elderly: employing IS technology acceptance theories for understanding the age-related digital divide. European Journal of Information Systems, 23(6), pp. 708-726

[5] Eurostat, (2022) Available online https://ec.europa.eu/eurostat/web/products-eurostat-news

[6] Eurostat, (2015) Internet use – Report for 2014. Available online: https://ec.europa.eu/eurostat

[7] Bèlanger France, Carter Lemuria, (2009) The impact of the digital divide on e-government use. Communications of the ACM, 52(4), pp. 132–135.

[8] Botrić Valerija, Božić Ljiljana, (2021) The digital divide and E-government in European economies. Economic Research - Ekonomska Istraživanja, 34(1), pp. 2935-2955.

[9] Official Gazette of the RS, "Strategy of Digital Skills Development in the Republic of Serbia for the period 2020-2024, No. 21/20

[10] Olson E. Katherine, Marita A. O'Brien, Wendy A. Rogers, Neil Charness, (2011) Diffusion of Technology: Frequency of Use for Younger and Older Adults. Ageing International, 36(1), pp. 123–145.

[11] Barbosa Neves Barbara, Fausto Amaro, Jaime R. S. Fonseca (2013) Coming of (old) age in the digital age: ICT usage and non-usage among older adults. Sociological Research Online, 18(2), pp.6.

[12] Tatnall Arthur, (2014) ICT, education and older people in Australia: A socio-technical analysis. Education and Information Technologies, 19, pp. 549–564

[13] Sackmann Reinhold, Winkler Oliver, (2013) Technology generations revisited: the internet generation. Gerontechnology, 11, pp. 493–503.

[14] Barnard Yvonne, Bradley D. Mike, Hodgson Frances, Lloyd D. Ashley, (2013) Learning to use new technologies by older adults: Perceived difficulties, experimentation behaviour and usability. Computers in Human Behavior, 29 (4), pp. 1715-1724

[15] Agudo M. Susana, Ángeles Pascual, Javier Fombona, (2012) Uses of Digital Tools among the Elderly. Scientific Journal of Media Education, pp. 193-201

[16] Russell Cherry, Campbell Andrew, Hughes Ian, (2008) Research: ageing, social capital and the internet: findings from an exploratory study of Australian 'silver surfers'. Australasian Journal on Ageing, 27(2), pp. 78–82.

[17] Sum Shima, Mark. R. Mathews, Mohsen Pourghasem, Ian Hughes, (2008) Internet technology and social capital: how the internet affects seniors' social capital and wellbeing. Journal of Computer-Mediated Communication, 14 (1), pp. 202–220

[18] Barbosa Barbara Neves, Jaime R. S. Fonseca ,Fausto Amaro ,Adriano Pasqualotti, (2018) Social capital and Internet use in an age-comparative perspective with a focus on later life. PLoS ONE, 13(2), e0192119.

[19] Kim Young Sek, (2008) Reviewing and critiquing computer learning and usage among older adults. Educational Gerontology, 34(8), pp.709–735

[20] Mayhorn Christopher, Aideen J. Stronge, Anne Collins, McLaughlin Wendy Anne Rogers, (2004) Older adults, computer training, and the systems approach: a formula for success. Educational Gerontology, 30(3), pp.185–203

[21] Statistical Office of the Republic of Serbia "Usage of Information and Communication Technologies in the Republic of Serbia, 2022" Available online: www.stat.gov.rs

[22] Oh Sarah Soyeon, Kyoung-A Kim, Minsu Kim, Jaeuk Oh, Sang Hui Chu, JiYeon Choi, (2021) Measurement of Digital Literacy Among Older Adults: Systematic Review. Journal of Medical Internet Research, 23(2): e26145

[23] Taha Jessica, Sharit Joseph, Czaja Sara, (2009) Use of and satisfaction with sources of health information among older Internet users and nonusers. Gerontologist. 49(5), pp. 663-673.

[24] Ragnedda Massimo, Bruce Mutsvairo (2018), Digital Inclusion: Empowering People Through Information and Communication Technologies (ICTs), In Ragnedda, M., and Mutsvairo, B. (eds) Digital Inclusion. An International Comparative Analyses, London: Lexington Book, pp. 7-10

[25] Huggins Robert, Hiro Izushi, (2002) The digital divide and ICT learning in rural communities: examples of good practice service delivery. Local Economy, 17(2), pp. 111-122.

[26] Dickinson Anna, Roos Eisma, Peter Gregor, Audrey Syme, Scott Milne, (2005) Strategies for teaching older people to use the world wide web. Universal Access in the Information Society, 4(1), pp. 3–15.

[27] Pan, Shuya, Jordan-Marsh Maryalice, (2010) Internet use intention and adoption among Chinese older adults: from the expanded technology acceptance model perspective. Computers in Human Behaviour, 26, pp.111-19.

[28] Schlomann Anna, Even Christiane, Hammann Torsten, (2022) How older adults learn ICT—guided and self-regulated learning in individuals with and without disabilities. Fronters of Computer Science, 3, 803740.

Social and Economic Sustainability from the Perspective of SMEs

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Abstract: Sustainability has been identified as an essential area of development for listed companies due to the corporate law initiative presented by the EU in 2021. This paper aims to grasp how SMEs can respond to stakeholders´ economic sustainability and responsibility demands. Regarding social responsibility, this study adopts the United Nations SDG declarations that implementing human rights forms the basis of social responsibility. In the Finnish context, economic responsibility has been referred to issues such as preventing corruption and a grey economy. This is supported by the recent EU Whistleblower Directive (2019/1937), which aims to facilitate anonymous reporting of abuses. This paper is based on the project of Green Responsibility´s case study research. As a result, we present a sustainability service model for SME accounting firms and their customers that provides neutral sustainability data or reports, e.g., for SMEs to gain a competitive advantage.

Keywords: corporate sustainability report, service model, SME, sustainability

1 Introduction

Sustainability has been acknowledged as an essential area of development for listed companies. So far, sustainability reporting has been obligatory for listed companies that employ more than 500 people in the EU. In recent years, small and medium-sized enterprises and SMEs' stakeholders (i.e., customers, employers, financers) have also started to require sustainability actions. In addition, if SMEs want to grow and collaborate with public companies, their partners will likely require sustainability verification or documentation in the future due to the corporate law initiative presented by the EU in 2021. Regardless of the increasing responsibility demands of SMEs, sustainability reporting has been optional for small and medium-sized companies. In addition, sustainability scholars have been mainly focused on investigating the environmental impacts of larger firms (e.g., pollution, recycling, energy, water, textiles), while SMEs' economic and social sustainability has received less scholarly attention. Moreover, scholars still need to find solutions regarding how SMEs can respond to the various demands of sustainability issues. Noteworthy, according to Chowdhury and Shumon [1], smaller firms account for most businesses in all countries worldwide. For example, more than 99 percent of European enterprises are SMEs, generating more than 85 percent of new employment in Europe. Thus, it is evident that achieving social sustainability in SMEs will be vital for society. It has also been argued that socially sustainable companies generally perform better than other companies that need to adequately maintain these practices, as these non-participating firms suffer from a negative reputation and a loss of brand value. Therefore, implementing social sustainability is essential for SMEs to maintain their competitiveness. [1] and create social capital [2], which is also crucial for SMEs [3].

The main objective of this study is to understand how SMEs can respond to the various stakeholders (e.g., large corporations) sustainability and responsibility demands. In more detail, we focus on economic and social responsibility in SME business as they are great enablers and drivers of environmental responsibility. Moreover, environmental sustainability is researched more substantially than economic and social sustainability why this study focuses on economic and social sustainability in SMEs. The theoretical framework of this study is based on the published and cited scientific research [11] [12] [13] [16] [17] [19] on both economic and social responsibility. Regarding social responsibility, this study adopts the United Nations SDG declarations that implementing human rights (e.g., equality, education) forms the basis of social responsibility. In addition, corporate purpose defines a company´s ground and execution in economic responsibility. Moreover, economic responsibility has been referred to issues such as preventing corruption and a grey economy. This is also supported by the recent EU Whistleblower Directive (2019/1937), which aims to facilitate anonymous reporting of abuses.

The questions related to economic and social responsibility are linked to the firm's corporate purpose, which can vary between enterprises. The limited company's operations aim to generate profit for the shareholders unless the articles of association stipulate otherwise. Moreover, an SME can decide its corporate purpose, e.g., in Finland. However, this aspect has not been much acknowledged in the scientific and societal discussion, as most people assume that profit maximization is the firm's sole purpose. [5] [6].

In designing sustainable service models for accounting SMEs, several sustainability frames such as ESG (Environmental, Social, Governance), GRI (Global Reporting Initiative), and ESRS (European Sustainability Reporting Standards) were compared to have a more comprehensive understanding of their emphasis on social and economic sustainability in this study. Findings disclosed the need for more precise, transparent, and unanimous comparable principals with social and economic sustainability as frames emphasize slightly different angles from SMEs' perspectives.

2 Theoretical background

Hart [4] pointed out that ensuring sustainability is on enterprises´ shoulders at the same time when patterns of policy innovations and consumptions move to sustainability. He refers that companies lead the way and pursue sustainability by helping to shape public policy and driving consumers´ behavior.

As Herzig et al. [7] state, the company's stakeholders demand information about the economic, ecological, and social goals. It can be said that the stakeholders determine the company's purposes. Therefore, the company should be able to provide information about sustainability-relevant issues by giving a corporate sustainability report (CSR reporting). There are many essential goals of sustainability reporting. One of them is informing stakeholders about non-financial issues that secure the legitimation of corporate activities that create environmental and social impacts. Another goal is to gain a competitive advantage. The third important goal is to increase corporate reputation and brand value. [7]. Currently, when there is no mandatory legislation to produce a comparable sustainability report, comparing the impacts between the companies is difficult.

When considering the possible economic effects of corporate sustainability reporting, we should also reflect on the impacts of mandatory reporting – if and when corporate sustainability reporting becomes compulsory for all companies. Christensen et al. [8] found the economic consequences of corporate sustainability reporting. These consequences include effects on capital markets and company behavior. The study suggests that mandatory corporate sustainability reporting can potentially improve information to investors and other stakeholders. [8]. The report content and the sustainability indicators should be standardized to make the

sustainability information comparable between companies. This leads to better decisions by investors.

Mandatory corporate sustainability reporting can also change the companies' business operations; stakeholders' demands can cause pressure on companies with a high reputation to expand and adjust their sustainability activities. Mandatory corporate sustainability reporting tends to improve a company's sustainability performance. Therefore, stakeholders can have a significant effect on companies' behavior. [8]. The sustainability and responsibility of companies' supply chains must also be reported to prevent the transfer of harmful activities abroad.

Regarding social responsibility, this study adopts the United Nations SDG declarations that implementing human rights (e.g., equality, education) forms the basis of social responsibility. In addition, economic responsibility has been referred to issues such as preventing corruption and a grey economy, and solid financial responsibility forms the basis of the responsibility of SMEs. EU´s Corporate social reporting directive [9] drives SMEs to have comparable corporate sustainability reports to describe social and economic sustainability levels and vision for the future of SME´s business and as a strategic management tool. The equable reporting sustainability model enables reporting objectively, confirming transparency.

2.1 Economic responsibility

Traditionally, business education and universities have taught that the primary purpose of a company is always to generate as much profit as possible [10]. And only from this perspective, the financial responsibility of companies is considered to override issues related to social or environmental responsibilities [11]. The financial responsibility of companies clearly and consistently discloses the company's reliability. The company's financial success and good economic indicators strengthen its image and reputation in the direction of its stakeholders. As per the findings of the Bank of Finland [12], businesses are concerned about inflation and rising expenses, including loan interest rates. According to Statistics Finland [13], energy costs are a significant cause of worry for companies and the decreasing purchasing power of customers and consumers. In companies, it is necessary to update cash flow calculations and forecasts and to take sufficient measures in time for adequate cash flow. Companies that have managed their financial responsibility will have priority in the availability of skilled labor. According to Sirkiä [14], companies should offer up-to-date personnel training to update skills and achieve new competencies, thus supporting the company's competitive advantage. The company's responsible operation and reporting enable a broader interest of financiers and investors, thus allowing more significant investments and the company's growth and success.

Every company aims to operate its business cost-effectively. This ensures the company's survival and satisfies its owners. However, as with any business, obstacles involving stakeholders must be identified and resolved. The upcoming

Corporate Responsibility Act is seen as a mandatory challenge for companies brought by the public authorities. This has been seen to cause cost pressure in companies. The company often perceives the legislation as unfavorable, making it difficult to survive in the competition. However, the company competes for customers' euros with companies in the same industry. The Corporate Responsibility Act treats all entrepreneurs in the industry in the same way. Thus, it does not weaken the position of an individual company and creates identical boundary conditions for all companies. The company's management has a significant impact on the company's responsibility. If the company is managed responsibly, it is usually managed well anyway. Responsibility starts from the company's strategy and the values of the management and the board representing the company's owners. In addition, the company's culture plays a significant role in responsibility: how does responsibility appear in the company's culture [15]?

2.2 Social responsibility

Human rights form the foundation of social sustainability. According to the United Nations [16], human rights mean that people have a right to be treated with dignity, and human rights are inherent in all human beings, whatever their nationality, place of residence, sex, national or ethnic origin, color, religion, language, or any other status. Every individual is entitled to enjoy human rights without discrimination. These rights are all interrelated, interdependent, and indivisible. [16]. The first six of the UN Global Compact's principles focus on the social dimension of corporate sustainability, of which human rights are the cornerstone. Social sustainability entails the human rights of specific groups: labor, women's empowerment, gender equality, children, indigenous peoples, and people with disabilities, as well as people-centered approaches to business impacts on poverty. In addition, social sustainability encompasses issues affecting them, for example, education and health. (United Nations) [17].

Supply chain social sustainability is concerned with the human side of sustainability. It refers to the practices and ways firms address issues related to the health, safety, career progression initiatives, freedom, and welfare of the people associated with the supply chain [1]. According to Wolf [18], nine leading indicators of social sustainability are (1) a healthy and safe work environment, (2) an acceptable minimum wage, (3) the specification of maximum work hours, (4) freedom to join an employee union, (5) a policy for child labor, (6) suitable living conditions, (7) non-discrimination, (8) a clear policy for corporate disciplinary practices, and (9) a policy for forced labor. In addition to the organizational side, social sustainability is also concerned with advocating for the local community and culture. SMEs' Social sustainability practices can include community development programs, poverty reduction programs, ethical and fair employment policies, and childcare and healthcare facilities [1].

Noteworthy, even though the stakeholders of SMEs and the legal initiatives by the EU have indirectly started to require sustainability issues from SMEs, SMEs face various challenges regarding measuring and implementing social sustainability. For example, a lack of resources and awareness and external problems, such as the non-existence of a tailored social sustainability standard for SMEs and lack of institutional support, are the challenges SMEs face regarding their society [1]. However, research has disclosed that social sustainability is also critical for SMEs.

2.3 Whistleblower Directive (2019/1937)

The Directive (EU) 2019/1937 of the European Parliament and of the Council of 23 October 2019 on the protection of persons who report breaches of Union law (the "Whistleblowing Directive") was introduced to establish secure internal and external reporting channels in different organizations. According to the Whistleblowing Directive [19], private and public organizations must offer whistleblowers a safe channel for reporting. One of the critical aspects of EU directives is accountability, transparency, and risk prevention. In promoting these principles, the task and role of the Whistleblower directive [19] has become significant. Responsibility is one key value that EU directives aim to promote. The Whistleblower Directive's anonymous reporting service can be used to reveal activities that are against ethical principles or environmental standards. The possibility of reporting detected abuses and illegalities in companies and organizations helps ensure that companies and organizations follow responsible practices. Protecting whistleblowers and encouraging them to report unethical activity is essential to promoting accountability.

Transparency is another important aspect of the implementation of EU directives. The role of the whistleblowing service in promoting transparency is emphasized, as abuses revealed through the service can play a significant role in the public review of the organization's operations. In addition, the importance of risk prevention is substantial, as employees can detect and report potential risks in time. Notification channels offer the opportunity to report, for example, security deficiencies, environmental harm, or data security breaches that might otherwise go unnoticed. This helps organizations react quickly and effectively before risks cause more serious financial or other harm.

3 Empirical case study

The research group defined the first preliminary research methods to achieve the goals set at the start of the project in autumn 2021. In that definition, qualitative and applied design science research methods were used. This analysis focuses on corporate responsibility for small and medium-sized enterprises (SMEs). Using a design science research method, we aim to determine the importance and influence

of corporate responsibility factors on SMEs' current operations and future profitability. In this context, the aim is to understand and describe the needs of SMEs under natural conditions.

When a situation is crucial, a case study is appropriate for reinforcing, challenging, or broadening the associated theory. It is also useful for analyzing deviations from norms, investigating everyday occurrences, and exploring previously inaccessible revealing phenomena. Case studies cover holistic and embedded models. In holistic planning, the global nature of the case is checked, and in embedded planning, several subunits are studied. [20] The applied design science research method aims to provide practical solutions to real-world problems by testing theories and considering the culture of the object being studied. Its results include an explanatory section that outlines the research's framework, objectives, process, and legitimacy. [28].

The qualitative research method is characterized by timelines, locality, and process flow, and participants are selected appropriately, or the research may have other limitations. By collecting data, the researcher gives a clue about the subjective thinking used in the study. [20]. The qualitative research method has many traditions, approaches, and ways of collecting and analyzing data. The analysis is based on real-life experiences, opinions, and visions. It is holistic data collection, where the researcher acts as a tool in phenomena and filtering real-world results through the researcher. [23]. Using the qualitative research method, the author actively creates knowledge in the data collection context. The data collected in this way is context-specific, which means that the same reality may appear different to the respondents, i.e., there may be several realities. Participants are asked open-ended questions, and the topic may change based on the answers. [20] [22] [23].

Qualitative research using a positivist approach is well-suited for examining complex and elusive phenomena arising from globalization. The contextualized nature of qualitative research allows for unexpected events to be accounted for, resulting in comprehensive descriptions of reality that consider various variables, relationships, meanings, and processes. Qualitative research is contextualized, which means it can account for unexpected events and provide comprehensive descriptions of reality. This type of research considers various variables, relationships, meanings, and processes. It focuses on the epistemological identification of regularities and generalizable observations of this reality. Ontologically, it assumes that external reality is difficult to measure but observable. Methodologically, it emphasizes carefully designing and implementing theoretical models and proposals. Positivist qualitative research produces new concepts and theories based on several data forms on complex current phenomena. The challenge in positivist qualitative research is the long time, commitment, and access to research objects for in-depth analysis. [22].

The challenge in qualitative research data collection methods is impartiality and forming the basis for accurate and reliable data. The subjectivity of group methods can be problematic, so group methods are often limited to new phenomena about

which little is known. [24]. In the case of an interview, the primary form of the question is an open-ended question. Questions can be asked by discussing the theme, as there are no critical points in the qualitative research method, but the interpretation is divided along the study's timeline. [21]. This study utilized various data collection methods to gain insight into the SMEs' perspective on directives, including document analysis, observation, unstructured surveys, thematic interviews, group interviews, and workshops. Research methods were used to answer questions on increasing SMEs' awareness and understanding of corporate responsibility. This study focuses on the question of how SMEs could respond to the demands of economic and social responsibility.

The research team and the authors occasionally defined and specified the research question set in the first phase. During the discussions, the authors emphasized the importance of refining and iterating the research question. Their goal was to gain fresh insights into how SMEs can respond to the demands of corporate responsibility, considering both the social and economic aspects of responsibility. The primary method was to compare and benchmark the responsibility and evaluation models related to the topics, such as ESG and SDG. In addition, sustainability reporting surveys already in use by other organizations were compared and analyzed, including questions concerning economic and social responsibility factors. From a national perspective, national laws and decrees indirectly related to responsibility, such as the Accounting Act and the Waste Act, were examined and analyzed. After analyses and comparisons, co-creation methods were chosen, focusing on the service design method. First, a survey of SMEs' current state of responsibility awareness was carried out using an unstructured survey. The current state survey charted how corporate responsibility currently affects the business operations of similar SMEs, how SMEs define green financial statements, what SMEs know about the Corporate Responsibility Act and the Sustainability Directive, and what sustainability reports SME accounting firms offer to their clients.

Based on the preliminary study, the research group decided to use group interviews to map the needs and requirements of SMEs related to corporate responsibility in more detail—the group interviews aimed to reach at least 40 participants from different companies focusing on accounting companies. In December 2021, the first group interview workshop was held. Seven group interview workshops on corporate responsibility, green financial statements, and sustainability reporting were held by the end of 2022. Research and development are often combined in business development and university project cooperation, for example, because research-oriented action is needed. Considering both parties ' goals, research-based development is halfway between research and development. Research-based service design fits into this field of research-based development. [26].

Service design can be used to implement internal and external business challenges, such as strategic initiatives or operational challenges, from a research perspective. In this approach, the objective is to solve business challenges, balance them with

the organization's capabilities, and clarify the view of the phenomenon or challenge to achieve the objectives. The starting point of service design is an external perspective to achieve actual business goals, considering the organization's capabilities. [25].

Based on the group interview workshops and the preliminary studies, the research group developed a corporate responsibility service for accounting firms aimed at SMEs and to increase awareness and understanding of corporate responsibility to meet the needs of SMEs. The service was designed using the co-creation service design method. Service design method workshops have been held five times for SMEs. The service designed with the help of service design (service descriptions and blueprints, which include, among other things, the customer's service path) was tested by SME accounting firms. Feedback was collected from the testing, based on which the service model was further developed. Subsequently, to describe the economic and social responsibility of the service model from the perspective of SMEs, sections were formulated for a corporate responsibility survey that SMEs could use as part of the financial statements to describe the level of economic and social responsibility. Group discussions and small group workshops were utilized in the iteration of the corporate responsibility survey to obtain as comprehensive feedback as possible and to specify the service model related to the corporate responsibility survey.

4 Results

The study is based on a case study research based on the project of Green Responsibility by LAB University of Applied Science and the Laurea University of Applied Science. Our project team has thoroughly analyzed various methods for measuring and evaluating sustainability, focusing on transparency and comparability. One of the tools we tested was the SDG assessment tool. The SDG framework has proven to be a valuable assessment tool for governments and global corporations, as it has contributed to improving sustainability levels in developed countries regarding poverty and hunger. However, the guidelines for SMEs need to be more comprehensive. Communicating sustainability data to stakeholders is crucial as it can transform into a competitive advantage. One way to do this is by publishing a sustainability report that consolidates all relevant data into a single document. Economic and social responsibility elements can also provide a competitive edge for SMEs. Our study proposes a sustainability service model for SME accounting firms and their clients, which aims to provide objective and unbiased sustainability data to enhance competitiveness.

During autumn 2021, a survey was conducted by sending open-ended questions on responsibility to 120 accounting firms. The survey had a response rate of 22.5%, with a total of 27 respondents. The study aimed to determine what types of

sustainability reports accounting firms to provide to their clients and assess SMEs' awareness of the upcoming EU Corporate Responsibility Act, which would define green financial statements. Additionally, the survey aimed to gather the respondents' views on how corporate responsibility impacts a company's operations and services. According to the study, only five accounting firms provided sustainability-related information or reports to their SME clients, and each report was unique. Respondents were more aware of the upcoming EU Corporate Responsibility Act, with 16 having some knowledge, but only five had detailed knowledge of the subject. About 12 respondents had an idea of what a green financial statement could be, while others needed more information or were still waiting to provide an answer. Four respondents claimed that responsibility did not affect their business, while the remaining respondents acknowledged the importance of stakeholder responsibility in business development and promoting social responsibility. The study found that considering sustainability positively affects future services and stakeholder cooperation. However, the price increase has raised concerns about the effect of responsibility on companies' profitability and future growth. In the spring of 2022, a survey was conducted for clients of accounting firms. Unfortunately, only five responses were received. Of those five, two respondents were aware of the development of the EU Corporate Responsibility Act and Directive. At the same time, the remaining three had varying opinions on the definition of green financial statements and their impact on operations. One respondent felt that sustainability-related reports were unavailable, while the other four highlighted environmental, social, and business impacts. Based on the provided answers, the research group conducted thematic interviews to understand better SMEs' needs and perspectives on added value, including social and economic responsibility.

During the first group theme interview workshop, 24 participants discussed responsible financial statements that could benefit everyone and the sustainability needs of SMEs. They examined various aspects such as taxation, employee well-being, training, personnel financial statements, working conditions, and internal and external responsibility development. As the discussion progressed, the participants delved into responsibility risk management, taxes, information security, wages, indirect logistics costs, financing support mechanisms, and personnel financial statements from an economic perspective. They also highlighted the importance of social responsibility, including training plans, collective agreements, employee well-being, fair treatment, labor market effects, and personnel responsibility.

In February 2022, a group theme interview was conducted to discuss the added value of responsibility. This was a follow-up to a previous discussion on the same topic. From the perspective of SME financial responsibility, the group identified competitiveness, improved risk management, taxes, and investors' shares as essential factors. On the other hand, the added value of social responsibility was seen as meeting stakeholders' demands for transparency, boosting employment, promoting equality and social justice, and setting a positive social example.

During the third workshop of the group theme interview, the focus was on how sustainability impacts the future of Small and Medium Enterprises (SMEs). It was discussed that considering responsibility in business operations is an excellent way to influence society, giving companies an advantage in recruiting a skilled workforce. Achieving this requires training for SME personnel and a change in attitude. Additionally, expert services should be produced to ensure better customer service.

During the fourth group theme interview, the discussion revolved around risk management and how to measure economic and social responsibility in terms of sustainability for SME stakeholders. The conversation highlighted various business risks such as inflation, financial challenges due to the coronavirus, personnel engagement, and sick leave. Existing factors that determine responsibility were identified, including energy consumption, sick leave, waste management, accidents, procurement, and the shadow economy. Seven companies participated in a survey regarding green financial statements, where the most important social responsibility indicators were staff absences due to illness, staff turnover, and training days. The most critical measurable factors of financial responsibility were taxes paid, investments, and the proportion of women and men in top management. Respondents also suggested measurable economic and social responsibility factors that SMEs could report, such as sickness absences, occupational accidents, the proportion of women and men in the workforce, fixed-term employment contracts, age structure, and training days. For financial responsibility indicators, the current systems could report taxes paid by tax type, state subsidies, gender diversity in senior management, and corporate fines paid.

During the autumn of 2022, the fifth group theme interview focused on the requirements of accounting firms to meet the sustainability needs of small and medium-sized enterprises (SMEs). Personnel's responsibility and competence were emphasized as customers sought expertise. This is particularly relevant to SMEs, who are increasingly interested in sustainability training and the risk of greenwashing. To address this, it is necessary to implement a responsible service model that incorporates economic and social responsibility perspectives, enabling SME personnel to communicate the benefits of responsibility. However, there are challenges related to uncertainty around sustainability reporting, upcoming directives, regulations, and legislative amendments. Furthermore, the sustainability awareness and needs of various SME stakeholders vary. As a result, financial and social responsibility reporting sections can serve as essential tools for strategic business planning.

The research group conducted group theme interviews, surveys, and benchmarking of previous responsibility frameworks, models, and sustainability reports to create a corporate responsibility survey. They held a mutual group workshop to define economic and social indicators, key figures, and questions for the survey. The workshop considered responses received since autumn 2021 and the impact of ESG, GRI, SDG, and especially CSRD. Using responsibility models and tools, the group

analyzed what SMEs should prioritize in their corporate responsibility survey to meet stakeholder demands. The research group focused on questions supporting SME responsibility, which can be answered using existing systems. This information allows SMEs to set development targets and monitor their sustainable development. The survey questions were divided into themes and data collecting.

Financial responsibility involves information on paid and unpaid enterprises, direct and indirect taxes, and fulfilling statutory commitments. The section on financial obligation emphasizes transparency and proper management of corporate governance to increase stakeholder trust. It also considers factors such as employee salaries, benefits, opportunities for input on company administration, redundancies, and profitability. A corporate responsibility survey evaluates the company's profitability, liquidity, and solvency, along with social responsibility factors such as equality, employment terms, working conditions, education, safety, and diversity. Based on survey responses, the company can develop a social responsibility strategy, set goals, and adjust its development plan to strengthen its responsible business practices.

Green Sustainability is a project to support small and medium-sized accounting companies in implementing sustainable practices. Through co-creation, benchmarking, and service-design tools, the sustainability service model enables companies to assess their current sustainability levels and develop plans for improvement in areas such as human rights, equality, financing, and funding. To achieve this, the project includes a corporate responsibility questionnaire with 50 questions that help companies assess their current sustainability practices and set goals for the future. Based on assessments and analyses conducted by a survey firm, vital data about social and economic sustainability levels and progress can be effectively presented through comprehensible and straightforward maps. This enables the identification of sustainability objectives and targets for the future. Moreover, interpretive factors serve as more comprehensive and in-depth explanations of sustainability and its reporting, such as the reasons behind the current state of sustainability and what needs to be addressed to enhance its level soon.

Conclusions

The importance of economic and social responsibility is emphasized as the EU Corporate Responsibility Act and the Sustainable Development Directive develop more precisely and expand to include the SME sector. Currently, SMEs in the value chains of large companies must present sustainability factors to stakeholders and members of the value chain. The social significance of SMEs as promoters of responsibility is significant through their large number and employment. By identifying and developing economic and social strategic priorities, SMEs can identify their significance and set sustainability goals for their business. By acting proactively in areas of responsibility, an SME can create a competitive advantage

in recruitment, for example. When economic and social responsibility is well implemented, it will likely affect both environmental responsibility and profitability positively.

Different responsibility frameworks, evaluation models, and tools for assessing financial and social responsibility exist. Currently, the most effective of these in the EU is the Sustainability Reporting Directive adopted by the EU in December 2022. In the future, it will be modified to cover a broader range of enterprises in 2025, 2027, and 2028, according to current information. The Directive's due diligence will focus on the number of people affected and how to remedy the situation in areas such as human rights, fundamental freedoms, gender equality, pay gaps, and accessibility measures so that social responsibility information will be presented, for example as part of SME reporting, will increase.

The Green Sustainability project formulated the factors to be emphasized regarding economic and social responsibility in the Corporate Responsibility Survey for Small and Medium-sized Enterprises. The aim of preparing the economic and social questions of the corporate responsibility survey was to focus on factors that can be answered with existing data. Both sections contain factors that focus on quantitative data related to economic and social responsibility, and factors that explain the data are presented in the responsibility reporting. Numerical factors contributing to SME sustainability data can be categorized as green financial statements, and factors explaining quantitative sustainability data can be classified as matters included in sustainability reporting. With the help of these, an SME can draw up a responsibility development plan, set economic and social responsibility goals, monitor responsibility development, and compare sustainability development within the same industry. This will increase awareness and development opportunities in the areas of responsibility, economic and social responsibility. In addition, SMEs reporting on responsibility gain added value for their stakeholders from their responsible operations. This allows them to improve their customer service in a more versatile way. Corporate responsibility issues, directives, laws, and regulations are incomplete and continue to evolve.

It should be noted that the research is limited to the needs of small and medium-sized enterprises in one EU Member State and EU and national regulations. However, the EU Sustainable Development Directive's due diligence obligation covers the value chains of prominent companies operating in the EU, extending to subcontractors in non-EU countries and indirectly linked stakeholders. Furthermore, the UN 2050 Programme and its associated SDGs have a global impact. Cultural differences must also be considered as constraints both nationally and within companies.

Some potential research areas to explore could involve expanding the scope of similar research within and beyond Europe while considering the requirements of EU directives regarding uniformity and comparability. Additionally, it could be beneficial to investigate different analytical models, processes, and data mining

techniques that can help collect and use clear, consistent, and comparable data to support the attainment of the 2050 Agenda.

References

[1] Chowdhury, P. & Shumon. R.: Sustainability Minimizing the Gap between Expectation and Ability: Strategies for SMEs to Implement Social Sustainability Practices, Sustainability 2020, 12 (16), pp. 6408; https://doi.org/10.3390/su12166408.

[2] Nahapiet, J. Ghoshal, S.: Social Capital, Intellectual Capital, and the Organizational Advantage, The Academy of Management Review 23(2), 1998. DOI: 10.2307/259373.

[3] Ciambotti, M. Palazzi, F.: Social capital and SMEs: An exploratory case study, Journal of International Business and Economics, 2015, 15(2), pp. 53-64, http://dx.doi.org/10.18374/JIBE-15-2.4.

[4] Hart, S.: Beyond Greening: Strategies for a Sustainable World, Harvard business review on green business strategy, 2007, 99.

[5] Leinwand, P. Mainardi, C.: Strategy That Works: How Winning Companies Close the Strategy-to-Execution Gap, Harvard Business Review Press, 2016, EBSCOhost, search.ebscohost.com/login.aspx?direct=true&db=e076mww&AN=1798414&site=ehost-live.

[6] Mackey, J. Rajendra, S.: Conscious Capitalism, With a New Preface by Authors: Liberating the Heroic Spirit of Business, Harvard Business Review Press, 2014, EBSCOhost, search.ebscohost.com/login.aspx?direct=true&db=e07mww&AN=675250&site=ehost-live.

[7] Bennet, M. Burritt, R.: Sustainability Accounting and Reporting Corporate Sustainability Reporting, An Overview, In a book by Schaltegger, S., Springer, 2006, pp. 301-302.

[8] Christensen, H.B., Hail, L. & Leuz, C.: Mandatory CSR and sustainability reporting: economic analysis and literature review, Rev Account Stud 26, 1176–1248, 2021, https://doi.org/10.1007/s11142-021-09609-5.

[9] Document 32022L2464, Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting (Text with EEA relevance), 2023, http://data.europa.eu/eli/dir/2022/2464/oj.

[10] Fontrodona, J. & Sison, A.: The nature of the firm, Agency Theory and Shareholder Theory, A Critique from Philosophical Anthropology, Journal of Business Ethics, 2006, 66, pp. 33–42.

[11] Carroll, A. B.: Carroll´s Pyramid of CSR: Taking Another Look. International Journal of Corporate Social Responsibility 1, 3, 2016. URL: http://jcsr.springeropen.com/articles/10.1186/s40991-016-0004-6.

[12] Bank of Finland, Euribor interest rates, 2022, URL: https://www.suomenpankki.fi/fi/Tilastot/korot/.

[13] Statistics Finland, Electricity price by consumer type, 2022, URL: https://www.stat.fi/tilasto/ehi#graphs.

[14] Sirkiä, J.: Leveraging digitalization opportunities to improve the business model. Lappeenranta: Lappeenranta–Lahti University of Technology LUT, 2020, URL: http://urn.fi/URN:ISBN:978-952-335-560-6.

[15] Turunen, J.: Exploring the Relationship between Corporate Financial Performance and Corporate Social Performance with Net Impact Method, Tampere University, Faculty of Management and Business, 2021, URL: https://urn.fi/URN:ISBN:978-952-03-2137-6.

[16] United Nations.: The Corporate Responsibility To Respect Human Rights, United Nations Human Rights Office of the High Commissioner, 2012, URL: https://www.ohchr.org/sites/default/files/Documents/publications/hr.puB.12.2_en.pdf.

[17] United Nations.: Global Compact, Do Business in Ways that Benefit Society and Protect People, 2023, URL: https://unglobalcompact.org/what-is-gc/our-work/social.

[18] Wolf, J.: The relationship between sustainable supply chain management, stakeholder pressure, and corporate sustainability performance, Journal of Business Ethics, 2014, 119, pp, 317–328.

[19] European Union.: Whistleblower Directive (2019/1937). Official Journal of the European Union, L 305/17, 2019, URL: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019L1937&from=EN.

[20] Gupta, RK. Awasthy, R.: Qualitative Research in Management: Methods and Experiences. New Delhi: SAGE Publications India Pvt, Ltd.; 2021.

[21] Taylor, S.J.: Introduction to Qualitative Research Methods: A Guidebook and Resource, John Wiley & Sons, Incorporated, 2015, ProQuest Ebook Central, https://ebookcentral.proquest.com/lib/laurea/detail.action?docID=7104054.

[22] Cassell, C. et al.: The SAGE Handbook of Qualitative Business and Management Research Methods: History and Traditions, 55 City Road, London: SAGE Publications Ltd, 2018, Sage Research Methods, DOI https://doi.org/10.4135/9781526430212.

[23] Cassell, C. Buehrins, A. Symon, G. editors: Qualitative methods in management research, Emerald Publishing Limited, 2006, ProQuest Ebook Central, https://ebookcentral.proquest.com/lib/laurea/detail.action?docID=258136.

[24] Cassell, C. et al.: The SAGE Handbook of Qualitative Business and Management Research Methods: Methods and Challenges, 0 vols. 55 City Road, London: SAGE Publications Ltd, 2018, Sage Research Methods, DOI https://doi.org/10.4135/9781526430236.

[25] Reason, B. et al.: A Practical Guide to Optimizing the Service Design for Business Customer Experience, John Wiley & Sons, Incorporated, 2015. ProQuest Ebook Central, https://ebookcentral.proquest.com/lib/laurea/detail.action?docID=4305714.

[26] Moilanen, T. Ojasalo, K. Ritalahti, J.: Methods for Development Work New Kind of competencies in business operations, Helsinki, Finland, BoD-Books on Demand, 2022, https://www.ellibslibrary.com/reader/9789528058090.

[27] SDG Assessment tool SDG Impact Assessment Tool, 2022, https://sdgimpactassessmenttool.org/en-gb.

[28] Peffers, K. Tuunanen, T. Rothenberger, T.M. & Chatterjee, S.: A Design Science Research Methodology for Information Systems Research, Journal of Management Information Systems, 2007, 24:3, 45-77, DOI: 10.2753/MIS0742-1222240302.

The role of AI in higher education

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Abstract: The use of information and communication technology (ICT) in higher education can have a significant impact on the quality of education. This paper explores how ICT can enhance learning outcomes, increase accessibility, improve collaboration and communication, and offer personalized and flexible learning experiences. Chatbots and artificial intelligence (AI) are discussed as powerful tools for providing personalized assistance and support to students with diverse learning needs and styles. The paper also highlights the challenges of teaching individuals with neurodiverse conditions and the importance of adapting teaching strategies to meet the needs of each student, calling attention to the fact that by using inclusive language and creating an inclusive learning environment, educators can leverage the power of ICT and AI to create a more equitable and effective learning experience for all.

1 Introduction

The integration of Information and Communication Technology (ICT) into higher education has become a topic of discussion in recent years. As technology advances, educational institutions have an opportunity to adapt to new learning trends and equip students with skills that align with the modern workplace. While some argue that ICT can revolutionize higher education by providing greater access to education and enhancing the quality of instruction, others claim that it is an ineffective and costly approach that fails to address the fundamental issues facing higher education today. In this essay, we will explore the role of ICT in higher education, examining its potential benefits and drawbacks (Alonso-Garcia et al., 2019).

On the one hand, proponents of ICT argue that it can revolutionize higher education by providing greater access to education. With the availability of technology, online courses and programs have become a popular option for students. ICT can allow students to participate in courses and programs from remote locations, which can be particularly beneficial for students who live in rural or isolated areas, have mobility issues, or cannot attend traditional classes due to work or family commitments. Additionally, ICT can provide greater flexibility and convenience for students who need to balance their studies with other commitments, such as work or family responsibilities. Moreover, ICT can enhance the quality of instruction by allowing for more interactive and engaging learning experiences. ICT can provide

opportunities for collaborative learning, interactive lectures, and real-time feedback, which can enhance student engagement, motivation, and learning outcomes (Pinto, Leite, 2020).

On the other hand, opponents of ICT argue that it is an ineffective and costly approach that fails to address the fundamental issues facing higher education today. ICT can be expensive to implement, requiring significant investment in technology infrastructure, software, and training for faculty and staff (Krezic et al., 2021). Additionally, ICT can be difficult to integrate into existing teaching and learning practices, and it can be challenging to ensure that all students have access to the necessary technology and equipment. Furthermore, there is a concern that online courses may not be as rigorous as traditional courses, leading to a lower quality of education (Raccanello, et al., 2021).

Despite these concerns, it is essential to note that the integration of ICT into higher education has already started to shape the future of education. As technology continues to advance, educational institutions must adapt to new learning trends and equip students with skills that align with the modern workplace. ICT offers numerous opportunities for students to learn and develop skills that are essential for the 21st-century workforce. With the help of ICT, educational institutions can provide personalized learning experiences, enhance student engagement and motivation, and promote lifelong learning.

In conclusion, while the role of ICT in higher education has its potential benefits and drawbacks, the integration of technology into education is inevitable. Educational institutions must adapt to new learning trends to equip students with the skills necessary for the modern workforce. While ICT may not be a perfect solution to the challenges facing higher education, it offers numerous opportunities for students to learn and develop essential skills. The key to success is to strike a balance between traditional and modern teaching methods and leverage technology to enhance the quality of education.

2 The use of ICT in higher education

Information and Communication Technology (ICT) can be used in higher education in several ways to enhance the quality of education and improve access to learning opportunities.

ICT can increase access to higher education for students who may not have access to traditional educational opportunities. For example, online courses and programs can be delivered asynchronously, allowing students to study at their own pace and convenience. This can be particularly beneficial for students who are working or have other responsibilities that make it difficult to attend traditional classes (Paudel, 2021). ICT can also facilitate collaboration and communication between students and instructors, which can improve the quality of education. For example, collaboration tools, such as discussion forums and video conferencing, can provide

students with a platform to ask questions, share ideas, and work together on assignments. This can help students develop critical thinking and problem-solving skills, as well as improve their understanding of course material.

ICT is also able to help to offer students more flexibility and convenience, allowing them to study at their own pace and convenience. For example, mobile learning allows students to access educational resources and tools through their mobile devices, which can be particularly useful for students who are on-the-go. This flexibility and convenience can make it easier for students to balance their academic studies with other responsibilities, such as work or family obligations. Through this, modern day ICT can provide students with personalized learning experiences, which can improve learning outcomes. For example, big data and analytics can be used to track student progress and identify areas where students may need additional support. This information can be used to provide individualized feedback and support, helping students improve their academic performance (Sadeghi, 2019).

All in all, ICT is providing an opportunity for enhanced learning outcomes. It enables the provision of a more engaging and interactive learning experience, which can improve learning outcomes. For example, multimedia tools, such as videos and simulations, can help students visualize complex concepts, making it easier for them to understand and remember the material. ICT can also provide personalized learning experiences, allowing students to learn at their own pace and receive individualized feedback, which can help them improve their academic performance (Ali, Abdel-Haq, 2021).

There is a multitude of tools that can enable the aforementioned positive outcomes, such as online courses, collaboration and communication through ICT, interactive multimedia tools, that would not have been possible without ICT. However, recent advances, such as the AR or VR, or mobile learning may enhance the user /student experience and through it the learning process of students. However, ICT is not only there to become the tool and channel of learning, but it can also support the teachers and administrators with big data analytics or systemic solutions such as the LMS.

- Online courses and programs: Online courses and programs use ICT to provide students with access to educational content, resources, and tools through the internet. These courses can be delivered asynchronously or synchronously, depending on the design of the course. Asynchronous courses are self-paced, allowing students to work through the material at their own pace, while synchronous courses require students to attend virtual classes in real-time. Online courses and programs can be delivered through a learning management system (LMS), which provides a centralized platform for instructors to create, manage, and deliver course content.
- Collaboration and communication tools: Collaboration and communication tools, such as video conferencing, instant messaging, and social media, can be used to facilitate communication and collaboration between students and instructors. These tools provide students with a platform to ask questions, share ideas, and work together on projects and

assignments. Collaboration and communication tools can also be used to provide students with real-time feedback, helping them improve their understanding of course material and their overall academic performance.

- Interactive and multimedia tools: Interactive and multimedia tools, such as videos, simulations, and games, can be used to engage students and help them develop critical thinking skills. These tools provide students with a more dynamic and engaging learning experience, helping them retain information more effectively. Interactive and multimedia tools can also be used to promote collaborative learning, allowing students to work together to solve problems and complete assignments.
- Virtual and augmented reality: Virtual and augmented reality technologies can provide students with immersive learning experiences that allow them to explore complex concepts and ideas in a more interactive and engaging way. These technologies can be used to simulate real-world scenarios and provide students with hands-on learning experiences. For example, virtual reality can be used to simulate laboratory experiments or fieldwork, allowing students to explore and experiment with different concepts in a safe and controlled environment (Radianti et al., 2021).
- Mobile learning: With the increasing availability of mobile devices, mobile learning has become a popular option for students. Mobile learning uses ICT to provide students with access to educational resources and tools through their mobile devices. This allows students to learn on-the-go, at their own pace and convenience (Chao, 2019). Mobile learning can also promote collaboration and communication, allowing students to work together on projects and assignments regardless of their location.
- Big data and analytics: Big data and analytics can be used to track student progress, identify learning gaps, and personalize the learning experience for individual students. These technologies provide instructors with data-driven insights that can help them improve the quality of their teaching and support students who may be struggling. Big data and analytics can also be used to track student engagement and monitor student performance, providing instructors with actionable insights that can be used to improve the learning experience for all students (Aldowah, Al-Samarraie, 2019)
- Learning management systems (LMS): An LMS is a software application that provides instructors with a platform to manage, track, and deliver educational content to students. LMS platforms typically include features such as course materials, assessments, discussion forums, and grading tools. LMS platforms can also provide analytics and reporting features that allow instructors to track student progress and identify areas where students may need additional support (Chen, Almunawar, 2019).

3 AI in higher education

While traditional ICT provides access to information and communication tools, AI goes beyond that by providing analytical capabilities, personalization, automation, and predictive analytics to support student learning. By leveraging AI in higher education, teachers can gain insights into student performance, provide personalized learning experiences, and offer targeted interventions to support student success (Bates et al., 2020).

AI is primarily concerned with analyzing and processing data to provide insights that can improve learning outcomes. Since AI has the capability to analyze large volumes of data generated from various sources such as student records, learning management systems, and online assessments, AI can provide insights to teachers to help them identify areas where students need support, monitor student progress, and offer personalized learning experiences (Ma, Siau, 2018). AI-powered tutoring systems can provide individualized support and feedback to students. These systems can adapt to a student's learning pace and style and provide immediate feedback and guidance. AI-powered assessments can even adapt to a student's performance, providing more challenging questions as they demonstrate mastery of a topic, and less difficult questions when they struggle. This enriches the potential role of ICT in higher education, since traditional ICT provides access to data and communication tools but lacks the analytical power that AI offers (Popenici, Kerr, 2017).

Traditional ICT provides tools to access and share information but does not provide personalization features to the extent that AI can (Vincent-Lancrin, van der Vliies, 2020). AI has the capability to provide personalized learning experiences based on the data it collects and analyzes. For example, an AI-powered learning system can adapt to a student's learning pace, provide targeted feedback on areas where the student needs to improve, and recommend learning materials based on the student's interests and learning style. AI can even automate certain tasks such as grading assignments, providing feedback, and even answering common student questions. What is more AI is available around the clock to answer questions and provide support to students, even outside of normal class hours (Ouyang, Zheng, Jiao, 2022).

One of the most important reasons for employing AI in education is that it can provide predictive analytics that can help teachers identify students who are at risk of falling behind and provide targeted interventions to support them. AI can analyze data on student performance, attendance, and engagement to identify students who are struggling and recommend targeted interventions to help them catch up. Predictions can also be based on patterns recognised through machine learning regarding students from certain demographic groups or a specific combination of traits leading to hardships in various field of studies.

4 AI for different learning styles

According to 's learning styles, there are four main learning styles: concrete experience, reflective observation, abstract conceptualization, and active experimentation. Each of these learning styles represents a different way in which individuals learn and process information. Artificial intelligence (AI) has the potential to support and enhance the learning experience for students with different learning styles (Stankovic et al, 2021).

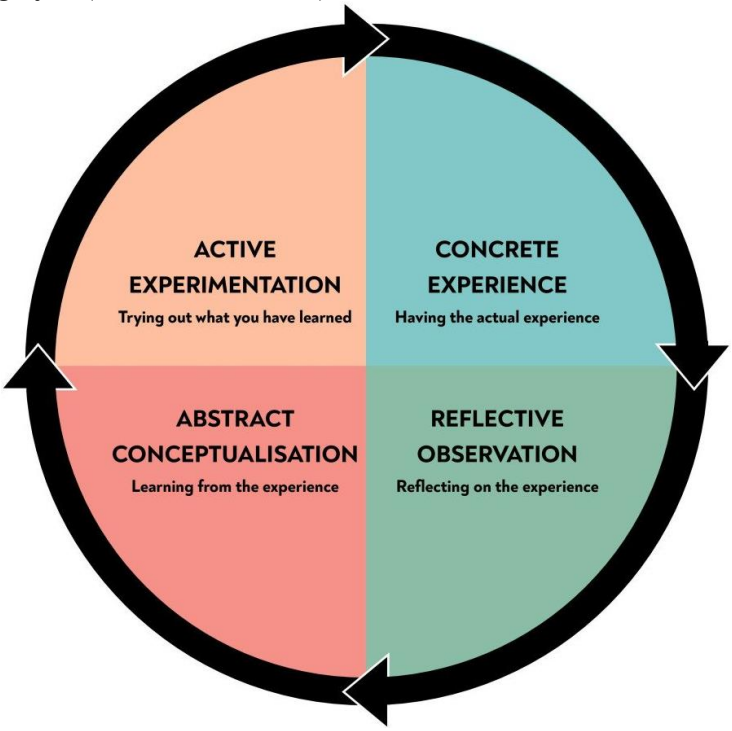

Figure 1

Source: https://www.simplypsychology.org/learning-kolb.html

For students who prefer concrete experience, AI can provide interactive simulations and virtual environments that allow them to engage with and explore new concepts in a hands-on way (Goel, 2021). These students may benefit from AI-powered chatbots that provide immediate feedback and support, helping them to build on their existing knowledge and develop new skills.

Reflective observers may benefit from AI-powered tools that allow them to review and reflect on their learning experience. For example, AI-powered analytics can provide insights on their learning progress and identify areas where they may need additional support (Fromm et al, 2021). This can help them to develop a deeper understanding of the material and identify ways in which they can improve their learning outcomes.

Students who prefer abstract conceptualization may benefit from AI-powered tools that provide personalized recommendations for learning materials and activities (Buyuksoy, Tascioglu, Ergin, 2020). By analyzing data on their learning preferences and performance, AI can recommend resources and activities that align with their individual learning style and help them to build on their existing knowledge.

Finally, students who prefer active experimentation may benefit from AI-powered simulations and games that allow them to apply their learning in a practical way. AI can provide real-time feedback and support, helping them to develop their skills and knowledge in a dynamic and engaging way (Estevez, Garete, Grana, 2019).

As described in this chapter, AI has the potential to support and enhance the learning experience for students with different learning styles (Bursac, Milosevic, Mitrovic, 2019). By providing personalized and interactive learning experiences, AI can help to improve student engagement, motivation, and outcomes, and ensure that all students have access to the tools and resources they need to succeed.

5 Chatbots, the virtual teachers

A chatbot is a computer program that simulates human conversation through text or voice interactions with users. It uses artificial intelligence and natural language processing techniques to understand and respond to user queries and provide assistance. A chatbot uses NLP to understand the meaning of user input and generate responses that are relevant and meaningful. Through its program a chatbot can recognize the intent behind a user's query and provide appropriate responses. After having recognized the users' intent, a chatbot can personalize responses based on user preferences, learning style, and history. For example, a chatbot can recommend learning materials based on a student's interests and previous interactions. Overall, a chatbot is a powerful tool that uses AI and NLP techniques to provide personalized and immediate assistance to students, enhancing their learning outcomes and academic performance.

However, or especially chatbots, and often AI in general is feared by teachers not only in higher education. Some teachers fear that chatbots could replace human interaction in the classroom, leading to a loss of personal connections between teachers and students. It is especially so, if technostress is highly prevalent in the life of the teachers, since technical issues may also be a concern for teachers who are not familiar with the technology and may not know how to use it effectively (Prebawaningsih, 2013).

Nevertheless, even teachers with high technology readiness may have some concerns regarding the use of chatbots in education. Teachers may be concerned about the accuracy of information provided by chatbots, as they rely on algorithms and data sets, which may not always be comprehensive or up-to-date (Zawacki-Richter et al., 2019). There may also be concerns about the privacy and security of

student data, as chatbots require access to personal information in order to provide personalized assistance.
These concerns, however, are not shared by students. All they see is the availability of immediate easy and cheap information support. A chatbot can provide assistance 24/7, ensuring that students have access to support even outside of regular office hours. A chatbot can provide students with access to study materials such as course readings, videos, and tutorials. It can also provide immediate feedback and assessment to students. A chatbot can support multiple platforms such as web, mobile, and social media, providing students with access to assistance anytime and anywhere. A chatbot can even support student engagement by giving reminders on upcoming deadlines, events, and activities.
However, a chatbot does not necessarily has to be a foe. It cannot only assist students, but also teachers with their everyday tasks. A chatbot can generate insights and analytics on student interactions, allowing teachers to identify areas where students need additional support and improve the quality of assistance provided. A chatbot can automate certain tasks such as grading assignments, providing feedback, and answering common student questions, saving teachers time and reducing their workload. By leveraging the features of a chatbot, educational institutions can provide students with an innovative and engaging learning experience, ultimately leading to better academic outcomes and increased success. Implementing chatbots in the classroom may require significant investment in technology and training, which may be a barrier for some institutions. Nevertheless, the application of certain AI solutions cannot be neglected since the students are already employing them in their everyday learning.

6 AI for students with learning difficulties

One of the most important roles of teachers is to enable people with less than favourable background or disabilities to still engage in and successfully complete higher education. In line with this it requires dedication and also extra efforts to provide educational opportunities and support for disadvantaged or marginalized groups in order to help them catch up with their peers and achieve greater social and economic mobility. Especially so, since learning difficulties can make it challenging for individuals to succeed in traditional educational settings. Accordingly, teachers have to pay extra attention to students with disabilities and have to have personalised study plans and materials for them However, advances in artificial intelligence (AI) are opening up new possibilities for supporting and empowering individuals with different types of learning difficulties(Campbell, 2022).
AI can help by providing text-to-speech and speech-to-text tools that can help individuals to access and create written materials, which is a great assistance for people with dyslexia. (Dyslexia is a common learning difficulty that affects an individual's ability to read and write.) Additionally, AI-powered apps and games

can help to build phonemic awareness and reading skills. The same applies to students with dyscalculia, which is a learning difficulty that affects an individual's ability to understand and work with numbers. AI can help by providing personalized math tutoring through adaptive learning algorithms and game-based learning activities (Di Fria, 2021).

However, AI is not only a way to support people with perception-based constraints but can also help students with specific physical impairments and also for individuals with neurodiverse conditions.

Individuals with visual impairments may have difficulty accessing visual materials such as diagrams and graphs. AI can help by providing audio descriptions of visual materials and tactile diagrams that can be 3D printed. Additionally, AI-powered assistive technologies such as smart glasses can help individuals to navigate their environment and access information more easily.

Teaching individuals with neurodiverse conditions can be challenging because each individual has unique strengths, weaknesses, and learning styles. What works for one individual with a neurodiverse condition may not work for another, and teachers need to be able to adapt their teaching strategies to meet the needs of each individual. This requires a deep understanding of the individual's condition and its impact on their learning, as well as a willingness to try different approaches and strategies. Another challenge of teaching individuals with neurodiverse conditions is the potential for social stigma and discrimination. Individuals with neurodiverse conditions may face negative stereotypes, attitudes, and behaviors from others, which can affect their self-esteem, motivation, and engagement in learning. Teachers need to be aware of these challenges and work to create a safe and inclusive learning environment that respects and values neurodiversity.

Finally, it can be challenging to provide the necessary accommodations and support for individuals with neurodiverse conditions within the constraints of traditional educational systems. Many individuals with neurodiverse conditions may require specialized materials, technology, or instructional methods to support their learning, and these resources may not always be readily available or accessible (Zheng et al, 2021). Teachers need to advocate for their students and work with other professionals and support staff to ensure that the necessary accommodations and support are provided. AI, however, is able to effectively support teachers in this regard too.

Individuals with Autism Spectrum Disorder (ASD), who may struggle with social interactions and communication, AI can help by providing social skills training through virtual reality (VR) simulations and chatbots that can simulate real-world scenarios. AI can also provide personalized feedback and support to help individuals improve their social interactions. Individuals with Attention Deficit Hyperactivity Disorder (ADHD) who may have difficulty with attention and concentration, AI can help by providing personalized reminders and schedules to help individuals stay on task. Additionally, AI-powered learning tools can provide immediate feedback and support to help individuals stay engaged and motivated.

All in all, AI has the potential to provide tailored and effective support for individuals with different types of learning difficulties. By providing personalized learning experiences, enhancing accessibility, supporting communication and social skills, providing reminders and feedback, and building specific skills through targeted interventions, AI can help individuals to overcome their learning difficulties and achieve their full potential.

Summary and conclusion

In summary, the use of ICT in higher education can contribute to the quality of education by enhancing learning outcomes, increasing accessibility, improving collaboration and communication, providing personalized learning experiences, and offering flexibility and convenience. By leveraging the power of technology, educational institutions can provide students with a more engaging and effective learning experience, ultimately leading to better academic outcomes and increased success. Chatbots, in particular, can provide students with personalized assistance and support that is tailored to their individual learning needs and styles. By using AI in education, we can improve access, efficiency, and engagement for all students. However, there are also concerns and challenges associated with the use of AI in education. These include the potential for job loss and ethical considerations around the use of student data. Nonetheless, the benefits of using AI and technology to support individuals with learning difficulties are numerous, from personalized learning plans and assistive technology to gamification strategies that can make learning more engaging and effective. It is also essential to recognize that teaching individuals with neurodiverse conditions can be challenging, as each individual has unique strengths, weaknesses, and learning styles. Teachers must adapt their teaching strategies to meet the needs of each student and work to create a safe and inclusive learning environment that respects and values neurodiversity.
In conclusion, the use of AI and technology in education has the potential to revolutionize learning and support individuals with learning difficulties, but we must be mindful of the challenges and ethical considerations that come with this technology. By using inclusive language and adapting our teaching strategies to meet the needs of all students, we can create a more equitable and effective learning environment for everyone.

References

[1] Aldowah, H., Al-Samarraie, H., & Fauzy, W. M. (2019). Educational data mining and learning analytics for 21st century higher education: A review and synthesis. Telematics and Informatics, 37, pp. 13-49.

[2] Ali, M., & Abdel-Haq, M. K. (2021). Bibliographical analysis of artificial intelligence learning in Higher Education: is the role of the human educator and educated a thing of the past?. In Fostering Communication and Learning

With Underutilized Technologies in Higher Education, pp. 36-52. IGI Global.

[3] Alonso-García, S., Aznar-Díaz, I., Caceres-Reche, M. P., Trujillo-Torres, J. M., & Romero-Rodríguez, J. M. (2019). Systematic review of good teaching practices with ICT in Spanish Higher Education. Trends and Challenges for Sustainability. Sustainability, 11(24), pp. 7150.

[4] Bates, T., Cobo, C., Mariño, O., & Wheeler, S. (2020). Can artificial intelligence transform higher education?. International Journal of Educational Technology in Higher Education, 17(1), pp. 1-12.

[5] Bursać, M., Milošević, D., & Mitrović, K. (2019, May). Proposed model for automatic learning style detecting based on artificial intelligence. In Proc. 11th International Scientific Conference "Science and Higher Education in Function of Sustainable Development" 24 – 25 May 2019, Mećavnik. pp. 47-54.

[6] Büyüksoy, C., Taşcıoğlu, Z., & Ergin, İ. (2020). Determining Learning Techniques by Using Artificial Intelligence and Observing the Impacts of Differentiated Education Model. European Journal of Teaching and Education, 2(2), pp. 122-130.

[7] Chao, C. M. (2019). Factors determining the behavioral intention to use mobile learning: An application and extension of the UTAUT model. Frontiers in psychology, 10, 1652.

[8] Chen, C. K., & Almunawar, M. N. (2019). Cloud learning management system in higher education. In Opening Up Education for Inclusivity Across Digital Economies and Societies, pp. 29-51. IGI Global.

[9] Di Fraia, G. (2021). DSAi: AI Powered Platform to Support the Use and Map-ping of Educational Content for SLDs Students. Downloaded from: https://ceur-ws.org/Vol-3102/short2.pdf

[10] Estevez, J., Garate, G., & Graña, M. (2019). Gentle introduction to artificial intelligence for high-school students using scratch. IEEE access, 7, 179027-179036.

[11] Fromm, J., Radianti, J., Wehking, C., Stieglitz, S., Majchrzak, T. A., & vom Brocke, J. (2021). More than experience?-On the unique opportunities of virtual reality to afford a holistic experiential learning cycle. The Internet and higher education, 50, 100804.

[12] Goel, P. (2021). Experiential Learning. InternatIonal Journal of teacher educatIon and teachIng, 1(2). pp. 118-127.

[13] Keržič, D., Alex, J. K., Pamela Balbontín Alvarado, R., Bezerra, D. D. S., Cheraghi, M., Dobrowolska, B., ... & Aristovnik, A. (2021). Academic student satisfaction and perceived performance in the e-learning

environment during the COVID-19 pandemic: Evidence across ten countries. PLoS One, 16(10), e0258807.

[14] Ma, Y. & Siau, K.L. (2018). Artificial Intelligence Impacts on Higher Education. MWAIS 2018 Proceedings. 42. Downloaded from: http://aisel.aisnet.org/mwais2018/42

[15] Paudel, P. (2021). Online education: Benefits, challenges and strategies during and after COVID-19 in higher education. International Journal on Studies in Education, 3(2), pp. .70-85.

[16] Perbawaningsih, Y. (2013). Plus minus of ICT usage in higher education students. Procedia-Social and Behavioral Sciences, 103, pp. 717-724.

[17] Pinto, M., & Leite, C. (2020). Digital technologies in support of students learning in Higher Education: literature review. Digital Education Review, (37), pp. 343-360.

[18] Popenici, S. A., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. Research and Practice in Technology Enhanced Learning, 12(1), pp. 1-13.

[19] Raccanello, D., Balbontín-Alvarado, R., da Silva Bezerra, D., Burro, R., Cheraghi, M., Dobrowolska, B., ... & Aristovnik, A. (2022). Higher education students' achievement emotions and their antecedents in e-learning amid COVID-19 pandemic: A multi-country survey. Learning and instruction, 80, 101629.

[20] Radianti, J., Majchrzak, T. A., Fromm, J., & Wohlgenannt, I. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. Computers & Education, 147, 103778.

[21] Sadeghi, M. (2019). A shift from classroom to distance learning: Advantages and limitations. International Journal of Research in English Education, 4(1), pp. 80-88.

[22] Stanković, N. L., Blagojević, M. D., Papić, M. Ž., & Karuović, D. (2021). Artificial Neural Network Model for Prediction of Students' Success in Learning Programming. Journal of Scientific & Industrial Research, 80(03), 249-254.

[23] Vincent-Lancrin, S. and R. van der Vlies (2020), "Trustworthy artificial intelligence (AI) in education: Promises and challenges", OECD Education Working Papers, 218, OECD Publishing, Paris,Downloaded form: https://doi.org/10.1787/a6c90fa9-en.

[24] Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education–where are the educators?. International Journal of Educational Technology in Higher Education, 16(1), pp. 1-27.

[25] Zheng, H., Mahapasuthanon, P., Chen, Y., Rangwala, H., Evmenova, A. S., & Genaro Motti, V. (2021, October). WLA4ND: A wearable dataset of learning activities for young adults with neurodiversity to provide support in education. In Proceedings of the 23rd International ACM SIGACCESS Conference on Computers and Accessibility, pp. 1-15.

[26] Zheng, H., Mahapasuthanon, P., Chen, Y., Rangwala, H., Evmenova, A. S., & Genaro Motti, V. (2021, October). WLA4ND: A wearable dataset of learning activities for young adults with neurodiversity to provide support in education. In Proceedings of the 23rd International ACM SIGACCESS Conference on Computers and Accessibility, pp. 1-15.

Secure University Decentralized Data Storage Solutions

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Abstract The secure storage of university data is crucial these days, as it involves the storage of sensitive data. Everything must be done to protect the personal data of students and the data of university employees. The university's reputation may depend on outsiders having access to this data. In the past, centralized data storage solutions did not provide sufficient protection, so it is advisable to investigate decentralized blockchain-based data storage options. In the blockchain, data is stored as blocks, so each block contains the previous block's hash value. For a hacker to modify the blockchain, he must change all the blocks going back to the Genesis block, which is a problematic solution depending on the size of the blockchain. DDoS attacks can also be easily avoided by using a university blockchain since the data is not stored centrally on a server but in different nodes.

Keywords: Blockchain, Database security,

1 Introduction

In the future, database security will become even more prominent as data volumes continue to grow. With the advent of IoT, Internet communication is no longer only between people, but also smart devices can communicate with each other. The servers can thus slowly become overloaded, and serious computer capacities will be needed to process the data.

The 5G network is currently being built, which can open new horizons in communication. It is easy to see that without adequate database security, 5G solutions can be at risk. Educational institutions must prepare for these threats. It is not only important to store university data, but also the personal data of students and employees that universities have. Thanks to modern eLearning solutions, teaching materials can no longer be prepared only in the form of presentations, but can also be made more colorful by means of video recordings. Establishing a secure and fast Internet connection between the university and the students should be an important aspect, even in the case of increased data volumes. In the future, educational institutions may be threatened by the following new types of threats:

- Malware can become more difficult to identify as it learns to mimic user behavior. This will make them more difficult to recognize,
- Traditional cloud-based centralized solutions can increase the risk of possible successful attacks, as attackers have been able to successfully identify their weak points until now,

Automated attack solutions using artificial intelligence may appear. These intelligent attacks will presumably be more difficult to defend against [1], that's why it's important to check which are currently the most secure data storage solutions.

2 Types of Data Storage Solutions

Storing data on physical devices is well known to everyone. Recently, data stored in the cloud has opened new horizons. Cloud-based solutions have already proven their advantage through easy access and synchronization, which facilitate data capture. In order to secure university data storage, it is necessary to examine both centralized and decentralized data storage solutions. In practice, data storage looks like this:

- Saving on physical devices. This can be the hard drive of the NVR, as well as pen drives and various discs (CD, DVD, Blue-Ray),
- Data storage in a centralized cloud. The data is stored in the cloud, which has a separate owner and operator. The server operator is responsible for data security.
- In the case of decentralized cloud-based data storage, the data is stored on a decentralized network. The data is not saved on a company's server, but on computers operated by independent individuals in many parts of the world. You can connect to such networks through smart contracts.

2.1 Centralized Data Storage Solutions

In the case of centralized cloud data storage, there have been a number of undesirable events in the past that may cause concern. Data leakage has occurred in many cases. In the case of university databases, the goal is to achieve the highest possible security, so it is necessary to examine the available data storage options and to search for new solutions that can provide the most effective security possible. Centralized data storage solutions are characterized by:

- Increasing storage costs. With the advent of IoT and Industry 4.0, the amount of data has increased significantly, requiring more bandwidth and storage capacity.
- Censorship and surveillance. Many people are concerned about the fact that others can observe, read, and in some cases even modify their data.

- As a result of DDoS attacks, the servers of many large companies were attacked. With decentralized storage, this cannot happen, since there is no central server that can fall victim to a directed attack. [2]

The local storage of data is more and more in the background, because as the amount of information increases, so do the amounts of data. The capacity of hard drives is limited, and access to local computers from a distance is difficult. Thanks to the centralized cloud-based solution, personal data can be accessed from almost anywhere, as long as an Internet connection is required. As a result of centralized storage, data loss due to hardware errors can be reduced, as backup copies are saved not only on the hard drive, but also in the cloud. The figure below illustrates the centralized data storage solution:

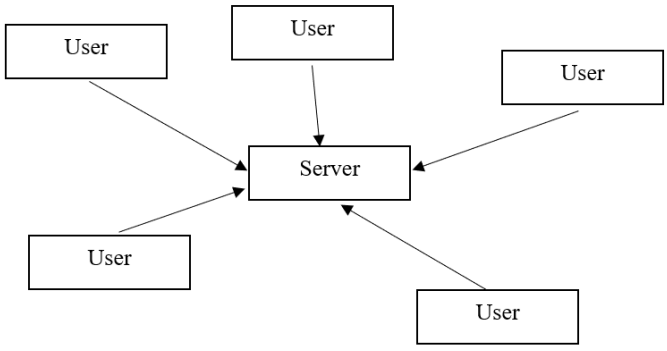

Figure 1
Centralized data storage solution

In the case of cloud-based data storage, the basic assumption is that the third party is a reliable service provider whose goal is to ensure that the data is always secure and available 24 hours a day. It may happen that the third party damages the data for their own personal benefit. You can modify them, release them to different bodies, or delete them. In order to prevent this, several cloud-based storage platforms are used at the same time. The disadvantage is that this method generates a lot of network traffic and bandwidth. [3]
In order to protect the data from third parties, it is recommended to encrypt it and upload it to the cloud. Centralized storage systems have the following weaknesses:

- Safety. If an unauthorized person has access to the server data, it can be compromised.
- Reliability. The server may become overloaded if too many requests are received at once. This is how DDoS attacks work.
- Data transfer speed. A fast connection to the server is essential. If users' computers are in different countries (which is usually the case), the data transfer speed may decrease, and some countries may impose restrictions.

- Scalability. Due to the centralized design, the capacity of the server is limited, and the data traffic is also regulated [4].

2.2 Decentralized Data Storage Solutions

Thanks to the decentralized data storage solution, the data is more secure than in the case of cloud-based storage, since it is distributed across many nodes. Furthermore, storage systems use public key encryption. Data is distributed flexibly between nodes and smart contracts are also used for automatic execution [5]. A Advantages of decentralized data storage:

- Performance is balanced as nodes share data volumes proportionally,
- High availability. Most of the hubs are available 24 hours a day. If some nodes become unavailable, the other nodes will continue to serve the user.
- A high degree of independence. Each node is independently responsible for following the rules, thus forming the blockchain ecosystem. An outside person or authority does not limit or regulate its operation.
- It divides the users' data into several pieces and then encrypts it to the nodes. In the event of a DDoS attack, the system remains operational.
- If some nodes do not work or become unreachable in the event of an attack, the other nodes can continue to function without interruption. In the centralized system, if the central server stops, the whole system will most likely be inoperable, therefore the data cannot be accessed [6].

Disadvantages:

- Due to the lack of central supervision, there is no chain of command that could give orders to perform various tasks,
- The so-called "usual" regulatory oversight is missing. The creator of the private blockchain defines the rules that are enforced by the smart contract. This is difficult to apply in some cases
- Determining which node has failed is critical, as each node must be checked,
- It is difficult to determine which node responded to the request since the same data is available on several nodes through a decentralized system [7].

In conclusion, it can be stated that in the case of decentralized data storage, the data is stored completely independently of each other on many nodes, which is a safety-enhancing factor, and therefore this type of blockchain technology is suitable to be part of the university data recording in the long term. Therefore, it is advisable to further investigate blockchain technology.

2.3 Blockchain technology

With the appearance of large amounts of data (Big Data), networks often become overloaded. Due to their division, blockchains enable more efficient data processing

and cost reduction. And by distributing the processing, they positively influence the Internet of Things (IoT) [8].

In their view, it will become technology such as the steam engine, energy supply, information, and Internet technology [9].

The first block of the blockchain is the genesis block, on which the rest are built. After that, each block is connected to the previous so-called parent block. The block consists of a header and a body. Their structure is as follows:

- Block version: contains the rules necessary to validate the block,
- Parent block hash: this is a 256-bit value that always points to the previous block. Without this, the chain could not be created,
- Merkle tree root extract: forms the extract of all transactions of all blocks,
- Timestamp: current timestamp in seconds. This is necessary for authentication,
- nBits: the current hash value expressed in a compact format,
- Nonce: 4-byte field that starts with 0 and continuously increases during hash calculations. [9] The figure below shows the structure of the blockchain.

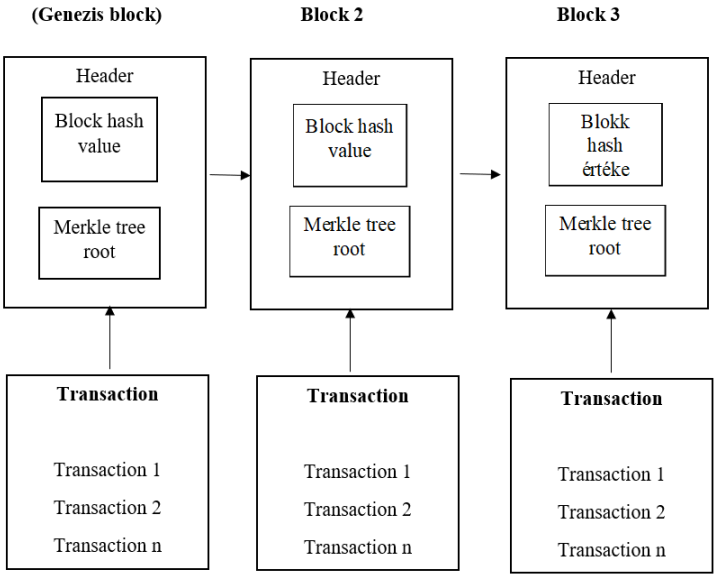

Figure 2
Blokchain strucutre [10]

3 Creation of a Universtiy Blockchain

In the case of the constitution of a self-sufficient, faculty-based blockchain, the educational institution may determine the advantageous and convenient conditions of data storage. These may be the following:

- Broader access to the blockchain in question,
- The definition of the size of blocks,
- The definition of terms of use,
- The original block (genesis block) to which will all the other blocks will connect, stays in the domain of the faculty,
- The limiting of access to the blockchain (only the authorized persons may use it),
- The definition of data protection policy,
- The blockchain may be started on multiple servers to uphold the security,
- The nodes are more easily monitored,the system will become more transparent,The eventual data compromising will be more easily identified [11], [12].

When creating the university blockchain called UDSC (Universities Data Storage Chain), the first step is to create the genesis block. The creation of the genesis block is shown in the third figure.

```
{
   "config": { // the config block defines the settings for our custom chain and has certain attributes to create a private blockchain
      "chainId": 987, // identifies UDSC blockchain
}
      "homesteadBlock": 0, // Homestead version was released with a few backward-incompatible protocol changes, and therefore requires a hard fork. UDSC chain however won't be hard-forking for these changes, so leave as 0
      "eip155Block": 0, // Homestead version was released with a few backward-incompatible protocol changes, and therefore requires a hard fork. UDSC chain however won't be hard-forking for these changes, so leave as 0
      "eip158Block": 0
   },
   "difficulty": "0x400", // This value is used to control the Block generation time of a Blockchain. The higher the difficulty, the statistically more calculations a Miner must perform to discover a valid block
   "gasLimit": "0x8000000",
   "alloc": {}}
}
```

Figure 3
Creating a genesis block [13]

The faculty-based blockchain may be constituted in the following manner, presented in the third figure. This blockchain called UDSC needs to be created for the purpose of storing the university teaching materials

.

University chain-util generate UDSC

the default settings would be used:

/default ~ university chain/UDSC/chainsettings.dat

chainsettings.dat include:

Database addresses [receiver (cloud storage) IP address, sender (university) IP address],

Database system addresses [receiver (university database) IP address, sender IP address],

Terms of GDPR database.

Next, the UDSC blockchain would be initialized, and the genesis block would be created

universitychain UDSC

The server will be started in those few seconds after the genesis block has been found, then the node address needs to be connected:

UDSC@192.168.0.1:8008

After these steps, the connection can be attempted from a second server:

universitychain UDSC@192.168.0.1:8008

After the message confirming the chain has been initialized, permission is not given for connection to the database. The address would be copied and pasted: 192.168.0.2

finally, permission for connection would be granted:

universitychain UDSC grant 192.168.0.2 connect.

Figure. 4
The creation of an UDSC blockchain [11,12,13]

Conclusions

In order to securely store university data, it is recommended to search for new solutions instead of already proven and convenient solutions. The advantage of centralized data storage is that it is fast and easily accessible. The data stored in the cloud can be kept up-to-date by the continuous synchronization of the devices, however, thanks to the central server, the system can easily become vulnerable.

The data stored in the blockchain can also withstand traditional DDoS attacks, since the data is not stored in one place, but in different nodes, which means that a hacker attack focused on one place cannot be launched against it.

However, for the sake of long-term and secure data storage, it is advisable for universities to think about creating their own blockchain, which allows them to regulate access to their own blockchain. By applying this method, they could have blockchain-based administrator rights, which could even form the basis of a secure data storage at the university level in the future.

References

[1] Deloitte: Protecting against the changing cybersecurity risk landscape. https://bit.ly/3k1gWEo (accessed: 2023.04.23), 2022.

[2] Medium: What Is Decentralized Storage? https://bit.ly/2UK9jaG https://bit.ly/3k1gWEo (accessed: 2023.04.23), 2022.

[3] Huige Li-Fangguo, Zhang Peiran, Luo1-Haibo, Tian1-Jiejie He: How to retrieve the encrypted data on theblockchain, KSII Transactions on Internet and Information Systems vol. 13(11), Nov. 2019, pp. 5560-5579.

[4] Andrew Tar: Decentralized and Distributed Databases, Explained. https://bit.ly/2ZEBqtl (accessed: 2023.04.23), 2022.

[5] Peng Jiang-Fuchun Guo-Kaitai Liang-Jianchang Laib-Qiaoyan Wen: Searchain: Blockchain-based Private Keyword Search in Decentralized Storage, Elseiver, 2017, pp. 781-792.

[6] Amer Rosic: Centralized vs Decentralized Storage, Redefining Storage Solutions with Blockchain. https://bit.ly/2NxIrX9 (accessed: 2023.04.23), 2022.

[7] Geeks for Geeks: Comparison – Centralized, Decentralized and Distributed Systems. https://bit.ly/3dYwLYw

[8] AMBRUS Éva: Blockchains, Hadmérnök, XII issue, 2. 2017, jun. 2017, pp. 1-11.

[9] Azaria Asaph: Medrec: Using blockchain for medical data access and permission management; 2016 2nd International Conference on Open and Big Data (OBD). IEEE, 2016, 99.pp. 25-30.

[10] Tanzeela Sultana Ahmad, Almogren Mariam, Akbar Mansour Zuair Ibrar Ullah, Nadeem Javaid: Data Sharing System Integrating Access Control Mechanism using Blockchain-Based Smart Contracts for IoT Devices Applied Sciences 10(2) 2020 pp. 1-21.

[11] Bálint Krisztián: The connection of a Blockchain with Students' Attendance Register based on Security Cameras, IEEE 19th International Symposium on Intelligent Systems and Informatics (SISY 2021), Subotica, Serbia, 2021, 191 p. pp. 67-70.

[12] Bálint Krisztián: Data Security Structure of a Students' Attendance Register Based on Security Cameras and Blockchain Technology, IEEE Joint 22nd International Symposium on Computational INTELLIGENCE and Informatics and 8th International Conference on Recent Achievements in Mechatronics, Automation, Computer Science and Robotics (CINTI-MACRo 2022) : Proceedings, Budapest, Hungaray, 2022, 41pp. 185-189.

[13] Bálint Krisztián: Modern, Decentralized Blockchain-Based Solutions for Saving Video Footage, IEEE 18th International Symposium on Intelligent Systems and Informatics (SISY 2020) Danvers (MA), Amerikai Egyesült Államok: IEEE, 2020, pp. 11-14.

Agricultural insurance: The solution to many economic problems.

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Abstract: Agricultural insurance is a useful tool for the development of the agricultural sector and for the growth of the economy. Agricultural insurance products help farmers manage the risk of agricultural production. It reduces the effects of losses and damages in case of natural disasters, influences the increase of investments in agriculture, improves the biosecurity of the farm, increases the value of the capital and serves as a loan guarantee. The agricultural sector is an important source of income and employment for a significant number of people around the world. Farmers' participation in the insurance market stabilizes farmers' income as it provides them with compensation in case of natural disasters, helping them to continue the productive activity of the farm. When buying insurance products, producers use more effective methods for agricultural risks management. Agricultural insurance reduces farmers' stress. The size of the effect of agricultural insurance schemes on economy indicators is related with the terms of the contract and the producer's risk preference. To increase the effectiveness of agricultural insurance, it is necessary the increase the financial knowledge of farmers, the use of sustainable agricultural practices, the diversification insurance models, the use of modern technologies, the definition of the role of agricultural insurance, the cooperation of interest groups for the success of agricultural insurance schemes, government helps, etc. In this study we will theoretically analyze the importance of farmers' participation in the agricultural insurance market. We will analyze the impact of agricultural insurance on agricultural sector, on agricultural production and on various economic indicators.

Keywords: agricultural insurance products, production, economy, profit, growth.

1 Introduction

Agricultural insurance includes businesses and individuals dealing with agricultural production, livestock, aquaculture, forestry, animals with high market value, greenhouse products, etc. According to Groupe Atlas (2017) agricultural products are threatened by a large number of risks. These risks are particularly high in

undeveloped countries or in developing countries where the conditions for growing agricultural products are minimal, there is no hygiene, there is no medical care for animals and the owners have minimal knowledge about the care of agricultural products in terms of growth and quality. In order to reduce these risks and develop rural and agricultural areas, the agricultural insurance system should be established, which is a key element in the development of agriculture and the stability of farmers' incomes when they face natural disasters (Wang et al. 2011).

In the conditions of global economy, the limited number of agricultural insurance products is in shortcoming of farmers in developing countries, since developed countries have a greater number of agricultural insurance products to offer. Farmers who are affected by natural disasters cultivate a limited number of agricultural products, shrinking not only their revenue but also tax income. The decrease in tax revenues reduces the state's ability to finance social services such as natural disasters. Income from exports decreases as a result of the reduction of exported products. Relocation from rural zones to urban ones increases, financial markets decrease and the demand for economic support to control crises increases. On macro level, poverty will increase. In order to decrease all these consequences, it is required to create a successful agricultural insurance system, which will not only help farmers to be more competitive in international markets, but will also affect the improvement of other economic indicators. Close cooperation between the government, insurance companies and farmers is important for the success development of agricultural insurance market.

The objectives of this study are:

- To theoretically examine the importance of farmers' in development countries participation in the agricultural insurance market.
- To identify the main categories of agricultural insurance products.
- To analyze the influence of agricultural insurance on agricultural sector, on agricultural production and on various economic indicators.

2 Categories of agricultural insurance products

The variety of insurance products offered by a country depends on government subsidies, information on insurance contracts, and the appropriate infrastructure for offering these products. Agricultural insurance products are divided into three broad categories, which include premium-based products, index-based products and multi-risk insurance products (Ray, 1981). The characteristics of each category are presented below.

- Single risk insurance products - this type of product covers clearly defined risks in specific areas such as hail, flood, fire, etc. Farmers are compensated only if the cause of the damage is determined. The price of the product is determined and computed on the cost of production or estimated production value (Cass et al.1996). These products are widely

offered by insurance companies. The risks that these products cover are small. They are called compensation-based products.

- Multiple - risk insurance products - these insurance products cover two or more risks, such as risks from natural disasters, plant or livestock disasters, etc. Compensation is based on ascertained losses of the insurer against a predetermined yield. Some contemporary multi-risk insurance products provide income (Baimisheva et al. 2019). According to the authors assessing the damage is expensive as the insurer must visit the farm at least twice, before the damage occurs and after the damage occurs in order to assess the loss. Products with multiple risks require farmers to use standard or best practices for preserving agricultural products. This type of insurance is not suitable for small farms
- Index-based insurance products - Index-based insurance connects payments with an observable, reliable and sustainable index. Some examples of indices are rainfall, temperature, animal mortality, river flows, etc. Data are evaluated easily and quickly. These products offer transparency in the calculation of loss assessment, fast payment of damages and low cost of damage assessment (Binswanger-Mkhize, 2012). In contrast to multiple insurance products that only insure yields, index insurance products also insure production quality. A weakness of these products is that in some cases, due to the lack of a strong link between the index and the yield of the farm, protection may not be provided. For example, a fire insurance product does not pay anything if the destruction of production comes as a result of disasters (Adeyinka et al. 2022). Therefore, farmers buy index insurance products when a considerable part of premium is subsidized by the government. The problem of asymmetric information can also reduce the willingness of farmers to adopt this type of product. Although this type of insurance is difficult for farmers to understand, it has always attracted the interest of insurance companies.

In developing countries, agricultural insurance programs are underdeveloped and include:

a. Microinsurance related to credit – participants are generally small farmers, who make regular premium payments to microfinance institutions in relation to their risk benefits. Microinsurance uses the same principles as traditional insurance in terms of policy pricing, underwriting, loss assessment, reinsurance, etc. Different to traditional insurance, these products are only available for low-income farmers.
b. Macro insurance – according to this scheme, governments benefit quick payments in the form of help in case of natural disasters.
c. Modified macro insurance– small farmers receive payments in case of disaster from the company they have negotiated. This company can be the company from which farmers buy inputs, cooperative, etc.

3 The role of agricultural insurance in agricultural production

Natural disasters cause serious damage to agricultural production. Agricultural insurance influences the stability of agricultural production by compensating farmers for losses caused by natural disasters. Many academics have studied the role that agricultural insurance has in reducing the negative consequences of natural disasters. Some of these studies have verified the positive impact that the development in insurance has on the growth in agricultural production.(Olumide & Akinbode, 2014) conducted a primary data study in Ondo, Nigeria. The study proved that the increase of farmers involvement in the insurance schemes has increased the investments in agriculture and therefore the agricultural production has also increased. Agricultural insurance, in addition to risk diversification, serves to ensure agricultural production, stabilizes the rural economy and protects farmers' profits (Zhan & Cao, 2010). The promotion of the agricultural system positively affects the promotion of agricultural production (Chen, 2020). Zeng et al., (2022) analyzed the effect of the agricultural insurance scheme on the economy. They concluded that agricultural insurance influences agricultural production positively and negatively before and after the occurrence of a disaster. The impact before the disaster is positive and negative (premium payment) and mostly positive after the disaster. According to Baskaran & Maher (2021) agricultural insurance is an instrument that can be used to reduce the instability of incomes, to increase elasticity and serve to increase productivity in the agricultural sector. The insurance company helps mitigate the losses caused by natural disasters or epidemics, it helps farmers to get loans to purchase agricultural equipment, which further influence the improvement of productivity (Li & Wang, 2021). From the analysis of ten years of panel data for thirty one provinces and cities, (Caifei, 2020) proved that the impact of agricultural insurance on agricultural production is major and increases with the increase of risk.

Kujawska et al., (2021) studied the correlation between the provision of agricultural products, agricultural production and the environment. Using technical methods for arrange preference according to resemblance to an ideal result, they empirically proved that there was a shared relationship between agricultural insurance, land productivity and the environment. According to the result of their study, the level of insurance coverage promotes the growth of land productivity. Spörri et al., (2012) studied the effect of insurance products on the economic performance of production farms in Hungary. Through an equation, they connected the economic performance model variables such as farm characteristics, farm manager characteristics, production characteristics with insurance demand model variables such as the farm manager's behavior and his attitude towards risk, the farm's exposure to risk, risk management methods, etc. According to this study they concluded a negative relationship between insurance and farm profit, land productivity and labor productivity.

Sihem (2017) studied a panel data for twenty three American and European countries for 15-year to analyze the link among agricultural insurance and agricultural productivity growth. To measure the productivity of the land, the author used seven independent variables in an independent linear regression model such as insurance coverage, climatic conditions, human capital stock indicators, exposure compensation, agricultural credit, production risk indicators and the stock of physical capital. This study concluded that as a result of the growth of the agricultural insurance market, we will have an increase in agricultural productivity. Zou et al., (2022) studied variables such as gross agricultural production, agricultural insurance premium expenses, the expanse of crops planted, the irrigated area, the rate of pesticide application, education, spatial dimensions of rural roads, the degree of urbanization, etc. to study the role of agricultural insurance in increasing agricultural output. Through various instrumental regressions based on a panel data of 31 provinces, they reach the conclusion that additional expenditures in agricultural insurance programs significantly increase agricultural production in China. Zhang et al., (2023) explored the pig insurance market in Deqing County, China. They concluded that farmers who exit the pig insurance scheme are inclined to reduce pig production. The authors evaluate pig insurance not only as a means of reducing risk, but as a way to promote pig production. According to Boyd et al., (2013) livestock insurance, through the sufficient livestock inputs, affects the production of livestock and the increase food security.

4 The effect of insurance on some important economic indicators

Crop insurance is the main tool for maintaining the sustainability of income, promoting technology, stimulating investments and increasing credit in agriculture. (Nagentran & Rajendran, 2017). According to (Grannis & Bruch, 2006) participation in livestock insurance schemes provides farmers with payments for the part of expenses that are not compensated by the government. By participating in livestock insurance, producers can use more effective methods for managing agricultural risks, which affects the biosecurity of the farm.

Livestock insurance provides several services such as stabilizing farmers' incomes, increasing the capital value, reducing livestock risks and helping to develop the productive activity of the farm. (Ray, 1981).

Many farmers, due to low income and lack of capital, cannot get loans. This situation affects the slowing of the improvement of the agricultural sector. Agricultural insurance schemes serve to overcome such difficulties. By purchasing livestock insurance products, farmers' access to loans increases (Nagentran & Rajendran, 2017).

Agricultural insurance is an instrument used by farmers to stabilize income in the situation of the destruction of agricultural production as a result of unfavorable

events. (Halcrow, 1949). Ke & Wang (2002) studied the effect of agricultural insurance on the income of farmers in 31 provinces of China for the period from 2007 to 2009. The analysis of their study showed that agricultural insurance has a positive impact on increasing farmers income . This impact is evident in the income of farmers with high or medium income. Kujawska et. al (2021) studied the relationship among crop insurance and soil production in Poland. The authors found that increasing the level of insurance coverage causes an increase in land productivity. According to the authors, farms with a low level of productivity had an average insurance value two times smaller than farms with a great level of production.

Agricultural insurance is difficult to apply when agriculture is in survival conditions, where product variability is high and farmers' awareness of agricultural insurance schemes is low. Agricultural insurance helps in agricultural risk management, stabilizes incomes, encourages investment and helps farmers in developing countries transition from survival agriculture to sustainable agriculture (Mârza et al. 2015). Agricultural insurance enables the repayment of loans, increases the budgetary stability of fiscal expenditures related to agriculture by transferring the climate risk to the private sector, promotes the growth of the agricultural sector, creates new jobs, reduces the possibility for fiscal outflow, reduces corruption and has a positive effect in food security and in macroeconomic stability of the country (Baskaran et al., 2021). Riesling (2017) relates the importance of agricultural insurance schemes to income stability, debt repayment even during periods of agricultural production decline, technological advancement and production growth.

Despite the importance of this sector in the development of agriculture and beyond, in developing countries the government investments for the agricultural subdivision are generally insignificant in relation to the revenue and employment offered by this segment. There are no options for farmers in case of fatalities. The creation of a fund by the governments of these countries for agricultural insurance corporations would decrease the value of the insurance premium and inspire farmers in developing countries to promote different crops by growing yield and varying the products planted.

In the table below, we have presented some researches done by different authors on the effects that agricultural insurance has in different economic indicators.

Authors	Indicators that are affected by agricultural insurance	The effect
(Wang et al. 2011), (Nagentran & Rajendran, 2017); (Ray, 1981); (Halcrow, 1949); Ke & Wang (2002); Riesling (2017)	Income	↑
(Olumide & Akinbode, 2014); (Baskaran & Maher, 2021); (Li & Wang, 2021); (Caifei, 2020); (Kujawska, Rzechuła, Tyszko, & Soliwoda, 2021)**;** (Sihem, 2017); (Ray, 1981); Riesling (2017)	Agricultural production	↑
(Zhan & Cao, 2010),(Baskaran & Maher, Brookings, 2021)	Profit of farmers The economy	↑ ↑
(Zeng, Qi, & Wang , 2022)**;**	The economy	↑/↓
(Li & Wang, 2021); (Nagentran & Rajendran, 2017); Baskaran & Maher, Brookings,2021)	Loan	↑
Spörri, Barath, Bokusheva, & Ferto, 2012)	Profit of farmers Land productivity Labor productivity	↓ ↓ ↓
(Ray, 1981)	Equity value	↑
Mârza et al. 2015; Riesling (2017)	Investment	↑
Baskaran & Maher, Brookings, 2021)	Fiscal expenses Food safety Employment Corruption	↓ ↑ ↑ ↓

Table 1

The importance of agricultural insurance in economic indicators according to different authors

Conclusions

Agricultural insurance has an important role in the growth of the agricultural sector and in the development of the economy. Agricultural products are threatened by a large number of risks. In order to reduce these risks and develop agricultural sector, the agricultural insurance system should be established. To increase the success of agricultural insurance, it is essential the intensification of financial knowledge of farmers, the use of sustainable agricultural practices, the variation of insurance models, the use of contemporary technologies, the collaboration of interest groups for the accomplishment of agricultural insurance schemes, government helps, etc. Agricultural insurance products include three broad categories, which are premium-based products, index-based products and multi-risk insurance products. Single risk insurance products covers clearly defined risks in specific areas such as hail, flood, fire, etc. Multiple - risk insurance products covers two or more risks, such as risks from natural disasters, plant or livestock disasters, etc. Index-based insurance products connects payments with an observable, reliable and sustainable index.
The development of the agricultural system positively affects the promotion of agricultural production. Many academics have verified the positive impact that the increase in insurance has on the increase in agricultural production. The increase of farmers participation in the insurance schemes increases the investments in agriculture and therefore the agricultural production also increases. Agricultural insurance is a tool that can be used to reduce the instability of incomes, to increase elasticity and serve to increase productivity in the agricultural sector. The insurance company helps mitigate the losses caused by natural disasters or epidemics, it helps farmers to get loans to purchase agricultural equipment, which further influence the improvement of productivity. Agricultural insurance affects farmers profit, land productivity, labor productivity, equity value, investment, fiscal expenses, food safety, employment, corruption and other important economic indicators.

References

[1] Adeyinka, A. A., Kath, J., Nguyen-Huy, T., Mushtaq, S., Souvignet, M., Range, M., & Barratt, J. (2022). Global disparities in agricultural climate index-based insurance research. Climate Risk Management, 35, 100394.

[2] Alrikabi, A. M. (2017). The Impact of Agricultural Insurance in Agricultural Sector Iraqi. Waist University.

[3] Baimisheva, T. A., Kurmaeva, I. S., Gazizyanova, Y. Y., Baimeshev, R. H., & Aiesheva, G. A. (2019). State regulation systems of agricultural insurance. In IOP Conference Series: Earth and Environmental Science (Vol. 315, No. 2, p. 022090). IOP Publishing.

[4] Baskaran, G., & Maher, B. (2021). Retrieved from Brookings: https://www.brookings.edu/blog/future-

evelopment/2021/05/26/agricultural-insurance-the-antidote-to-many-economic-illnesses/

[5] Baskaran, G., & Maher, B. (2021) Agricultural insurance: The antidote to many economic illnesses. Washington, DC., USA. Retrieved from https://www.brookings.edu/blog/future-development/2021/05/26/agricultural-insurance-the-antidote-to-many-economic-illnesses/

[6] Binswanger-Mkhize, H. P. (2012). Is there too much hype about index-based agricultural insurance?. Journal of Development studies, 48(2), 187-200.

[7] Boyd, M., Pai, J., & Porth, L. (2013). Livestock mortality insurance: development and challenges. Agricultural Finance Review, Vol. 73 No. 2, 233-244, file:///C:/Users/grise/Downloads/Boyd_Pai_Porth_AFR2013.pdf.

[8] Caifei, L. (2020). Empirical Analysis on the Effect of Agricultural Insurance on Production——Based on panel data of 31 provinces and cities in China from 2008 to 2018. EBLDM pp. 2-7, https://www.e3s-conferences.org/articles/e3sconf/pdf/2020/74/e3sconf_ebldm2020_01013.pdf). Shandong: EDP Sciences.

[9] Cass, D., Chichilnisky, G., & Wu, H. M. (1996). Individual risk and mutual insurance. Econometrica: Journal of the Econometric Society, pp. 333-341.

[10] Chen, R. (2020). The Impact of Agricultural Insurance on Agricultural Production: An Empirical Study Based on Anhui Province of China. THE INTERNATIONAL JOURNAL OF BUSINESS & MANAGEMENT, 336-342, https://www.internationaljournalcorner.com/index.php/theijbm/article/view/152079/105886.

[11] Grannis, J. L., & Bruch, M. L. (2006). The Role of USDA-APHIS in Livestock Disease Management within the USA. CAB International, pp. 19-28, UK: CABI.

[12] Groupe Atlas. (2017). Agricultural insurance: products and schemes. https://www.atlas-mag.net/en/article/agricultural-insurance-products-and-schemes: Atlas Magazine.

[13] Halcrow, H. G. (1949). Actuarial Structures for Crop Insurance. American Journal of Agricultural Economics, pp. 418-443, https://onlinelibrary.wiley.com/doi/epdf/10.2307/1232330.

[14] Kujawska, A. K., Rzechuła, A. S., Tyszko, J. P., & Soliwoda, M. (2021). Crop Insurance, Land Productivity and the Environment: A Way forward to a Better Understanding. Agriculture, 11(1108), pp. 1-17, file:///C:/Users/grise/Downloads/agriculture-11-01108.pdf.

[15] Ke, B., & Holly Wang, H. (2002). An assessment of risk management strategies for grain growers in the Pacific Northwest. Agricultural Finance Review, 62(2), pp. 117-133.

[16] Kurdyś-Kujawska, A., Sompolska-Rzechuła, A., Pawłowska-Tyszko, J., & Soliwoda, M. (2021). Crop insurance, land productivity and the environment: A way forward to a better understanding. Agriculture, 11(11), pp. 1108.

[17] Li, Y., & Wang, Z. (2021). Analysis on the effect of farmer income of policy-based agricultural insurance. ACTA AGRICULTURAE SCANDINAVICA, SECTION B—SOIL & PLANT SCIENCE2022, VOL. 72, NO. 1, 386-400, https://www.tandfonline.com/doi/epdf/10.1080/09064710.2021.2005820?needAccess=true&role=button.

[18] Munyoro, G., & Moyo, B. A. (2019). The significance of agricultural insurance in the development of the agricultural sector in Zimbabwe: A case study of Mashonaland Central Province. International Journal of Research in Business, Economics and Management, 3(1), pp. 15-33.

[19] Mârza, B., Angelescu, C., & Tindeche, C. (2015). Agricultural insurances and food security. The new climate change challenges. Procedia Economics and Finance, 27, pp. 594-599.

[20] Nagentran , M., & Rajendran, R. (2017). Economic Analysis of Crop Insurance A Critical Review. Shanlax International Journal of Economics, 5(2), pp. 25-31, https://www.researchgate.net/publication/334917534_Economic_Analysis_of_Crop_Insurance_A_Critical_Review.

[21] Olumide, A., & Akinbode, O. (2014). EVALUATION OF EFFECTS OF AGRICULTURAL INSURANCE SCHEME ON AGRICULTURAL PRODUCTION IN ONDO STATE. RUSSIAN JOURNAL OF AGRICULTURAL AND SOCIO-ECONOMIC SCIENCES, 28(4), pp. 3-8, https://rjoas.com/issue-2014-04/article_01.pdf.

[22] Ray, P. K. (1981). Agricultural insurance: Theory and practice and application to developing countries. Rome: PERGAMON PRESS .

[23] Riesling, E. (2017). The importance of crop insurance and how it will benefit farmers. https://www.myfarminfo.com/

[24] Sihem , E. (2017). Agricultural Insurance-Agricultural Productivity Nexus: Evidence from International Data. Journal of Service Science Research, 9, pp. 147-178, file:///C:/Users/grise/Downloads/JoSSR_2017_09_008-_Sihem_147_178.pdf.

[25] Spörri, M., Barath, L., Bokusheva, R., & Ferto, I. (2012). The Impact of Crop Insurance on the Economic Performance of Hungarian Cropping Farms.

EAAE , pp. 1-15, file:///C:/Users/grise/Downloads/The_Impact_of_Crop_Insurance_on_the_Economic_Perfo.pdf.

[26] Zeng, S., Qi, B., & Wang , M. (2022). Agricultural Insurance and Agricultural Economic Growth: The Case of Zhejiang Province in China. International Journal of Environmental Research and Public Health, pp. 1-21, file:///C:/Users/grise/Downloads/ijerph-19-13062-v2.pdf.

[27] Zhan, D., & Cao, B. (2010). Market Failure and Supply Model of Chinese Agricultural Insurance. Third International Conference on Business Intelligence and Financial Engineering, pp. 390-394, https://ieeexplore-ieee-org.cuarzo.unizar.es:9443/stamp/stamp.jsp?tp=&arnumber=5621817. Hong Kong: IEEE.

[28] Zhang, Y., Zhu, X., & Turvey, C. (2023). On the Impact of Agricultural Livestock Microinsurance on Death-Loss, Production and Vaccine Use: Observations from a Quasi-Natural Experiment in China. The Geneva Papers on Risk and Insurance. Issues and Practice41(2), pp. 225-243, https://www-jstor-org.cuarzo.unizar.es:9443/stable/pdf/24736554.pdf?refreqid=excelsior%3A676fd9b31b21e431d0a74d2251eef276&ab_segments=&origin=&acceptTC=1.

[29] Zou, B., Ren, Z., Mishra, A. K., & Hirsch, S. (2022). The role of agricultural insurance in boosting agricultural output: An aggregate analysis from Chinese provinces. Agribusiness, 38, pp. 923-945, file:///C:/Users/grise/OneDrive%20-%20European%20University%20of%20Tirana/Desktop/Livestock%20insurance/boosting%20agricultural%20output%20%20An%20aggregate%20analysis%20from.pdf.

[30] Zubor-Nemes, A., Fogarasi, J., Molnár, A., & Kemény, G. (2018). Farmers' responses to the changes in Hungarian agricultural insurance system. Agricultural Finance Review.

[31] Wang, M., Shi, P., Ye, T., Liu, M., & Zhou, M. (2011). Agriculture insurance in China: History, experience, and lessons learned. International Journal of Disaster Risk Science, 2, pp. 10-22.

Hungary's digital economy and society maturity in the light of DESI 2022

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Abstract: Numerous digital services are available in our current economy and society, such as public and business services, which enhance efficiency and convenience for citizens. There has been notable advancement in digitalizing education, social media, and entertainment. However, individuals require digital competencies to utilize these services effectively, making digital competency a critical prerequisite for optimal use. The ongoing development of digital services and digital competencies among society members is crucial for the competitiveness of the economy and society. This paper highlights areas where development is suitable and where improvement is necessary, considering factors such as time, society, countries, and regions. The paper focuses on Hungary and evaluates its maturity applying the Digital Economy and Society Index. It recognizes the significance of education and awareness in strategic areas that will shape our future.
Keywords: DESI, DII, Network Readiness Index, Hungary, Digital intelligence, Digital competences, Digital Readiness, Digital Maturity, SME

1 Introduction

In 2023, Hungary's digital economy and society have made significant strides, positioning the country as a notable player in the digital landscape. With a focus on fostering innovation, technological advancement, and digital inclusion, Hungary has achieved remarkable maturity in its digital economy and society, however, there is always some space to develop and improve. The nation has witnessed a rapid expansion of its digital infrastructure, including robust broadband networks and advanced mobile connectivity, enabling seamless digital communication and access to information for its citizens. Furthermore, Hungary has invested heavily in cultivating a thriving startup ecosystem, nurturing entrepreneurial talent, and promoting digital entrepreneurship. This has contributed to the emergence of innovative digital solutions and a vibrant tech industry. Moreover, Hungary has prioritized digital literacy and skills development, ensuring that its population is equipped with the knowledge and capabilities needed to thrive in the digital era, despite the fact that it is not reflected in the (self-)assessment of the people. As a result, Hungary's digital economy and society have flourished, driving economic

growth, improving public services, and enhancing the overall quality of life for its citizens.

1.1 Situation in Hungary today

Hungary's digitalization efforts have resulted in an increasingly digital economy and society, which brings forth a wide array of services. These services not only enhance the efficiency and productivity of the economy but also provide convenience to citizens while expanding opportunities. In the public sector, services such as eEszt, eRecipe, eHungary, and NAV have been introduced, streamlining administrative processes and facilitating interactions between the government and its citizens. Additionally, the business sector has embraced digitalization, offering a plethora of services like e-tickets for transportation (MÁV, BKV, theaters, cinemas), SmartBank for online banking, and online shopping platforms.

Furthermore, digitalization has revolutionized communication in Hungary, enabling people to connect effortlessly. Popular messaging applications such as Skype, WhatsApp, Telegram, and Messenger have become integral parts of daily interactions, allowing individuals to stay connected with friends, family, and colleagues across distances. Education has also experienced a significant shift towards digital platforms. Due to the emergency remote teaching during the COVID-19 pandemic platforms like Teams, Zoom, GoogleMeet and Webex have become an integral part of teaching practices. These digital tools have provided new opportunities for learning and collaboration, making education more accessible and flexible [1].

Moreover, digitalization has profoundly impacted the realm of entertainment and leisure. Social Media like Facebook, Twitter, streaming platforms like Netflix, HBOgo, Spotify, and Pandora have gained immense popularity, offering a wide range of content and experiences to entertain and engage individuals. Additionally, the concept of remote work has been widely embraced, with home offices becoming a new way of working. This transition has been facilitated by digital technologies, enabling professionals to work efficiently from the comfort of their homes, fostering flexibility and work-life balance [2], [3].

This paper presents three indicators – the Digital Economy and Society Index (DESI), the Network Readiness Index (NRI), the Digital Intelligence Index (DII) – and evaluates Hungary’s situation in light of these index numbers. Furthermore, it evaluates the Digital Readiness Level, presents a Digital Maturity Model and assesses SMEs’ position in relation to these models. Finally, it links the findings to the digital maturity of the population in order to understand why education and training is a key component in achieving a higher digitalization status and growth rate.

2 Digital Economy and Society level in Hungary

2.1 The Digital Economy and Society Index

The Digital Economy and Society Index (DESI) has been a vital tool for the European Commission to monitor the digital progress of Member States since 2014 [4]. The DESI reports provide a comprehensive analysis of Europe's digital performance by utilizing a composite index, which incorporates various indicators that are relevant to the digital landscape, offering a summary of each country's digital development [5].

The primary purpose of the DESI is to track the evolution of EU Member States across four main dimensions of digitalization, namely (1) digital public services, (2) digital skills of the human capital, (3) integration of digital technologies and (4) connectivity (Figure 1). By assessing these key aspects, the DESI reports enable policymakers and stakeholders to gain insights into the overall digital performance of each country. This monitoring mechanism plays a crucial role in identifying areas of strength and areas that require improvement, facilitating evidence-based policy-making and promoting the development of a digitally inclusive and competitive European Union.

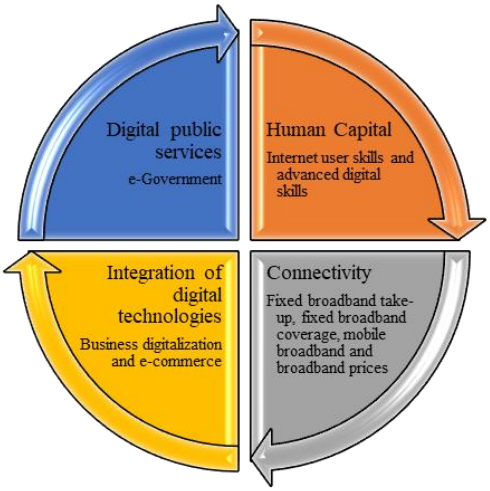


Figure 1.
Structure of DESI 2021 (Source: Developed by author)

The EU member states have achieved a different state of digital economy and society. Northern EU states like Finland, Denmark, the Netherlands and Sweden lead the group gaining a high level of digitalization in each aspect of the Index. On the other hand, Hungary is lagging behind the EU average (52.3) and takes the 22nd place with its combined 43.8 score (Figure 2) [6].

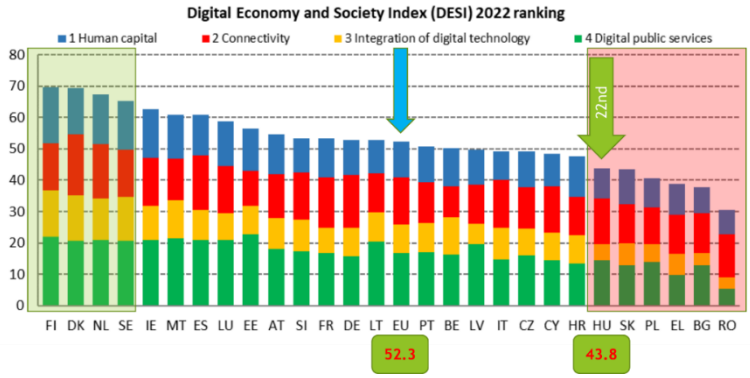


Figure 2.

Digital Economy and Society Index, 2021 [4]

Analyzing member states Figure 3 shows the average yearly growth in scores and in percentage in relation to the countries' 2017 DESI score. In the case of Hungary in the period between 2017 and 2022 the state of digital economy and society is at a lower level compared to the most developed countries, its relative growth rate is higher than those of the flagship countries. However, as the average yearly growth rate for Hungary is under the convergence curve, the country slightly underperforms while the countries over the curve perform better than what convergence curve shows.

In relation to the absolute growth the countries with higher digital economy and society index develop more than the countries in the bottom end, despite their growth rate being lower.

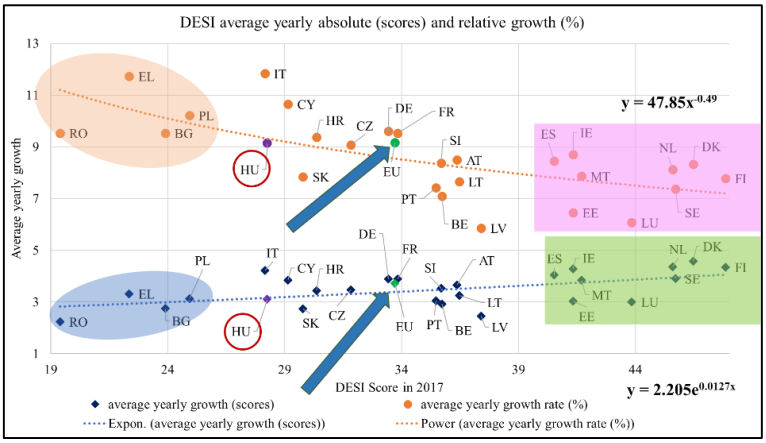


Figure 3.

DESI – Member States' progress, 2017-2021 (source: developed by author based on [4])

Compared to the EU average Hungary followed the EU growth trend between 2017 and 2022 and managed to gain 1.5 times higher DESI score by 2022 (Figure 5).

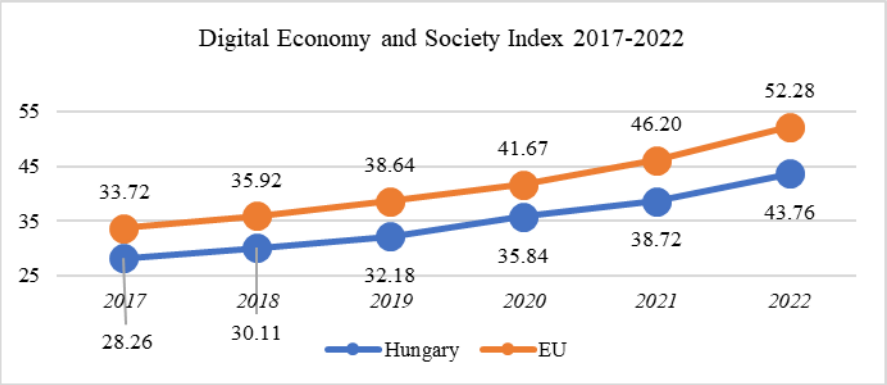


Figure 4.

Hungary's DESI index (scores) compared to the EU 2017-2022 (Source: developed by the author based on [4])

However, in detail Hungary outperforms in the field of Connectivity and Digital Public Services while there is serious lack in digital skills (Human Capital) and in the field of Integration of digital technologies (Figure 6).

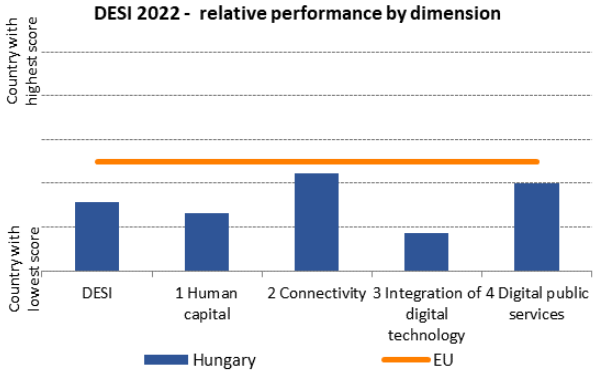


Figure 5.

DESI 2022 –relative performance by dimension [5]

The Connectivity indicator performed the best, putting the country to the 13th place in the EU (scores 57.6). Each sub indicator continuously improves, as for example there is a 97% fast broadband coverage, 84% mobile broadband take-up among individuals and 83% overall fixed broadband take-up. There is still room in the 5G coverage to develop (18% of populated area).

Regarding digital public services Hungary is the 21st with a score of 57.4. The sub indicators are slowly improving, 81% of the internet users are also e-Government

users, and as part of the digital government, there is a 64% rate of digital public services to citizens and 74% rate of digital public services to businesses.

The Human Capital indicator scored 38.4 (23rd among the EU countries), which level is even worse compared to the 2021 level. 49% of the population had at least basic digital skills, while only 22% of the population had digital skills above the basics [6]. Out of the active population (aged 15-74) a mere 3.9% are ICT specialists and an even lower rate of graduates got degree in ICT field (3.1%).

The Integration of digital technology shows the least positive picture; Hungary is the 25th among the EU countries scoring 21.6. The numbers show a positive trend with time, however, the rate of integration of digital technologies in industry, trade and services by SMEs and enterprises is still extremely low. In the case of enterprises, 21% of the them share information electronically, 13% of them use social media, 7% of them take advantage of Big data possibilities, 21% of them use cloud services, 3% of them deploy Artificial Intelligence and 13% issue e-Invoices. In the case of SMEs, 34% of them operate with at least a basic level of digital intensity, 18% of them sell online out of which 7% sell online cross-border.

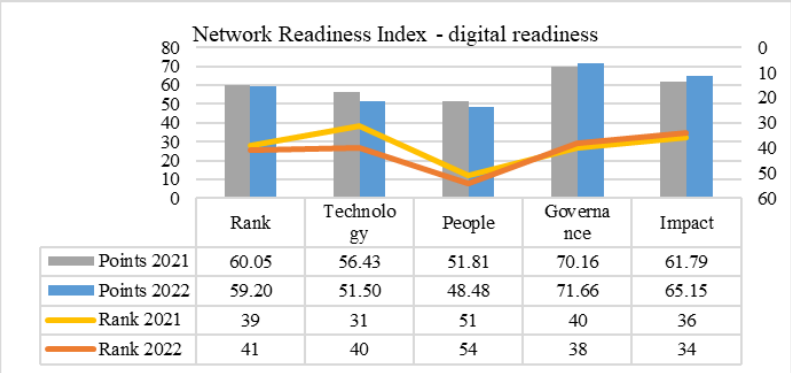
In summary, Hungary has good connectivity and a relatively wide scale of digital public services, however, both the human and the business sectors (enterprises and SMEs as well) need serious improvement to catch up with the digitally more developed countries.

2.2 Network Readiness in Hungary

The Network Readiness Index (NRI) is a comprehensive assessment of a country's ability to leverage information and communication technologies (ICTs) for social and economic development [7]. It provides an overall measure of a nation's preparedness to participate in the digital economy and harness the benefits of the digital revolution. The NRI takes into account various factors such as ICT infrastructure, affordability, skills and education, regulatory environment, and the social and economic impact of ICTs. By analyzing these indicators, the NRI offers valuable insights into a country's strengths and weaknesses in terms of its digital readiness and highlights areas that require attention and improvement. Governments, policymakers, and businesses can utilize the NRI to identify areas for investment and policy reforms to enhance their digital ecosystems and foster inclusive growth. It serves as a benchmarking tool that enables countries to assess their progress and compare themselves with their peers on a global scale. Ultimately, NRI plays a crucial role in guiding nations towards building resilient and thriving digital economies in an increasingly interconnected world.

The network Rradiness of Hungary shows similar results as for DESI. As seen in Figure 7, Hungary needs to improve on Skills and education (People) and Technology, the points for these aspects lowered from 2021 to 2022, while the

points for the regulatory environment and the economic and social impact of ICTs increased.



	Rank	Technology	People	Governance	Impact
Points 2021	60.05	56.43	51.81	70.16	61.79
Points 2022	59.20	51.50	48.48	71.66	65.15
Rank 2021	39	31	51	40	36
Rank 2022	41	40	54	38	34

Figure 6.
Network readiness index (Source: developed by authors based on [7])

2.3 Digital Intelligence in Hungary

The Digital Evolution is a comprehensive tracking system that assesses the state and momentum of the global economy's digitalization process [8]. Covering 95% of the world's population over a twelve-year period from 2008 to 2019, this measurement, known as the Digital Intelligence Index (DII), offers valuable insights and guidance for both businesses and policymakers in their pursuit of digital growth. The DII is determined by two primary factors: the current state of digitization and the pace of digitization over time. It segments countries into four distinct categories based on their digital development (Figure 8).

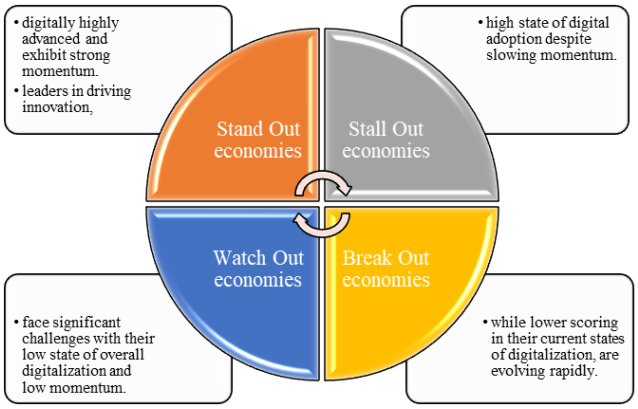


Figure 7.
Digital Intelligence Index segmentation

The *Stand Out* economies are highly advanced digitally and demonstrate strong momentum, positioning themselves as leaders in driving innovation. *Stall Out* economies, on the other hand, have achieved a high level of digital adoption but experience a slowdown in momentum [9]. *Break Out* economies may have lower scores in their current state of digitalization, but they are evolving rapidly and show great potential for future growth. Finally, the *Watch Out* economies face significant challenges with their overall low level of digitalization and lack of momentum. By categorizing nations in this way, the DII enables stakeholders to identify areas of strength and weakness, providing valuable insights for strategic decision-making and targeted interventions to foster digital transformation.

Considering Hungary's position, it needs to be highlighted that despite the initiatives and the Digital Success Program [10], Hungary still needs to make serious effort to catch up even with the neighboring and further Eastern-Central European countries. The countries that used to belong to the socialist block are either at a better Digital Evolution Momentum (Figure 10), as for instance Kazakhstan, Russia and the Eastern Central European countries like Croatia, Slovakia, Slovenia, or Czechia or are developing faster as the V4 countries, Slovenia and Slovakia, etc. As classical economic theory would presume, Hungary which is at a lower digital evolution momentum, should develop at a faster rate.

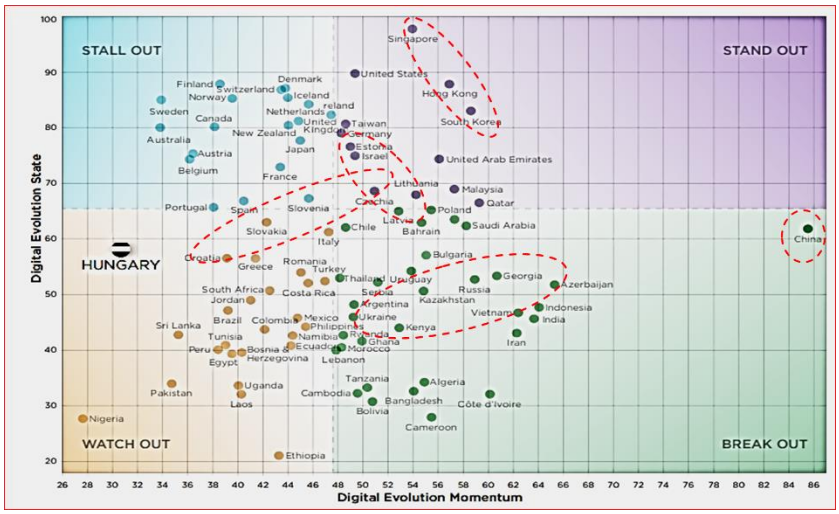


Figure 8.
Countries on the Digital Planet Map [8]

2.4 Digital Readiness Level

Several research compiled digital maturity models [11]–[16], some defining a three pillar model while others define four [17], [18] or five pillars for digital maturity [19], [20]. Each digital maturity framework aims at measuring and enhancing digital

maturity, and emphasizes that pillars must be in balance, otherwise an enterprise cannot step forward in the path of digital transformation. The three-pillar framework focuses on three key pillars and ten distinct features. The first pillar is *leadership*, encompassing overall vision and fostering a culture of innovation within an organization. The second pillar is *technology*, which involves evaluating the effectiveness of technology infrastructure, processes, and systems, as well as creating external networks. The third pillar is *value*, which includes assessing skills, workforce performance, optimized operations, and the optimization of external networks. By utilizing this comprehensive framework, organizations can gain insights into their digital maturity and identify areas for improvement, ultimately driving their digital transformation initiatives forward.

Deloitte's Digital Maturity Model [20] is an industry-standard assessment tool that plays a crucial role in evaluating an organization's digital capability. By examining five well-defined business dimensions, which encompass 28 subdimensions, this model offers a comprehensive view of an organization's digital maturity across its various functions. The assessment provides valuable insights that enable benchmarking against industry standards, allowing organizations to gauge their digital performance relative to their peers. Moreover, the model assists in identifying gaps in digital capabilities, enabling organizations to establish key areas to prioritize and determine where to begin their digital transformation journey.

The first dimension of the Digital Maturity Model is the *customer*. This dimension emphasizes the importance of providing customers with a seamless digital experience, where they perceive the organization as their digital partner. By leveraging their preferred channels of interaction, organizations can empower customers to take control of their connected future both online and offline. The *strategy* dimension focuses on how businesses transform and operate to gain a competitive edge through digital initiatives. It emphasizes the integration of digital strategies within the overall business strategy. The *technology* dimension underpins the success of digital strategy by enabling the creation, processing, storage, security, and exchange of data, all of which are essential for meeting customer needs at low costs and minimal overheads. The *operations* dimension highlights the execution and evolution of processes and tasks through the utilization of digital technologies, driving strategic management and enhancing overall business efficiency and effectiveness. Lastly, the *organizations and culture* dimension stresses the significance of defining and developing an organizational culture with appropriate governance and talent processes to support progress along the digital maturity curve. This flexibility allows organizations to achieve their growth and innovation objectives in the digital era.

2.5 Journey to digital maturity

Embarking on the journey towards digital maturity involves several key steps. The first step is for organizations to assess their current position in their transformation

journey. This involves evaluating their digital capabilities, strengths, and weaknesses to establish a baseline. Once this assessment is complete, organizations can then create goals and develop plans for their digital transformation. These goals should encompass both short-term and long-term objectives, outlining the desired outcomes and milestones to be achieved along the way. As part of this journey, organizations must also make strategic investments in impactful transformation projects. These projects can vary depending on the organization's current digital maturity level, which can range from being a digital outsider to a digital expert or champion. By investing in the right initiatives and leveraging digital technologies effectively, organizations can progress along the maturity spectrum, ultimately becoming digital leaders in their industry.

The journey to digital maturity encompasses several stages, starting from being a Digital Outsider and progressing towards becoming a Digital Champion [21], [22]. In the initial stage, the *Digital Outsider*, organizations have limited or no digital presence, lacking the necessary infrastructure and awareness of digital technologies (Figure 9).

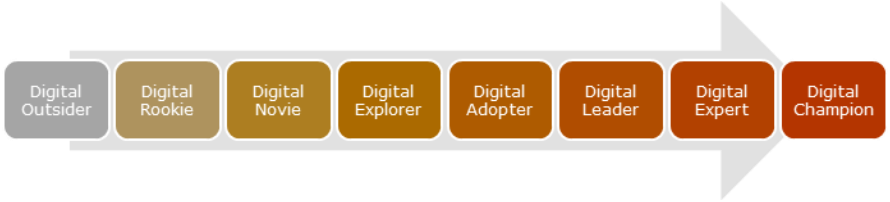


Figure 9.
Digital Readiness Level - From Outsider to Champion [22]

As they begin their digital transformation, they transition to the *Digital Rookie* stage, where they start experimenting with digital tools and strategies, albeit with limited understanding and implementation. The next stage, the *Digital Novice*, indicates a deeper engagement with digital technologies, accompanied by a growing understanding of their potential. As organizations continue to invest in digital capabilities and broaden their knowledge, they become *Digital Explorers*, actively seeking innovative solutions and experimenting with emerging technologies. The subsequent stage, the *Digital Adopter*, signifies a significant integration of digital practices and technologies into various aspects of the organization, resulting in increased efficiency and effectiveness. As the journey progresses, organizations strive to become *Digital Leaders*, excelling in digital innovation, customer experience, and business transformation. The next stage, the *Digital Expert*, represents organizations that possess advanced digital capabilities, leveraging cutting-edge technologies and data-driven insights to drive continuous improvement and gain a competitive edge. Finally, the pinnacle of the journey is reached when an organization becomes a *Digital Champion*, recognized as a leader in their industry, consistently pushing the boundaries of digital innovation and setting the standard for others to follow. Each stage in this journey represents a

significant step forward in digital maturity, and organizations must navigate through these stages to remain competitive and relevant in the rapidly evolving digital landscape.

3 Potentials of digitalization for SMEs

The digital transformation journey of small and medium-sized enterprises (SMEs) is driven by two key factors: firmographics and behavioral characteristics. Firmographics, encompassing the size, sector, age of business, staff profile, and product/service type, play a crucial role in shaping an organization's digital strategy. Understanding these factors helps SMEs tailor their digital initiatives to suit their unique context and requirements. Additionally, behavioral characteristics, such as digital readiness, tech adoption profile, and attitude towards growth and business risk, greatly influence the pace and extent of digital transformation. Digital readiness, in particular, has become increasingly important as SMEs strive to adapt to the "new normal" and navigate the digital landscape effectively. The concept of the digital divide highlights the gap in skills, readiness, financing, and attitudes towards growth and the use of digital technology. SMEs that successfully cross this divide are able to enhance their digital capabilities and embrace new ways of working. By embracing digital tools, technologies, and strategies, SMEs can improve their operational efficiency, expand their market reach, and foster innovation. It is essential for SMEs to recognize the significance of these factors and proactively address them to unlock the full potential of their digital transformation efforts.

3.1 Categories of SME digital readiness to respond to COVID-19

The COVID-19 pandemic had a significant impact on small and medium-sized enterprises (SMEs), with their response varying based on their digital readiness. The crisis highlighted the importance of digital capabilities in ensuring business continuity and resilience. As we transition to the post-COVID business environment, SMEs need to adapt in two key dimensions: their level of digital readiness and their ability to adjust to the new normal [23] (Figure 10).

Some SMEs may fall into the category of "Fadeaways," struggling to survive as they lacked sufficient digital readiness and failed to adapt effectively. On the other hand, the "Reinventors" seized the opportunity to transform their business models, leveraging digital technologies to meet evolving customer needs and capture new market opportunities (traditional retails shops, hospitality, events). The "Adaptors" demonstrated flexibility by quickly adjusting their operations and adopting digital

tools to remain competitive (construction, manufacturing and traditional professional services).

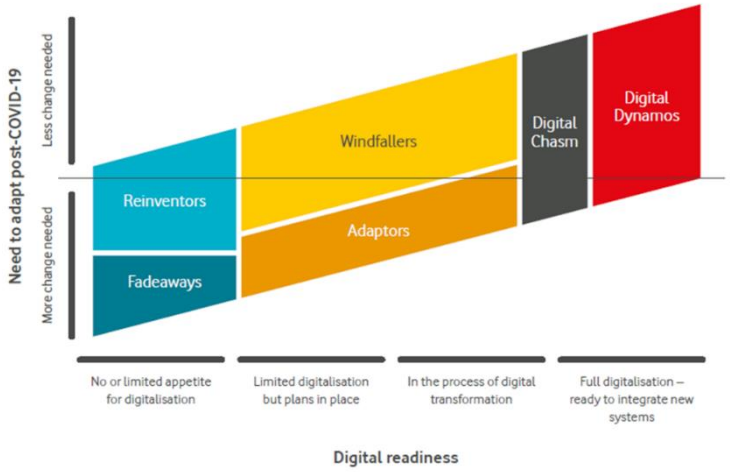


Figure 10.
Digital maturity of SMEs - From Fadeaways to Digital Dynamos [23, p. 13]

The "Windfallers" experienced unexpected success during the pandemic due to their existing digital readiness, enabling them to capitalize on emerging trends (legal services, insurance, logistics, healthcare). However, the crisis also exposed the "Digital Chasm," or "Digital Divide" the gap between digitally advanced and digitally lagging SMEs. Bridging this gap requires concerted efforts to provide support, resources, and training to enhance digital readiness among SMEs. Lastly, the "Digital Dynamos" were already digitally mature and continued to thrive in the post-COVID environment, leveraging their advanced digital capabilities to maintain their competitive edge (software, online retailers and banking and financial services). Overall, adapting to the post-COVID business environment entails a focus on digital readiness and the ability to embrace digital transformation as a strategic imperative for long-term success. The most digitalized SMEs have identified new business opportunities during COVID-19 at more than double the rate of the least digitalized.

3.2 Supporting SMEs to cross the digital divide

According to the Vodafone Policy Paper [23] government can help and support SMEs to be able to step forward in the long path from Fadeaways to Digital Dynamos by providing a flexible and guided digital investment scheme, providing training programs, access to high-speed connectivity, thus closing the connectivity gap. These governmental programs should be provided to the SME that have not crossed the Digital Chasm or Digital Divide.

Figure 11.
Governmental support options for SMEs [23, p. 23]

4 Are we digitally mature?

A survey in 2019 by [24] served to explore the digital maturity of the population in Hungary. According to the results (Figure 12) 61% of the population aged between 15 and 75 still considers themselves digitally immature and 20% of the population believe that they are digitally mature. The rest of the population is digitally open, which shows a positive attitude.

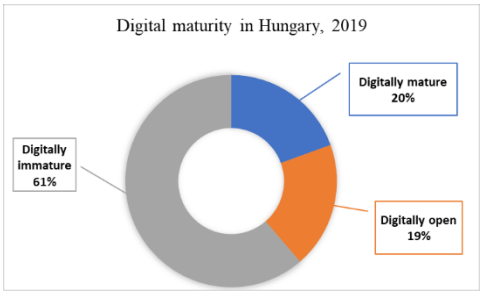


Figure 12.
Distribution of population aged 15.75 by digital maturity (source: developed by author based on [24]

The low level of digital maturity needs to be developed in the near future. The Digital Divide in the population is also due to the different level of "digitalization" of the groups in the Digital Society. The digital landscape can be divided into several groups based on individuals' engagement with technology [25]. *Digital hermits* are those who rarely use technology, either due to economic constraints or a deliberate choice to avoid overwhelming stimuli or trust issues. However, with workplaces increasingly demanding computer proficiency, this state cannot be sustained for long. *Explorers* have taken initial steps into the digital world, but their engagement feels more compelled than voluntary. *Nomads*, while still uncertain and insecure, use the web primarily as an additional source of information, relying more on traditional mediums like books. *Wanderers* show greater involvement than nomads but lack at least one of the eight essential qualities of settlers. *Settlers*, on the other hand, are considered ideal citizens of the information society. They possess qualities such as multitasking ability, online administration skills, adaptability to new websites, extensive digital communication, and a strong presence on social media. They heavily rely on web-based information sources and enthusiastically embrace multimedia devices. Finally, *conquerors* represent the most digitally advanced group, fully immersed and proficient in the digital realm. As for SMEs the Digital Divide split the citizens into one who crossed the Digital Divide line and the ones who have not (hermits, Explorers, Nomads and Wanderes).

Thirdly, the challenges stands at the Z and α generations, since despite of their digital exposure to t digital technology and the digital society, they are still not digitally mature (Figure 13).

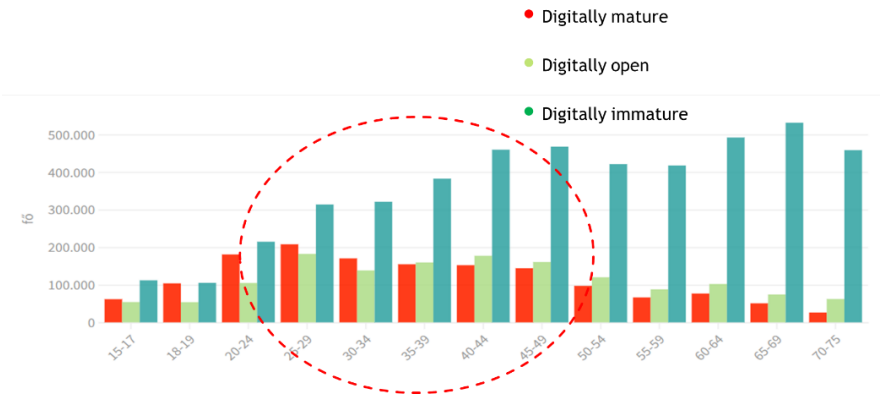


Figure 13.
Age group distribution by digital maturity in Hungary 2019 [24]

The percentage distribution of age groups by digital maturity clearly shows that in the active population the proportion of population with digital maturity is low compared to digital immaturity and digital openness. The situation in Hungary calls for further digitally intensive trainings and trainings to improve digital skills and

competences. Citizens, similarly to SMEs, need to be supported to reach the skills and competence level of Digital Conquerors, since SMEs that are getting more and more digitalized will need labor force with high digital skills and competences and members of the Z and α generations entering the labor market without digital maturity will not be able to fulfill the market and industry requirements and demand.

The Digital Competence Wheel is a possible tool to assess an individual's digital skills and competences [26]. Its purpose is to provide an overview of digital competences, and offer concrete and specific tools to how these competences can be elevated and improved. It serves as a valuable resource for individuals and organizations seeking to assess and develop their digital skills in an ever-evolving digital landscape.

Conclusions

The various indicators and index numbers show some contradictions but converge in the case of Hungary. In Hungary as could be seen from the DESI, DII and NRI, the digitalization should speed up to reach the average yearly growth rate of the countries standing at the same digitalization level. A speeding up digitalization could move the Hungarian economy from the 'Watch out' to the 'Stall out' economy, reaching a double effect and achieving a higher digitalization momentum and digital evolution state. Since the country has a backlog in the Human Capital and the Integration of digital technologies, further training programs are required in the everyday operation of not only the SMEs, but already in schools and higher education to improve the digital skills and competences of people [27]–[29]. Further incentives are required to help SMEs to apply more and more digital tools and possibilities and transform their operational, manufacturing and administrative processes digital.

The Digital Chasm and Digital Divide could be narrowed with direct investments into SMEs being in the groups of Fadeaways, Reinventors and Adaptors. SMEs in the Adaptors category, which need more change and have limited digitalization but plans to digitalize are the easiest to support since these SMEs have the will to digitalize [30], [31]. These SMEs are also Digital Explorers, Adopters who could easily become Digital leaders in their economic sector.

The present research compared three index numbers and explored how Hungary perform according to these indicators. The situation of Hungarian SMEs in terms of digitalization and the digital maturity of SMEs and the population have also been discussed. The paper summarized what incentives can be provided and how education and training could boost digitalization and improve the country's performance.

References

[1] D. J. Cranfield, A. Tick, I. M. Venter, R. J. Blignaut, and K. Renaud, "Higher Education Students' Perceptions of Online Learning during COVID-19—A Comparative Study," Education Sciences, 11(8), pp. 403, Aug. 2021, doi: 10.3390/educsci11080403.

[2] A. Tick, G. Szabó, and R. Zs. Reicher, "Contribution of a CRM System to the Creation of a Family-Friendly Working Environment," ACTA POLYTECH HUNG, 18(11), pp. 75–96, 2021, doi: 10.12700/APH.18.11.2021.11.5.

[3] D. Cranfield, I. Venter, A. Tick, R. Blignaut, and K. Renaud, "'THE E-LEARNING QUAGMIRE OF COVID-19: AN ACADEMIC PERSPECTIVE," in INTED2023 Proceedings of 17th International Technology, Education and Development Conference, Valencia, Spain, 2023, pp. 4716–4725. Accessed: Apr. 16, 2023. [Online]. Available: https://library.iated.org/view/CRANFIELD2023ELE

[4] European Commission, "The Digital Economy and Society Index (DESI) | Shaping Europe's digital future." European Commission, 2022. Accessed: May 29, 2023. [Online]. Available: https://digital-strategy.ec.europa.eu/en/policies/desi

[5] European Commission, "Digital Economy and Society Index (DESI) 2022 - thematic chapters," 2023. Accessed: Jun. 10, 2022. [Online]. Available: https://digital-strategy.ec.europa.eu/en/library/digital-economy-and-society-index-desi-2021

[6] European Commission, "Digital Economy and Society Index (DESI) 2022 - Hungary," 2023.

[7] The Portulans Institute, "Network Readiness Index – Benchmarking the Future of the Network Economy," https://networkreadinessindex.org/, 2022. https://networkreadinessindex.org/ (accessed Mar. 16, 2023).

[8] The Fletcher School, "Digital Intelligence Index," Digital Planet, Dec. 01, 2020. https://sites.tufts.edu/digitalplanet/digitalintelligence/ (accessed Jul. 15, 2023).

[9] B. Chakravorti, R. S. Chaturvedi, C. Filipovic, and G. Brewer, "DIGITAL IN THE TIME OF COVID." The Fletcher School at Truft University, 2020. Accessed: May 19, 2022. [Online]. Available: https://sites.tufts.edu/digitalplanet/files/2021/03/digital-intelligence-index.pdf

[10] KFÜ, "Digital Success Programme," About Digital Success Programme, 2023. http://digitalisjoletprogram.hu/en (accessed Mar. 10, 2023).

[11] A. Aras and G. Büyüközkan, “Digital Transformation Journey Guidance: A Holistic Digital Maturity Model Based on a Systematic Literature Review,” Systems, vol. 11, no. 4, p. 213, 2023, doi: 10.3390/systems11040213.

[12] Á. Gubán and Á. Sándor, “A KKV-k digitáliserettség-mérésének lehetőségei,” Veztud, 52(3), pp. 13–28, Mar. 2021, doi: 10.14267/VEZTUD.2021.03.02.

[13] T. Haryanti, N. A. Rakhmawati, and A. P. Subriadi, “The Extended Digital Maturity Model,” BDCC, 7(1), pp. 17, Jan. 2023, doi: 10.3390/bdcc7010017.

[14] R.-L. Ochoa-Urrego and J.-I. Peña-Reyes, “Digital Maturity Models: A Systematic Literature Review,” in Digitalization, D. R. A. Schallmo and J. Tidd, Eds., in Management for Professionals. Cham: Springer International Publishing, 2021, pp. 71–85. doi: 10.1007/978-3-030-69380-0_5.

[15] T. Thordsen, M. Murawski, and M. Bick, “How to Measure Digitalization? A Critical Evaluation of Digital Maturity Models,” in Responsible Design, Implementation and Use of Information and Communication Technology, M. Hattingh, M. Matthee, H. Smuts, I. Pappas, Y. K. Dwivedi, and M. Mäntymäki, Eds., in Lecture Notes in Computer Science, 12066. Cham: Springer International Publishing, 2020, pp. 358–369. doi: 10.1007/978-3-030-44999-5_30.

[16] C. Williams, D. Schallmo, K. Lang, and L. Boardman, “Digital Maturity Models for Small and Medium-sized Enterprises: A Systematic Literature Review,” in Proceedings of the XXX ISPIM Innovation Conference: Celebrating Innovation: 500 Years Since Da Vinci, I. Bitran, S. Conn, C. Gernreich, M. Heber, E. Huizingh, O. Kokshagina, M. Torkkeli, and M. Tynnhammar, Eds., Florence: ISPIM, 2019, pp. 1–15.

[17] M. Gill and S. VanBoskirk, “The Digital Maturity Model 4.0,” p. 17, 2016.

[18] S. VanBoskirk, M. Gill, D. Gree, A. Berman, J. Swire, and R. Birrell, “The Digital Maturity Model 5.0,” pp. 18, 2017.

[19] I. V. Aslanova and A. I. Kulichkina, “Digital Maturity: Definition and Model,” in Proceedings of the 2nd International Scientific and Practical Conference “Modern Management Trends and the Digital Economy: from Regional Development to Global Economic Growth” (MTDE 2020), Yekaterinburg, Russia: Atlantis Press, 2020. doi: 10.2991/aebmr.k.200502.073.

[20] Deloitte, “Digital Maturity Model, Achieving digital maturity to drive growth.” Deloitte, 2018. Accessed: Feb. 28, 2023. [Online]. Available: https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Technology-Media-Telecommunications/deloitte-digital-maturity-model.pdf

[21] DRL, “Digital Readiness Level,” https://drl-tool.org/about, 2017. https://drl-tool.org/about (accessed Mar. 10, 2021).

[22] The Manufacturer, “Free Digital Readiness Level Tool shows the way to industrial digitalisation,” The Manufacturer, 2018. https://www.themanufacturer.com/articles/free-digital-readiness-level-tool-shows-the-way-to-industrial-digitalisation/ (accessed Mar. 20, 2023).

[23] Deloitte, “SME Digitalisation - charting a course towards resilience and recovery,” Vodafone, 2020. Accessed: Dec. 10, 2022. [Online]. Available: https://www.vodafone.com/sites/default/files/2020-10/sme-digitalisation.pdf

[24] I. Tatár, “Digitális érettség Magyarországon,” PanMedia.hu, Mar. 30, 2020. https://panmedia.hu/digitalis-erettseg/ (accessed Feb. 16, 2023).

[25] A. Buda, “Generációk, társadalmi csoportok a 21. században,” Ma.Tud., 180(1), pp. 120–129, Jan. 2019, doi: 10.1556/2065.180.2019.1.12.

[26] A. Skov, “The Digital Competence Wheel,” https://digital-competence.eu/, 2015. https://digital-competence.eu/ (accessed Jul. 17, 2022).

[27] R. Saáry, J. Kárpáti-Daróczi, and A. Tick, “Profit or less waste?: Digitainability in SMEs: A comparison of Hungarian and Slovakian SMEs,” Serb J Management, 17(1), pp. 33–49, 2022, doi: 10.5937/sjm17-36437.

[28] Z. R. Szabó and L. Hortoványi, “Digitális transzformáció és ipar 4.0: magyar, szerb, szlovák és román tapasztalatok,” Külgazdaság, vol. 65(5-6), pp. 56–76, 2021, doi: 10.47630/KULG.2021.65.5-6.56.

[29] A. Tick, J. Kárpáti-Daróczi, and R. Saáry, “‘To familiarize or not to familiarize’ - Industry 4.0 implementation in SMEs in Hungary,” in Possibilities and barriers for Industry 4.0 implementation in SMEs in V4 countries and Serbia, T. Milan, Ed., Bor: University of Belgrade, Technical Faculty in Bor, Engineering Management Department (EMD), 2022, pp. 35–61. [Online]. Available: https://media.sjm06.com/2022/04/MONOGRAPHY_I4.0_2022.pdf

[30] A. Tick, “Industry 4.0 Narratives through the Eyes of SMEs in V4 Countries, Serbia and Bulgaria,” ACTA POLYTECH HUNG, 20(2), pp. 83–104, 2023, doi: 10.12700/APH.20.2.2023.2.5.

[31] A. Tick, R. Saáry, and J. Kárpáti-Daróczi, “Conscious or Indifferent: Concerns on digitalisation and sustainability among smes in Industry 4.0,” Serb J Management,17(1), pp. 145–160, 2022, doi: 10.5937/sjm17-36412.

Is green banking gaining momentum? Evidence from Albania

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Abstract: Green banking has gained momentum recently due to growing awareness of environmental issues and the need for sustainable development. Many banks and financial institutions have adopted green banking practices as part of their corporate social responsibility efforts and to meet the increasing demand for sustainable financial services. The present study offers insights into green banking in Albania. One hundred fifty-five questionnaires were completed with the employees of commercial banks operating in the country. Three aspects of green banking are explored 1. Daily operations, 2. Environmental Policies, and 3. Investments in green projects. The results show that banks in Albania are focused on protecting the environment in their daily operations by reducing the use of paper and energy, introducing energy-efficient equipment, and using environmentally friendly banking practices (e-mail, e-statement, online transfers, Etc.). Also, Research and Development continuously focuses on environmental issues. Banks have green environmental performance evaluation practices (environmental sustainability measures, energy saving) and have planned the construction of green branches (energy efficient buildings/green buildings Etc.). Additional research is needed to explore environmental protection literacy and how the latter impacts the behaviour of all the stakeholders in the banking system in Albania. Also, how the European Integration of Albania and Green Deal Agenda affects the green banking further development.

1 Introduction

In the face of diminishing resources and environmental challenges, concerns for sustainable development are rising (Gura et al., 2021). There is a need to tackle sustainability, which can be achieved by integrating national and international policies regarding the circular economy (CE), the green economy (GE), and the bio-economy (BE). These concepts offer various solutions to sustain economic, social, and environmental objectives(Gura et al., 2021). Climate change, environmental degradation is an issue that has affected all countries. Society is increasingly becoming aware of the importance of the environment, so there is a need for banks in their activities to focus on protecting the environment by using green strategies. (Mir & Bhat, 2022) Banks influence the environment through internal activities, such as electricity, water, and paper, and external activities indirectly, such as investment, lending, risk management, etc. Managers, employees, and investors create green products and design environmentally friendly policies, contributing to sustainability. According to Zhixia, Hossen, Muzafary, & Begum (2018), green banking is a form of banking where banks, during their activity, keep in focus the protection of the environment by realizing green financing and thinking about sustainability in the future. According to Oyegunle & Weber (2015), the application of green practices by banks has been developed in developed and developing countries. This shows an ever-increasing awareness of the effect of climate change and the importance of the environment in many countries. The biggest banks in Albania have started to apply green practices in their operations. In Albania, climate change creates physical and transition risks that have a social and economic impact on Albanian companies and families but can also have a financial impact, thus affecting the financial system's stability (Topalli & Monnin, 2023). This study aims to examine green banking potential in Albania. And the main objectives are: to identify the environmental policies followed by banks in Albania and to identify the daily operations of banks in the environmental protection framework. Based on the purpose of the paper, the two research questions that arise are:

RQ 1: Do banks in Albania have environmental policies to protect the environment?

RQ 2? Do banks in Albania support investments in green projects?

The descriptive analysis with the result obtained from the questionnaire was used to provide answers to the raised research goals. However, this paper presents some initial results of the study since more in-depth analyses should be undertaken to identify green banking practices, the factors that influence them, and their impact on environmental performance.

2 Literatura review

2.1 What is green banking?

Now Green Banking is a concept that is used all over the world nowadays. The main goal is the prevention of environmental degradation (Shakil, Azam, & Raju, 2014). According to Mathew (2021), Green Banking is a new development focusing on banking operations and investments that protect the environment. Green banking refers to banks' efforts to use the bank's resources responsibly and keep sustainability in focus. Otherwise, green banking is also known as ethical, sustainable banking focusing on environmental protection (Vijai, 2018). Green banking is an initiative of banks to be conscious in society by creating environmental sustainability (Sharma & Choubey, 2022). Green Banking is defined as banks that follow green practices aimed at protecting the environment during their activity. Green banking has two approaches: First, banks' internal operations are green. Banks use renewable energy and automation and strive to minimize the carbon footprint of their activities. Second, banks support financing and green projects. Green banking includes several aspects, from their activity to protect the environment to how and where their money is invested (Islam & Das, 2013).

2.2 Green banking Products

Green banks have adapted their banking products into green banking products to fulfil their focus on protecting the environment. Some green banking products are:

- Green mortgages Through these loans, banks offer loans to customers with lower interest to buy houses that use high energy efficiency.
- Green car loan banks encourage customers to buy cars with high fuel efficiency by offering low-interest rates.
- Green credit cards include debit and credit cards related to environmental activities.
- Green savings accounts, Green CDs, these products enable individuals to invest their savings in green projects aimed at protecting the environment.
- Mobile Banking, Online banking Through these services, clients can do any action in their account without physically going to the bank. Clients can save time, money, paper, and fuel for transportation.

2.3 The importance of green banking.

Green banking applied by banks affects the creation of a sustainable environment. However, banks also increase their image and the number of clients by attracting customers ready to contribute to protecting the environment. Green banking practices not only contribute to environmental protection (Shameem & Haleem,

2021). Banks play an essential role in lending to individuals and businesses, influencing the country's economic development. Therefore, they impact promoting a sustainable environment (Nath, Nayak, & Goel, 2014). According to Weber (2016), one of the main factors affecting the banks' ability to take on new challenges, such as green banking, is the size of the banks. In order to make green investments, banks must evaluate the risks so as not to endanger either themselves or the client.

Environmental degradation creates risks for banks and has indirect costs for banks. Green banking is significant both for banks and the economy and avoids credit, legal and reputational risks. Green banks finance green technology and projects that reduce pollution. Every bank should aim to protect the environment and, in this way, minimize credit risk, legal risk and of reputation (Hoque, Mowla, Uddin, Mamun, & Uddin, 2019). According to (Deka, 2015), bank clients benefit from green banking practices as they are convenient and less cost-effective because it is unnecessary to go to the bank to carry out their transactions. Even for banks, green banking brings benefits as they have less postal costs and the workload of bank employees decreases. According to the study by Miah & Rahman (2018), it was identified that the old banks are with less environmental performance compared to new banks as new banks are equipped with modern and green technologies.

But on the other hand, the environmental performance of the banks was not affected by the size or profitability of the banks. According to Chen, Siddik, Zheng, Masukujjaman, & Bekhzod (2022), from their analysis, it was observed that the daily operations and the efforts of bank employees to follow green practices positively affect green financing. At the same time, the banks' efforts to follow green practices with customers had no significant impact.

Also, the study done by Shaumya & Anton Arulrajah (2017) identified that green banking practices affect the bank's environmental performance. Daily operations and green practices followed by employees also affected the environmental performance of banks. However, it was observed that customer-related green practices did not significantly impact environmental performance. According to Mir & Bhat (2022), the green banking practices followed by the banks make the banks save money and energy and, in this way, affect the growth of the country's GDP.

3 Methodology

3.1 Survey instrument

The methodology is based on primary data, and the research instrument used to conduct the study is the questionnaire. The questionnaire is composed of three main sections. In the first section are questions related to the banks' efforts to protect the environment, as are questions related to Daily Operations, Environmental Policies and Goals, Investments in green projects etc. The second section includes questions

about Organizational Social Capital, which are not subject to analysis in this paper. In the third section, the demographics of the respondents are collected, such as age, gender, education level, and experience.

3.2 Sampling and Data Collection

The data was collected in the period July - December 2022. The questionnaire is distributed online to employees of commercial banks operating in Albania. A balance has been kept, so we have almost the same number of questionnaires from each bank. A total of 155 questionnaires were completed.

As can be seen from Table 1, most of the surveyed employees are women, respectively 73.5%, while 26.5% are men. This is also related to the fact that in the banking system in Albania, the majority of employees are women. Approximately 50% of the employees belong to the 31-40 age group, 35.5% to the 20-30 age group, a small number of 5.2% belong to the 41-50 age group, and 9.7% are over 50 years old. Most employees, 74%, have a master's degree, 24.5% have completed a bachelor's degree, and 1.3% have a doctorate. Regarding the years of experience in the banking system, 26.5% have 1-3 years of experience, 13% have 4-6 years, and most interviewees have more than six years of experience, meaning they know the banking system very well.

Demographics	Value	Frequency	Frequency percentage
Gender	Male	41	26.5%
	Female	114	73.5%
Age	20-30	55	35.5%
	31-40	77	49.7%
	41-50	8	5.2%
	Over 50	15	9.7%
Educational Level	Bachelor	38	24.5%
	Master	115	74.2%
	PhD	2	1.3%
	1-3 years	41	26.5%
Experience	4-6 years	20	12.9%
	Over 6 years	94	60.6%

Table 1

Demographics

Source: Authors elaboration

4 Results

To identify the daily operations of banks in the framework of environmental protection, the environmental policies followed by banks in Albania and the engagement of banks in green projects, the questionnaire addressed to bank employees is adapted from Malsha, Arulrajah, & Senthilnathan (2020). As presented in Table 2, six questions were used as follows to identify the daily operations followed by the banks to preserve the environment. The analysis shows that 88% of banks have taken initiatives to reduce the use of paper and energy, and 67% use energy-efficient equipment. Also, most banks use environmentally friendly banking practices (e-mail, e-statement, online transfers, Etc.) to reduce paper by 91%. Banks' efforts and goals to protect the environment during daily activities can only function with the support of their employees. Therefore, banks encourage their employees to communicate online to save paper use. 55% of banks regularly organise seminars to promote environmentally friendly practices in day-to-day operations because the more significant the knowledge about the environment, how they can protect and improve the quality of the environment during their work directly affect the functioning of the purpose of banks to protect the environment. Most of the banks, 94%, as seen from the table, use the same practice with their clients, who try to push them to use environmentally friendly banking services such as e-statement practices, online transfers, Etc.

From the results of the table, banks, during their daily activities, try to protect the environment. In order to analyse the environmental policies followed by the banks, nine questions were analysed. 65% of "Research and Development" banks pay attention to environmental protection. Since only in recent years has green banking started to be applied by banks, it is noted that only 42% of banks regularly perform environmental audits. 63% of banks have green environmental policies and pollution prevention plans. Banks have programs where they encourage employees to make suggestions about how banks can influence the preservation of the environment, and accordingly, approximately 55% of banks apply this practice. At the corporate level, 78% of banks promote an environmentally friendly policy. To support their environmental policies, approximately 49% of banks have agreements related to the environment with relevant parties/actors (suppliers, customers, Etc.).

On the other hand, 61% of banks support environmentally friendly companies by purchasing their items, such as printers, computers, Etc., from these companies. Also, 49% of banks encourage businesses that apply for loans to respect environmental standards. 45% of banks use green environmental performance assessment practices (environmental sustainability measures, energy saving measures, Etc.) to assess how much they have achieved their goal to protect the environment. Moreover, in the future, the banks' focus will be protecting the environment since the construction of green branches (energy efficient buildings/green buildings) is planned in 58% of the banks. Also, in Table 2, investments in green projects made by banks are analysed. Approximately 56% of

banks develop specific green products and services besides traditional banking products. Banks offer loans for projects related to environmental protection and energy saving; this practice is followed by 59% of banks. In addition, 59% of banks promote and facilitate environmentally oriented businesses through grants, loans, and special guidelines. Most of the banks, 74%, have undertaken several initiatives and independent green projects, such as planting trees.

60% of banks offer lower-interest green mortgage loans to homebuyers/energy-saving loans classified as pro-environment, and 47% offer green car finance at lower interest to buy a car with low or zero emission. Also, 69% of banks promote and facilitate credit lines for green projects. In addition to loans, banks have also considered savers by developing green deposit schemes, a term deposits for investors who want to invest their excess cash reserves in environmentally friendly projects). On the other hand, to limit environmental damage, banks refuse to give loans for projects that harm the environment. Most of the banks have invested in electronic banking and mobile banking. However, this may have happened before in the digitisation framework of banks rather than specifically in the environmental protection framework.

The main constructs	**Indicators**	**Strongly Disagree**	**Disagree**	**NA/D**	**Agree**	**Strongly Agree**
Daily Operations	Your bank has taken initiatives to reduce the use of paper and reduce energy.	1.29%	1.29%	9.03%	37.42%	50.97%
	Your bank has introduced energy efficient equipment	0%	1.94%	30.32%	31.61%	36.13%
	Your bank uses environmentally friendly banking practices (e-mail, e-statement, online transfers, etc.) to reduce paper	0%	0.65%	7.74%	26.45%	65.16%
	Your bank encourages customers to use	0.00%	0.00%	5.16%	27.10%	67.74%

	environmentally friendly banking services such as e-statement practices, online transfers, etc.					
	Your bank encourages employees to communicate through online communication	0.00%	1.29%	5.81%	40.00%	52.90%
	Your bank regularly organizes seminars to promote environmentally friendly practices in day-to-day operations	2.58%	5.16%	36.77%	33.55%	21.94%
Environmental Policies and Goal		**Strongly Disagree**	**Disagree**	**NA/D**	**Agree**	**Strongly Agree**
	In your bank "Research and development" is continuous on environmental issues.	0.65%	3.23%	30.32%	39.35%	26.45%
	In your bank and branches, the environmental audit is done regularly.	3.23%	6.45%	47.10%	19.35%	23.87%
	Your bank has green environmental policies and pollution prevention plans.	0.00%	5.16%	30.32%	33.55%	30.97%

	Employee incentive programs for environmental suggestions are in place	1.94%	14.84%	28.39%	33.55%	21.29%
	Your bank has green environmental performance evaluation practices (environmental sustainability measures, energy saving measures etc)	1.29%	14.84%	39.35%	23.23%	21.29%
	In your bank is planned the construction of green branches (energy efficient buildings/green buildings)	0.65%	3.23%	38.06%	29.68%	28.39%
	Your bank has environmental-related agreements with relevant parties/stakeholders (suppliers, customers, and etc.)	0.00%	1.94%	49.03%	29.03%	20.00%
	Your bank promotes an environmentally friendly policy at corporate level	0.65%	0.00%	20.65%	45.16%	33.55%

	Your bank purchases its stationeries, equipment's and other items from environmentally friendly companies (e.g. printers, computers, and etc.)	0.00%	2.58%	36.13%	36.13%	25.16%
	Your bank asks businesses that apply for loans to respect environmental standards	0.65%	3.87%	46.45%	25.81%	23.23%
		Strongly Disagree	**Disagree**	**NA/D**	**Agree**	**Strongly Agree**
Investments in green projects	Your bank develops specific green products and services and adds them to the list of traditional banking products.	0.00%	10.97%	33.55%	35.48%	20.00%
	Your bank provides loans for projects related to environmental protection and energy saving.	0.00%	3.23%	37.42%	40.00%	19.35%
	Your bank implements several initiatives, independent green	0.00%	3.23%	23.23%	38.71%	34.84%

	projects. (eg planting trees).					
	Your Bank promotes and facilitates environmentally oriented businesses through grants, loans and special guidelines	0.65%	1.29%	10.32%	47.74%	40.00%
	Your bank promotes and facilitates credit lines for green projects.	0.65%	1.29%	29.68%	42.58%	25.81%
	Your bank provides green mortgage loans with lower interest for customers who buy energy-saving houses/loans classified as pro-environmental).	0.65%	0.65%	39.35%	23.87%	35.48%
	Your bank finances the purchase of green cars (Lower interest financing to buy a low-emission or zero-emission car)	10.97%	7.74%	34.84%	22.58%	23.87%
	Your bank has developed green deposit schemes (a term deposit for investors seeking to invest their excess cash reserves in	3.23%	14.19%	31.61%	34.84%	16.13%

	environmentally friendly projects).					
	Your bank refuses to grant loans for projects that have a negative impact on the environment	4.52%	12.26%	50.32%	21.29%	11.61%
	Your bank refuses to grant loans for projects that have a negative impact on the environment.	5.16%	10.97%	28.39%	34.84%	20.65%
	My bank made investment in electronic and online banking	0.00%	1.94%	16.13%	19.35%	62.58%
	My bank made investment in mobile banking	0.00%	1.29%	4.52%	28.39%	65.81%

Table 2
Environmental policies of banks
Source: Authors elaboration

Conclusions

This paper aims to identify the potential of green banking in Albania. From the above descriptive analysis, it was evident that banks in Albania have begun to become aware of the importance of the environment, so they have begun their efforts by drafting environmental policies. In corporations, 78% of banks promote an environmental policy with the environment. To support their environmental policies, approximately 49% of banks have agreements related to the environment with relevant parties/actors such as suppliers, customers, Etc. In their initiative to protect the environment, they rely on their employees. Banks have programs that encourage employees to suggest how banks can influence the preservation of the environment. Banks have also increased green banking products and services. 60% of banks offer lower-interest green mortgage loans to homebuyers/energy-saving loans classified as pro-environment, and 47% offer green car finance at lower interest to buy a car with low or zero emission. Also, 69% of banks promote and facilitate credit lines for green projects. Although the Albanian banking sector has started to offer green banking products, further actions are needed to support green

projects to achieve sustainability against climate risks (Topalli & Monnin, 2023). Therefore, in its medium-term strategy for 2022-2024, the Central Bank of Albania focuses on monitoring climate risks for banks and the economy. The banking sector is vital in protecting the environment and creating sustainability through its daily activity, environmental policies, and investment in green projects.

References

[1] Chen, J., Siddik, A., Zheng, G.-W., Masukujjaman, M., & Bekhzod, S. (2022). The Effect of Green Banking Practices on Banks' Environmental Performance and Green Financing: An Empirical Study. Energies, 15(1292), pp. 1-22. https://doi.org/10.3390/en15041292.

[2] Deka, G. (2015). Green banking practices: a study on environmental strategies of banks with special reference to state bank of India. Indian Journal of Commerce & Management Studies, VI(3), pp.11-19.

[3] Gura, K. S., Kokthi, E., & Kelemen-Erdős, A. (2021). Circular Pathways Influential Factor in Albania through Green Products Approximation. Acta Polytechnica Hungarica, 18(11).

[4] Gura, K. S., Kokthi, E., Hodaj, N., & Zoto, O. Circular economy pathway influential factors in Albania through green products approximation. In 3rd international conference, pp. 179.

[5] Gura, K. S., Gura, S., & Kokthi, E. How branding strategy use labeling on products as a policy tool in shifting toward circular economy. In 3rd International conference, pp. 431.

[6] Hoque, N., Mowla, M., Uddin, M., Mamun, A., & Uddin, M. (2019). Green Banking Practices in Bangladesh: A Critical Investigation. International Journal of Economics and Finance; 11(3), pp.58-68.

[7] Islam, S., & Das, P. (2013). Green Banking practices in Bangladesh. OSR Journal of Business and Management , 8(3), pp. 39-44.

[8] Malsha, K., Arulrajah, A., & Senthilnathan, S. (2020). Mediating role of employee green behaviour towards sustainability performance of banks. Journal of Governance and Regulation , 9(2), pp. 92-102, DOI: 10.22495/jgrv9i2art7.

[9] Mathew, A. (2021). Green banking: an innovative initiative for sustainable financial devlopement. EPRA International Journal of Multidisciplinary Research, 7(12), pp. 2455-3662.

[10] Miah, M., & Rahman, S. (2018). Factors affecting environmental performance: evidence from banking sector in Bangladesh . Int. J. Financial Services Management, 9(1), pp. 22-38. DOI: 10.1504/IJFSM.2018.089917.

[11] Minxhozi, L. (2022). Green Finance - Possibilities for the financial sector in Albania. Bank of Albania.

[12] Mir, A., & Bhat, A. (2022). Green banking and sustainability – a review. Arab Gulf Journal of Scientific 40(3), pp. 247-263, DOI 10.1108/AGJSR-04-2022-0017.

[13] Nath, V., Nayak, N., & Goel, A. (2014). Green banking practices – a review. IMPACT: International Journal of Research in Business Management, 2(4), pp. 45-62, www.impactjournals.us.

[14] Oyegunle, A., & Weber, O. (2015). Development of Sustainability and Green Banking regulations existing codes and practices. Cigi papers, 65, pp. 1-12,www.cigionline.org.

[15] Shakil, M., Azam, K., & Raju, M. (2014). An Evaluation of Green Banking Practices in Bangladesh . European Journal of Business and Management, 6(31), pp.8-16.

[16] Shameem, A., & Haleem, A. (2021). A Study On Green Banking Practices In Banking Industry: Sri Lankan Context. Journal of Contemporary Issues in Business and Government 27(1), pp. 490-505.

[17] Sharma, M., & Choubey, A. (2022). Green banking initiatives: a qualitative study on Indian banking sector. Environment, Development and Sustainability, 24, pp. 293–319, https://doi.org/10.1007/s10668-021-01426-9.

[18] Shaumya, K., & Anton Arulrajah, A. (2017). The Impact of Green Banking Practices on Bank's Environmental Performance: Evidence from Sri Lanka. Journal of Finance and Bank Management, Vol. 5, No. 1,, 77-90.

[19] Topalli, M., & Monnin, P. (2023). Climate Risks in Albania and their Relevance to the Central Bank. SUERF Policy Brief, No 541, 1-7, t www.suerf.org/policynotes.

[20] Vijai, C. (2018). A Study on Customer's Awareness on Green Banking Initiatives in Selected Public and Private Sector Banks with Special Reference. International Journal of Innovative Research in Science,Engineering and Technology, 7(11), pp. 9362-9367, www.ijirset.com.

[21] Weber, O. (2016). The impact of green banking guidelines on the sustainability performance of banks:The Chinese case. Policy Brief, 79, pp. 1-6, www.cigionline.org.

[22] Zhixia, C., Hossen, M., Muzafary, S. S., & Begum, M. (2018). Green banking for environmental sustainabilitypresent status and future agenda: experience from Bangladesh. Asian Economic and Financial Review, 8(5), pp. 571-585.

Mental Health in The New Reality

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Abstract: The COVID-19 pandemic has affected our lives in many areas. A new acronym developed: "BANI" (Brittle, Anxious, Non-linear, Incomprehensible) - referring to our world's unforeseen and frequently chaotic changes; it puts enormous pressure on us humans - how to adapt quickly and continuously. At the same time we have learned to highly value our health. The process of digital transformation has affected the healthcare worldwide. The use of digital technology has helped to preserve the health of many people in recent years. In our days "e-Health" is a widely used "buzzword". The number of advertisements and smartphone applications encouraging a healthy lifestyle is enormous. The purpose of this paper is: to draw attention to the everyday use of a very simple health-preserving method. This method can be used by everyone. It is easy to implement, effective and safe. It does not require the use of any digital device. Its effectiveness on a person's mental and physical state has been scientifically proven. This is the conscious deep ("diaphragmatic") breathing exercise. The author reviews some latest scientific evidence and explains what to do and how to implement it in practice in order to preserve our health.

Key words: e-health, "BANI", stress, physiology, slow diaphragmatic breathing (SDB)

1 Introduction

1.1 Changes in today's world

We all know that change is natural and constant in all areas of life. During and after the COVID-19 pandemic, changes have accelerated in an extreme way in the world.

Throughout history, philosophers, economists and scientists - working in various fields -have created various "models" to biefly describe the current situation, the "state of things".

The acronym "VUCA" (Volatility, Uncertainty, Complexity, Ambiguity) is created at 1985 by economists Warren Bennis and Burton Nanus (Bennis et al, 1986). "Volatility" covers the constant change of the world. "Uncertainty" is for: lack of knowledge about a situation or an event. Complexity mostly associated with the quantity of factors needed to analyse and with the relations between them.

Ambiguity associated with the inability to understand conditions or events, the lack of clarity. (Taskan et al, 2022)

In March 2022 Jamais Cascio - author and global thinker -, created the "BANI" model. This acronym states for: Brittle, Anxious, Non-linear, Incomprehensible. These words remind us: in our days many changes are not only surprising, but sometimes completely desorienting (Cascio J. 2020). Togan A. in her overview briefly analyzes the relationship between VUCA and BANI from a practical point of view. (Togan A., 2023). It seems that in today's world, the amount and speed of changes is greater than ever before. The logical consequences of all this has a strong influence on people's mental and physical health.

1.2 Changes is the field of healthcare

Usage of digital technologies is integral part of our daily live. During the pandemic we learned how to use digital technology in "remote consultation" with medical health care providers. More and more people are using smartphone applications which developed for healthy life. "e-Health" has become a widely used buzzword.

1.2.1 What is e-Health?

World Health Organization (WHO) defines e-Health as "the cost-effective and secure use of information and communications technologies in support of health and health-related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research." (WHO, e-Health, 2023). WHO elaborated a Global Strategy on Digital Health 2020-2025, in order to promote healthy lives and wellbeing for everyone. (WHO, Digital Health 2023)

1.2.2 What is mental health?

Mental health is a complex continuum. "Mental health is a state of mental well-being that enables people to cope with the stresses of life, realize their abilities, learn well and work well, and contribute to their community." (WHO, Mental Health, 2022) It is obvious, the people's mental health is essential to personal, community and socio-economic development. Let's think about this part of the quoted definition: "Mental health... enables people to cope with the stresses of life..." The question is: how?

2 Stress

2.1 Meaning of the word "stress"

We use this word day by day frequently... In the scientific literature we can read large number of different definitions. The word "stress" is derived from the Latin strictus = tight (Arcanum, 2023). At the beginning is used in physics, to refer the interaction between a force and the resistance to counter that force. The Hungarian scientist Janos Selye was the first, who used this term to describe the "general adaptation syndrome" or "nonspecific response of the body to any demand"(Selye, 1936). Interesting to note, that Selye did not use the word "stress" in his above mentioned publication, but only ten years later. This word started to used widely in the 1950s (Siang Yong Tan, 2018). The german scientist Fabian Hutmacher in his conceptual analysis found that many psychology textbook charactize "stress" as the notion that "*things are getting too much and out of balance"* (Hutmacher F. 2021).WHO defines stress: "as a state of worry or mental tension caused by a difficult sitatuation. Stress is a natural human response that prompts us to address challenges and threats in our lives. Everyone experiences stress to some degree. The way we respond to stress, however, makes a big difference to our overall well-being" (WHO Stress, 2023).

2.2 Some physiological changes in human body caused by stress

The autonomic nervous system is divided into the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS). When our body is stressed, the SNS contributes to what is known as the “fight or flight” response. During this response in our body there are lots of quick physiological changes. (Eg.: the adrenalin and cortisol level increases in our blood, heart beats faster, blood pressure rises, our breathing is hurried and superficial, etc.). Once the crisis is over, the SNS activity decreases parallel the PNS activity increases, and as a result our body returns to the pre-emergency state (APA, 2023; Yaribeygi H. et al, 2017).

3 Stress management

3.1 Healthy lifestyle

We are all aware of its components: balanced diet, sufficient daily water intake, healthy sleep habits, regular physical exercises, satisfactory social interactions.The author of this article convinced that the above list is not complet. Certainly all of them are essential for our health. One thing is missing from this well known list.

This is the deep "diaphragmatic breathing exercise" that should be done regularly. Before discussing this in details, let's review some basic biological facts related to breathing.

4. The human respiratory system

4.1 Some facts - from practical point of view

Respiration is a fundamental function of the human body, and it can be defined as: the exchange of oxygen and carbon dioxide between the organism and the environment via the cyclic act of ventilation (Mitsea E. et al 2022). In the microstructure of the two lungs, gas exchange happens in millions of microscopic alveolar units. Gas exchange takes place through the walls of these alveolar units (Berne & Levy, 2010). The human lungs' surface area for gas exchange is approx. 140 quadratmeter (Knudsen et al, 2018).

Breathing is an automatic process. From the moment we are born, we breath throughout our entire lives. Most adult people breath 12-16 times per minute. - It means, during a day we take around 20'000 breath! The physiological regulation of breathing is extremely complicated. - At the same time, we can voluntary control our mode of breathing - certainly within certain limits. At rest, during normal quiet inspiration with each breath we inhale approx. 500 ml of fresh air. With maximum inspiration ("take a very deep breath") 2'500 - 3'000 ml air enters into our lungs (Berne & Levy, 2010).

The major respiratory muscle is the diaphragm. This large, dome-shaped muscle located below the lungs and it divides the chest cavity from the abdominal cavity. During inspiration the diaphragm contracts and protrudes into the abdominal cavity and moves the abdomen outward to create negative pressure in the chest. It creates negative intrathoracic pressure, so the air from ouside flows into the lungs. During quiet breathing the diaphragm moves approximately 1 cm; however, during very deep breathing it can move as much as 10 cm. In rest, our expiration is passive, the diaphragm returns to its domed resting configuration, as a result, the lungs deflate and expel air (Berne & Levy, 2010).

Buzsaki writes in his book: "Life is governed by rhythm. Brain functions are governed by oscillatory activity" (Buzsaki, 2006). Breathing is also a rhythmic, cyclical activity. The respiratory system is one of the most integrated systems of the body and breathing is bidirectionally related with stress, emotion, and pain (Pratschner et al, 2023). Boyadzhieva and Kayhan in their detailed overview of the literature summarized how respiration modulates neural, cognitive and emotional processes (Boyadzhieva and K. 2021).

4.2 Nose breathing

Nasal breathing has important physiological functions by filtering, warming and humidifying inhaled air and in the nose cavity and the so called paranasal sinuses are producing an imporant gas: nitric oxide (NO). In 1998 the Nobel Prize in Physiology or Medicine was awarded to three pharmacologists for their discoveries concerning "The nitric oxide as signaling molecule in the cardiovascular system" (Nobel Prize, 1989). Research confirmed that nitric oxide is physiologically important in airway regulation, reduces respiratory tract infections by antibacterial activity and by inactivating viruses (!) (Martel et al 2020). Nasal nitric oxide remotely controls pulmonary function as well (Martel et al 2020; Jeong J-H, 2021; Spector, 2023).

Certainly the nose enables olfaction. The olfactory cleft is at the roof of the nasal cavity. During nasal breathing the airflow stimulates olfactory sensory neurons in the olfactory bulb, which synchronizes respiratory rate and neural oscillations in the different parts of the brain (Boyadzhieva, 2021). Breathing mode (nose vs mouth) and respiratory phase (inspiration vs expiration) can influence memory performance (Zelano et al. 2016). Molle and Benoit summarize the effect of breathing through the nose on memory (Molle et Benoit, 2019).

The practical benefit of this knowledge: "If you are in a dangerous environment with fearful stimuli our data indicate (tells Christina Zelano in the Northwestern's University's YouTube video) you can respond more quickly if you are inhaling through your nose" (Zelano, YouTube 2017).

Due to the facts listed above important to emphasize and keep in mind: *always breath in through your nose while your mouth is closed.*

5 Conscious breathing exercises

5.1 General overview

In the tradition of ancient eastern cultures, the health-preserving benefit of regularly performed breathing exercises - as part of the Yogi and the martial arts - known for thousands of years. Many of the relevant statements of these cultures make about the breath in our days verified through science. In recent decades, scientific interest increased worldwide: what physiological effect these breathing exercises have. (Bu B. et al, 2010; Hamasaki, 2020; Jayawardena et al. 2020; Moore et al. 2023).

Regular breathwork practices have emerged as potential tools for stress management and well-being, because of the respiratory system has influence on different brain regions, which regulate behavior, thinking and emotion (Balban, 2023; Ficham 2023).

I ask the reader to pause and do the following simple exercise: stand or sit comfortably with a straight back and relaxed shoulders. Place one palm in the center of your chest and the other on your belly (Figure 1). Take a few deep breath through your nose with your mouth closed and observe how much your abdominal wall moves.

Figue 1.
Inhale slowly and deeply through the nose with a minimum movement of the chest

Slow breathing in research has been defined as a respiratory rate less the 10 breath a minute (Russo et al, 2017). It has been known for a long time that slow breathing increases the variation in time intervals between heartbeats (Brown 2005). Healthy humans were studied and have found that controlled slow breathing, 6 breaths per min, is associated with positive effect on blood pressure, compared to breathing 12 -16 per min (Bernardi, 2001; Chang 2013, Zhang 2016).

5.2 Slow diaphragmatic breathing

Slow diaphragmatic breathing (SDB) also called "deep breathing", "belly breathing", "abdominal breathing".

5.2.1 How to practice slow diaphragmatic breathing?

There are countless breathing exercises - with different approaches. The author of this study himself practices the following:
A. *Mindset* - decide that you will focus exclusively on your breathing for the next five minutes.
B. *Body position* - this exercise can be done standing, sitting or lying on your back position. Place one palm in the center of your chest and the other on your belly.
C. *Start the controlled ventilation:*
1.) Inhale through your nose (with closed mouth) and inflate your belly like a balloon, feeling it gently press into your hand, while counting to four in your mind;
2.) Hold your breath, while counting to three in your mind;
3.) Exhale slowly through your mouth and contract your abdominal muscles, while counting to six in your mind;

4.) Hold your breath, while counting to three in your mind.
Repeat the cycle for five minutes.

Why you should focus on making your exhales longer (counting to six) than your inhales (counting only to four)? Because of during longer exhales the parasympathetic nervous system is more active, and it sends the message to your brain: "calm down". This slow, diaphragmatic breathing exercise can give you a sense of relaxed energy. The number "365" is a good reminder. Three times a day take six slow diaphragmatic breath per minute - during five minute - and repeat all 365 days of the year (Saulnier N, 2021).

5.2.2 Scientific evidence for the effectiveness of diaphragmatic breathing

Magnon V. and his research team were studying 25 young adults and 22 older adults subjective and objectively measured changes after deep and slow breathing exercise. The participants' subjective anxiety and physiological stress significantly decreased after only a 5 minutes deep and slow breathing exercise (Magnon V. et al 2021). Daily deep breathing exercise can lower resting blood pressure and reduce psychological stress and anxiety" (Birdee, 2023; Tavoian 2023).

Hamasaki conducted a literature review regarding the current evidence of the effect of diaphragmatic breathing on health. Mr. Hamasaki, who in addition to being a practicing medical doctor, also regularly practices martial arts. His own personal experience reinforces the effectiveness of diaphragmatic breathing. He summarizes in his study: "Diaphragmatic breathing has an impact on the brain and cardiovascular, respiratory, and gastrointestinal systems through the modulation of the autonomic nervous function" (Figure 2); (Hamasaki, 2020).

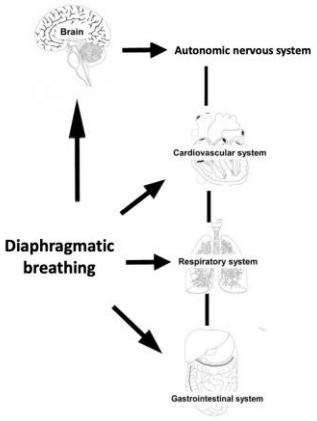

Figure 2

The effect of diaphragmatic breathing on various organs
(this figure is based on Hamasaki's figure 1 (Hamasaki, 2020)

Due to the physiological effect of diaphragmatic breathing exercises, it can improve the function of the autonomic nervous system , which regulates the general balance of the human body.

Conclusion

We live in a fast-paced, stressful world. In order to maintain our physical and mental health - additionally to the well know advices as balance diet, sufficient daily water intake, healthy sleep habits, regular physical exercises, satisfactory social interactions - it is advisable to start practicing regularly the slow diaphragmatic breathing exercises.

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References

[1] APA =American Psychological Association (2023). Stress effects on the body, March 8, 2023 https://www.apa.org/topics/stress/body

[2] Arcanum (2023); https://www.arcanum.com/hu/online-kiadvanyok/Lexikonok-magyar-etimologiai-szotar-F14D3/s-F3B58/stressz-F3D39/

[3] Balban M.Y., Neri E., Kogon M.M, Zeitzer M.J., Spiegel D., Hugerman D.A. (2023). Brief structured respiration practices enhance mood and reduce physiological arousal Cell Reports Medicine 4, 100895

[4] Bennis W. & Nanus B. (1986). Leaders. The Strategies For taking Charge Harper & Row, New York, (quoted by: vuca-world.org)

[5] Bern & Levy, Physiology, Sixth Edition, 2010, pp. 41-476, MOSBY Elsevier ISBN: 978-0-323-07362-2

[6] Bernardi L, Gabutti A, Porta C. (2001). Slow breathing reduces chemoreflex response to hypoxia and hypercapnia, and increases baroreflex sensitivity. Journal of Hypertension, 19: 2221–2229

[7] Birdee G, Nelson K, Wallston K, Nian H, Diedrich A, Paranjape S, Abraham R, Gamboa A. (2023). Slow breathing for reducing stress: The effect of extending exhale; Complementary Therapies in Medicine 73, 102937

[8] Boyadzhieva A. and Kayhan E (2021). Keeping the Breath in Mind: Respiratrion, Neural Oscillations and the Free Energy Principle, Frontiers in Neuroscience 15.

[9] Brown, R.P., and Gerbarg, P.L.: (2005) Sudarshan Kriya yogic breathing in the treatment of stress, anxiety, and depression: part I-neurophysiologic model. Journal of Alternative and Complementary Medicine (New York, N.Y.)11, pp. 189-201.

[10] Bu B, Haijun H, Yong L., Chaohui Z, Xiaoyuan Y. and Singh A.F. (2010). Effects of martial arts on health status: A systematic review, Journal of Evidence-Based Medicine 3(4) pp. 205-219.

[11] Buzsaki, G. (2006) Rhythms of the Brain. New York, NY: Oxford University Press

[12] Cascio J.: Facing the age of chaos. Institute for the Future. Published:Apr.29 2020. https://medium.com/@cascio/facing-the-age-of-chaos-b00687b1f51d

[13] Chang Q., Liu R., Shen Z. (2013). Effects of slow breathing rate on blood pressure and heart rate variabilities. Intertnaional Journal of Cardiology 169: e6–e8.

[14] Fincham, G.W., Strauss, C., Montero-Marin, J., Cavanagh K. (2023). Effect of breathwork on stress and mental health: A meta-analysis of randomised-controlled trials. Nature Scientific Reports 13, 432

[15] Hamasaki H.: Effects of Diaphragmatic Breathing on Healh (2020). A Narrative Review, Medicines (Basel) 7(10): 65.

[16] Herrero,J.L., Khuvis, S., Yeagle,E., Cerf, M., Mehta, A.D. (2018). Breathing above the brain stem: volitional control and attentional modulation in humans. Journal of Neurophysiology 119, pp. 145-159.

[17] Hutmacher F. (2021). Putting Stress in Historical context: Why It Is Important That Being Stressed Out Was Not a Way to Be a Person 2,000 Years Ago; Frontiers in Psychology 12.

[18] Jayawardena A, Ranasinghe P, Ranawaka H, Gamagge N, Dissanayake D, and Misra A. (2020). Exploring the Therapeutic Benefits of Pranayama (Yogic Breathing): A Systematic Review International Journal of Yoga; 13(2) pp. 99-110.

[19] Jeong J-H (2021). Nasal Nitric Oxide in the Upper Airway Inflammatory Diseases Journal of Rhinology; pp. 81-88, Artigo em Coreano | WPRIM (Pacífico Ocidental) | ID: wpr-900601

[20] Kluger, D:S:, and Gross, J. (2020).: Depth and phase of respiration modulate cortico-muscular communication. Neuroimage 222:117272

[21] Knudsen, L., Ochs, M. (2018). The micromechanics of lung alveoli: structure and function of surfactant and tissue components. Histochemistry and Cell Biology 150, pp. 661–676

[22] Magnon V., Dutheil F., Vallet G. (2021). Benefits from one session of deep and slow breathing on vagal tone and anxiety in young and older adults, Nature Portfolio Scientific Reports 11:19267

[23] Martel J, Ko Yun-Fei, Young J.D. and Ojcius D.M. (2020). Could nasal nitric oxide help to mitigate the severity of COVID-19? Microbes and Infection 22(4-5), pp. 168-171

[24] Mitsea E., Drigas A., Skianis C. (2022). Breathing, Attention & Consciousness in Sync: The role of Breathing Training, Metacognition & Virtual Reality, Technium Social Sciences Journal 29, pp. 79-97, ISSN: 2668-7798

[25] Molle L. and Benoit CÉ. (2019). The Respiratory Modulation of Memory, Journal of Neuroscience 24 39 (30) pp. 5836-5838;

[26] Moore B., Dodley D., Woodcock S. (2023). The Effects of a Martial Arts-Based Intervention on Secondary School Students' Self-Efficacy: A Randomised Controlled Trial. Philosophies, 8(3), 43;

[27] Nobel Prize 1989; https://www.nobelprize.org/prizes/medicine/1998/7543-the-nobel-prize-in-physiology-or-medicine-1998/

[28] Pratschner D.S, Sibille K.T., Fillingim R.B. (2023). Conscious connected breathing with breath retention intervention in adults with chronic low back pain: protocol for a randomized controlled pilot study Pilot Feasibility Studies 9. 24; 9(1):15.

[29] Russo M.A., Santarelli D.M., O'Rourke D. (2017). The physiological effects of slow breathing in the healthy human Breathe Sheff Engl, 13 (4) pp. 298-309

[30] Selye H.(1936). A Syndrome produced by Diverse Nocuous Agents, Nature

[31] Siang Yong Tan and A Yip (2018). Hans Selye (1907-1982): Founder of stress theory, Singapore Medical Journal, 59(4) pp. 170-171.

[32] Saulnier N.: Le petit livre de la respiration, (2021) Edition FIRST, pp. 54.

[33] Spector B.M., Shusterman, D.J., Zhao K. (2023). Nasal nitric oxide flux from the paranasal sinuses, Current Opinion in Allergy and Clinical Immunology 23(1) pp. 22-28,

[34] Taskan B., Junca-Silva A, Caetano A. (2022). Clarifying the coneptual map of VUCA: a systematic review. International Journal of Organizational Analysis ISSN: 1934-8835

[35] Togan A.: VUCA vs BANI - Which Will Come Out on Top? 13.April 2023; https://theagilecompany.org/vuca-bani/

[36] Tavoian D. and Craighead H.D.(2023). Deep breathing exercise at work: Potential applications and impact Frontiers in Physiology. 14; 1040091

[37] Yaribeygi H., Panahi Y., Sahraei H., Johnston P.T., Sahebkar A. (2017). The impact of stress on body function: A review Experimental and Clinical Sciences Journal 16: 1057-10

[38] WHO Digital Health; 2023: https://www.who.int/health-topics/digital-health#tab=tab_1

[39] WHO e-Health; 2023: https://www.emro.who.int/health-topics/ehealth/

[40] WHO Mental Health; 17 June 2022; who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response

[41] WHO Stress; 21 February 2023; https://www.who.int/news-room/questions-and-answers/item/stress

[42] Zelano C., Jiang H., Zjou G., Arora N., Schuele S., Rosenow J., Gottfried JA.; (2016) Nasal respiration entrains human limbic oscillations and modulates cognitive function. Journal of Neuroscience 36:12448–12467.

[43] Zelano's YouTube Video (2017) from the Northwestern University: How you breathe affects memory and fear; https://www.youtube.com/watch?v=1KNn0NYjMWg

[44] Zhang Z., Wang B., Wu H., Chai X., Wang W., Beng CK. (2016). Effects of slow and regular breathing exercise on cardiopulmonary coupling and blood pressure. Medical & Biological engineering & Computing; 55: 327–341

The relationship between technostress and self-driving cars

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Abstract: Technological advances have occurred in every era, but they are not always seen as beneficial. Technostress refers to the negative effects of technology on human behaviour and decision-making, as well as the physical effects on the body. The constant flow of information and the need to learn and use different tools and devices contribute to technostress. Not everyone is receptive to new technologies and finds it difficult to adapt, which can increase inequalities in society. In the 21st century, technological developments are having a significant impact on people's lives and this article examines whether society is ready to use these tools effectively or whether it is fearful of the industrial revolutions underway. We use a quantitative study focusing on young people's perceptions of technology to analyse the impact. The paper also discusses coping mechanisms and possible solutions to mitigate the problems caused by modern technology.

Keywords: technostress, self-driving cars

1 Introduction

Technostress is a problem that describes the stress and pressure caused by technology in people's lives. This problem is caused by the inexperience of new technologies, where people make mistakes or rush to use technology, which reduces efficiency and quality of work. Technostress can trigger long-term mood swings and acute depression, and can increase people's insecurity and social isolation at work. Information overload is one of the main factors contributing to technostress. People are unable to distinguish between important and irrelevant information and often have to deal with too much information at once, leading to confusion and decision-making difficulties. [1] [2] [3] [4]

And brain freeze occurs when the brain becomes overloaded and cannot function properly. The rise in technostress is a consequence of technological advances over the past decades. People are increasingly exposed to the demands of machines and new technologies, which contributes to the development of technostress. The easy accessibility of information and the constant flow of data put additional pressure on people. People's bad feelings about new technologies often stem from a lack of

understanding of these technologies. Rapid changes in technology also make it difficult for people to keep up and learn how to use them. New technologies require more and more processing and memory, which may be beyond the typical capabilities of humans. Technostress is a growing problem due to the rapid development of the ICT industry. People have to adapt constantly to new technologies, which are becoming increasingly complex and alien. This increases stress and uncertainty in people's daily lives. [5] [6] [7]

In sum, technostress is a problem of stress and pressure caused by technology in people's lives. Information overload, technological invasion, rapid technological change and technological inexperience all contribute to technostress and exacerbate negative feelings. It is important for people to be aware of technology and learn to adapt to new developments to reduce the impact of technostress on their lives. [8] [9] [10] [4]

Technological progress is impacting people's lives in the 21st century. New technologies create opportunities to expand knowledge and skills, but not everyone is able to respond and learn quickly to new changes. New technologies can improve society's well-being and quality of life, but they can also increase generational and socio-economic disparities and create individual inequalities. I used a quantitative study to analyse young people's perceptions of technology, to see if we are ready to use sophisticated devices and systems or if we are more apprehensive about the process of industrial revolutions. [11] [12] [13] [14] [15]

2 Technostress

We were always suspicious of the technology because of its reliability. Although we use advanced technologies that can be flawed, we do not consider them reliable because of their unreliability. For people, technology creates unpleasant memories and fear because it can betray and violate their lives. Undesirable technological advertising causes difficulties and fears for people because it can easily violate their privacy. People today are afraid of social media and online presence as personal information can be easily accessed and leaked. However, jobs, friends and families are putting pressure on people to be present online. The use of ICT is now essential for efficiency and connectivity, and people can miss important events and information if they do not use it. The Covid19 epidemic has exacerbated this situation, where people need the use/assistance of a computer or other smart device to work. [16] [17]

Technostress is a complex phenomenon that is perceived differently by different demographic groups. Older generations are generally less accustomed to new technological developments than younger generations. Educational attainment may also influence the level of technostress, as those with lower levels of education tend to experience less technostress. This is probably because lower educated people

work in areas where they use less advanced technological tools and are therefore less exposed to technostress. Employed people tend to experience higher technostress than unemployed people, as work stress and information overload are part of their daily lives. The unemployed tend not to have the latest technological tools, so they feel less unreliable and can cope with technostress more easily. Positive perceptions of individuals' lives can also influence technostress, as those who have a positive view of their lives are less likely to feel stressed by technology. [18]

In addition to technostress, techno-fatigue is also experienced by those who experience technostress. Technostress is also associated with work flexibility and work-family problems. People who are satisfied with their lives, identify with their profession or are ambitious in their career are less likely to experience technophobia. [19] [20]

It is important to emphasise that it is not only demographic characteristics that influence the level of technostress, but also the relationship between different areas of an individual's life and technological difficulties. Therefore, individuals need to develop strategies to help them cope with technostress. This could include, for example, a positive view of life as a whole, work-life balance, flexibility and career development opportunities. [21] [22] [23]

In conclusion, technostress has different effects on different demographic groups and a number of factors influence its perceived level. Age, education and different aspects of individual life all play a significant role in the development and management of technostress. It is important for individuals to find their own stress management strategies in order to be able to deal effectively with technology stress and maintain a healthy balance.

3 Self-driving cars

Autonomous vehicles are currently available for both public and private transport, although their use is limited and their take-up is not growing rapidly. Presenting data from an international study, the paper discusses the trust in autonomous vehicles and the factors influencing it. The study identifies the main threats, quantifies their prevalence and explores the reasons for fear of autonomous vehicles. People who have not yet adopted autonomous vehicles express concerns about the potential negative consequences, such as hacking, system failures or lack of control. [24] [25]

At the same time, advocates of autonomous vehicles promise positive effects, such as faster reaction times and increased computing power. They claim that these vehicles can fit well into the transport network of smart cities and have a positive impact on society, carbon emissions and the natural environment. [24] [25]

Self-driving car technology still raises many questions. While a fully autonomous car is unlikely, autonomous vehicles aim to demonstrate modes of transport where human supervision is not essential to perform certain tasks. Autonomous vehicles are capable of performing their tasks autonomously, but a human driver must always be present, unlike autonomous systems, which do not require human involvement. [26]

There are six different levels of autonomy, with level 5 being the highest, where the vehicle performs all tasks autonomously. Legal and moral concerns make people less willing to hand over control of their car to an autonomous system. However, the introduction of autonomous cars in the EU is controversially influenced by the 1968 Vienna Convention on Road Transport, which requires all vehicles to have a driver. In the US, however, the day of self-driving cars is approaching and the National Highway Traffic Safety Administration (NHTSA) has issued new guidelines for self-driving cars. [26] [27]

All car manufacturers must ensure that self-driving cars are safe for both passengers and road users. Standards have been revised and clarified to ensure that cars meet federal motor vehicle safety standards. These standards specify the characteristics, capabilities and test procedures that vehicles must have. [28]

Self-driving cars are becoming increasingly available, but there are still many questions about their reliability and legal framework. Autonomous vehicles still require human driver assistance and EU laws restrict their deployment. In the US, however, government regulations and policies are increasingly supporting the development of self-driving cars. Safety and adherence to standards will play an important role for car manufacturers to create reliable and safe self-driving vehicles in the future. [29]

Like all new technologies, self-driving vehicles raise some concerns in people. People have always feared the emergence of machines and industrial revolutions, especially the loss of jobs. But the concerns are not just about protecting jobs. Although self-driving cars may be the way of the future, it is not yet known whether they are safer than traditional modes of transport. While driving, unexpected situations often arise where sudden decisions have to be made. These decisions can be minor, such as whether to go through a yellow light, but there are also situations where decisions have to be made to risk lives. People are uncertain and nervous about new and unfamiliar means of transport. The history of automobility bears witness to this. Although the Wright brothers' flight in 1903 in the United States did not lead to instant air travel, there were similar questions about the reliability and safety of self-driving car technology. Car manufacturers are investing billions in the development of self-driving vehicles, but studies have shown that people are less enthusiastic about the introduction of new technology and more concerned. A study from the University of Michigan found that drivers still desire certain automated capabilities, but are reluctant to completely hand over driving to a vehicle. [30] [31] [32]

According to Accenture's consumer survey, nearly half of those surveyed would prefer to drive a self-driving car, while the other half would prefer a technology that allows them to take control if necessary. People are also concerned that the operation of a fully autonomous system is not fully regulated. In 2014, majorities in the US, UK and Australia expressed concerns about driverless vehicles. Interestingly, they were not willing to pay more for such convenience. However, the future of driverless cars is promising, with more than two-thirds of respondents predicting that 50% of cars will be self-driving by 2050, according to research. However, widespread adoption is still to come and user attitudes will change over time. It is important to consider the readiness and expectations of users to understand the barriers to the uptake of self-driving cars. Public perceptions of public transport are more positive, as people are more interested in cleanliness and comfort than in self-driving cars. Passenger satisfaction levels differ between men and women. Overall, although car manufacturers are constantly developing self-driving technology, people's attitudes and readiness are still slow. [25]

Among the technical developments, the readiness of users and observers is as important as the functioning of the technology itself. The readiness of users determines their willingness to participate in the testing and adoption of new technologies. In the case of self-driving vehicles, users' confidence in the technology is particularly important. Trust is a key indicator of ICT readiness. Building trust is a key step for the uptake of autonomous cars, as users perceive risks and expect increased safety when using intelligent systems.

Self-driving vehicles also raise a number of ethical and societal issues. For the adoption of autonomous cars to be successful, it is important to take into account public concerns and ethical issues. In addition to reliability and safety, other factors such as user experience and comfort should be taken into account when designing autonomous vehicles. The automotive industry needs to be alert to the needs and concerns of the public so that the technology can truly achieve widespread acceptance.

Programming autonomous vehicles involves particularly difficult ethical choices. One example is how the car should behave during the inevitable accident. Research and debate on the ethical issues of autonomous cars can help to make such decisions. Moral Machine is a platform developed by the Massachusetts Institute of Technology that gathers human opinions on moral issues related to autonomous cars. The answers to moral dilemmas have a major impact on the acceptance of autonomous vehicles. [33]

Research shows that people generally agree that autonomous cars should cause fewer accidents. However, the results change when respondents imagine themselves as the person sitting in the car. It is therefore important to take into account the perspective of the people concerned when making ethical decisions. Not only the reliability and efficiency of the technology, but also the trust of users and society are key to the uptake of self-driving vehicles. Making ethical decisions and taking

into account public concerns is essential to increase the acceptance of the technology. [34]

Self-driving cars are being developed and deployed in the transport industry. The hardware and software for these vehicles have already been created and the software is constantly being updated to make it as responsive as possible to its environment. The self-driving system can assess traffic conditions, select car behaviour and use the data to identify upcoming scenarios. However, the cars' software could pose a risk of hackers gaining access to the data and taking control of the vehicle. Therefore, developing and protecting security systems is a major challenge for car manufacturers and consumers. [35]

Self-driving cars also pose ethical dilemmas and problems related to collisions, where self-driving cars have to give way to other vehicles. However, because of this, self-driving car "drivers" often encounter obstacles in normal traffic, which can be a disadvantage when making purchasing decisions. The confidence of road users is key to successful uptake, but lack of information and technological uncertainties can reduce this confidence.

Information and communication about self-driving cars is important to convince and understand users. People need to become more familiar with these systems to overcome information gaps, reduce stress and anxiety, and increase perceived knowledge. User acceptance is influenced by the user's perception of the technology as user-friendly and useful. In the case of self-driving cars, the evaluation and criteria of benefits may differ for each user. [36] [37] [38]

Overall, the development and adoption of self-driving cars poses many challenges and questions. Security and software protection is a key concern, as hackers can compromise the safety of cars and passengers. Solutions to ethical dilemmas and collisions also need to be found to ensure that self-driving cars respond appropriately. Social acceptance and people's trust are key to successful take-up, so information and communication about self-driving cars is important.

4 The research

We launched a quantitative study using an online questionnaire to examine the individual opinions of potential users/customers. The data cannot be considered representative as the sampling was based on convenience. However, the data can be considered relevant to the subject of our survey, as we were able to reach 666 people in the three-month period from January 2022 to April 2022. In order to determine whether there is a difference in responses by country of birth, we collected responses from 116 additional foreign respondents in addition to the majority of Hungarian respondents (N=550). Despite the relatively small number of non-Hungarian respondents, there were no significant differences in any of the countries surveyed

(Albania, Finland, Germany, Kazakhstan, Mongolia, Poland, Romania, Serbia, Slovakia, Poland and Mongolia). As a result, all the data collected are now presented together. Ten respondents chose not to disclose their gender, leaving a sample of 368 male and 288 female respondents. The survey was able to reach a wide range of people aged between 12 and 70 years, but the average age of respondents was 27.366 years, with a standard deviation of 10.978, indicating that respondents were largely young.

Figure 2 shows how respondents were distributed by age.

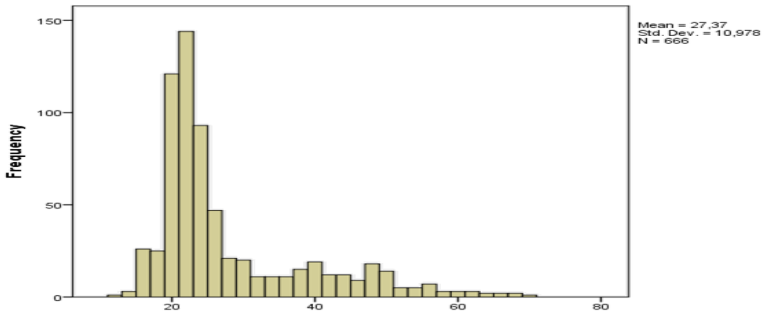

Figure 1.
Age distribution of respondents

The average age of the female population was slightly higher than the average age of the male population (28.326, standard deviation: 11.989), but this difference was not statistically significant due to the wide age range. Respondents' views on autonomous vehicles in general and self-driving cars in particular were mixed. The following distribution can be obtained by measuring the degree of confidence people have in such cars using the six autonomy phases mentioned earlier.

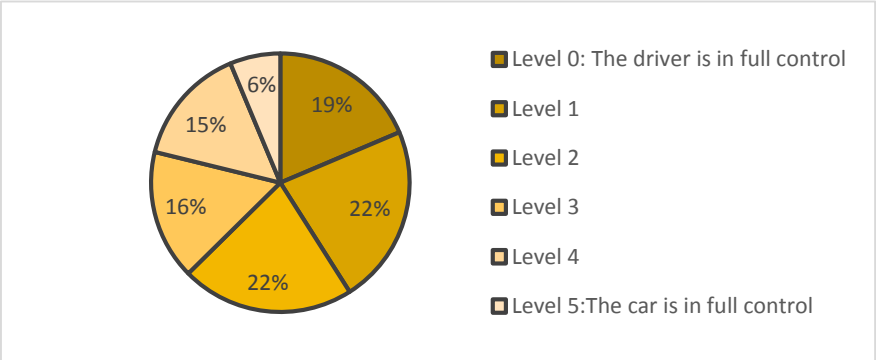

Figure 2.
The 6 stages of autonomy

The majority of respondents, as shown in Figure 2, were only interested in the lower level of autonomy offered to their car. Only 6% of people would be interested in

using self-driving cars if the car had full control, and 15% would want to use the car if they could still take back and seize control if needed. These findings are in line with the global research described earlier. The vast majority of people are not yet ready for self-driving cars.

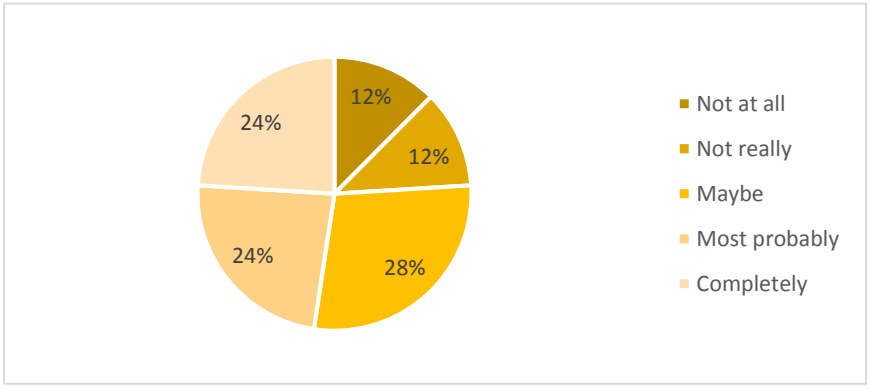

Figure 3.
Distribution of respondents

The main question is whether there is a pattern of who is in favour of self-driving cars and who is against their introduction on roads. To assess this, we used the responses to the question "I would support the introduction of autonomous vehicles". Figure 4 shows the distribution of respondents.

About half of the respondents (perhaps not as direct users or owners) would be in favour of the introduction of self-driving cars, which is in line with the data presented in Figure 4 and shows the resistance to the adoption of autonomous vehicles. In comparison, only a quarter of respondents were opposed. Only the sample of 470 respondents is included in the survey, as those who answered "maybe" in the middle do not support or oppose the idea of autonomous cars. The proportion of those opposed to autonomous cars was interestingly balanced by gender, as shown in the table below. However, men were more likely than women to approve of driverless cars. Acceptance of autonomous cars can therefore be considered a gendered issue, which is fully supported by the global literature cited earlier.

	What is your name?		Total
	Male	Female	
Does not support the introduction of autonomous vehicles	78	79	157
Supports the introduction of autonomous vehicles	208	105	313
Total	286	184	470

Table 1.

Distribution of respondents by gender and attitude towards autonomous vehicles

Our study shows that those who want self-driving cars have a unique characteristic. In the table below, we present only those values examined in our questionnaire where the means for and against self-driving cars differed significantly.

	Levene's Test for Equality of Variances		t-test for Equality of Means				
	F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.
I would be afraid of self-driving cars in my environment *	17,165	,000	13,567	475	,000	1,652	,122
Self-driving cars will have a positive impact on emissions *	19,269	,000	-14,127	475	,000	-1,499	,106
Self-driving cars will have a positive impact on society *	,971	,325	-21,211	311,78	,000	-1,980	,093
Self-driving cars will reduce the number of accidents *	14,153	,000	-22,519	475	,000	-2,023	,090

Table 2.

The difference between those who want self-driving cars and those who don't.

As the data above shows, proponents of automated vehicles believe that autonomous cars will have a positive impact on society, carbon emissions and ultimately our natural environment. This is because they will have much faster reaction times than humans, thanks to their improved sensing systems and computing power. On the flip side, individuals who oppose autonomous vehicles are also concerned about their ability to drive through their neighbourhoods.

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. 2-tailed	Mean Diff.	Std. Error Diff.
Fear: hackers tampering with your car	*	1,709	,192	4,071	328,468	,000	,557	,137
Fear: the self-driving system will break down	*	34,534	,000	7,574	475	,000	,819	,108
Fear: The car decides differently than I want it to.	*	13,075	,000	9,264	475	,000	1,048	,113
Fear: Fear of new technology	*	6,691	,010	7,639	475	,000	,928	,121
Fear: people (in different professions, such as drivers) losing their jobs.	*	3,473	,063	6,241	289,252	,000	,857	,137
Fear: control cannot be regained	*	17,769	,000	7,190	475	,000	,920	,128
Fear: losing the joy of driving	*	11,664	,001	7,150	475	,000	,974	,136
Fear: personal data security cannot be guaranteed	*	,467	,495	6,610	317,859	,000	,836	,127

Table 3.

Differences in the importance of different fear factors

Although there is typically a greater fear of possible bad outcomes, such as hacking, system failures or lack of control, among people who are not yet prepared for autonomous cars, the fear is activated differently depending on the specific concern. The table below highlights that anxiety varies significantly in all circumstances, although the difference is largest when decisions are made in a way other than by the manager and smallest when hacker risk is present. These concerns and potential benefits aside.

Summary

The emergence of self-driving cars as a new technological development has a major impact on society. In many cases, lack of acceptance is a barrier to progress. The use of autonomous cars in private transport is still in its early stages, although they have become an integral part of public transport in many cities. Although the hardware and software for autonomous systems have been developed, their use is still limited. The study also found that women were generally less receptive and open to autonomous cars, which is in line with their main perceived concerns. Manufacturers should therefore be prepared to serve the needs of both genders independently. The article also explores why more than half of respondents

expressed fears of autonomous cars and how these fears differ between men and women.

The results show that those who are not yet ready for autonomous cars are mainly concerned about potential negative outcomes, such as hacking, system failures and loss of control. However, it is not clear whether these concerns are the main cause of their pessimism or merely a consequence. On the other hand, proponents of autonomous vehicles believe they will have a positive impact on society and the environment, offering improved reaction times through advanced sensor systems and computing power. This different attitude could potentially be both a cause and an effect of the way individuals perceive autonomous vehicles.

Overall, this research helps demystify some aspects of trust in autonomous systems, providing valuable insights for manufacturers and policy makers. By addressing the concerns raised in this study, they can pave the way for the seamless integration of autonomous cars into the private transport networks of future smart cities.

Sources

[1] N. Dragano és T. Lunau, „Technostress at work and mental health: concepts and research results.," Current opinion in psychiatry, %1. kötet33(4), pp. 407-413, 2020.

[2] G. Bondanini, G. Giorgi, A. Ariza-Montes, A. Vega-Muñoz és P. Andreucci-Annunziata, „Technostress dark side of technology in the workplace: A scientometric analysis.," International Journal of Environmental Research and Public Health, %1. kötet17(21), p. 8013, 2020.

[3] P. R. Bhagat, F. Naz és R. Magda, „Role of Industry 4.0 Technologies in Enhancing Sustainable Firm Performance and Green Practices.," Acta Polytechnica Hungarica, %1. kötet19(8), pp. 229-248, 2022.

[4] A. Okanović, B. Jokanović, V. Đaković, S. Vukadinović és J. Ješić, „Innovating a model for measuring competitiveness in accordance with the challenges of industry 4.0.," Acta Polytechnica Hungarica, %1. kötet17(7), pp. 67-88, 2020.

[5] M. Tarafdar, Q. Tu, B. S. Ragu-Nathan és T. S. Ragu-Nathan, „The impact of technostress on role stress and productivity.," Journal of Management Information Systems, %1. kötet24, p. 301–328, 2007.

[6] J. Bloem, M. Van Doorn, S. Duivestein, D. Excoffier, R. Maas és E. Van Ommeren, „The fourth industrial revolution.," Things Tighten, %1. kötet8, pp. 11-15, 2014.

[7] E. M. Hallowell, „Overloaded circuits.,” Harvard business review, %1. kötet11, pp. 1-10, 2005.

[8] P. Borle, K. Reichel, F. Niebuhr és S. Voelter-Mahlknecht, „How are techno-stressors associated with mental health and work outcomes? A systematic review of occupational exposure to information and communication technologies within the technostress model.,” International Journal of Environmental Research and Public Health, %1. kötet18(16), p. 8673, 2021.

[9] B. Domokos és Z. Baracskai, „On the other Side of Technology: Examining of Different Behavior Patterns with Artificial Intelligence.,” Acta Polytechnica Hungarica, %1. kötet19(9), 2022.

[10] M. Chiappetta, „The Technostress: definition, symptoms and risk prevention,” Senses and Sciences, %1. kötet4(1), 2017.

[11] R. Ayyagari, V. Grover és R. Purvis, „Technostress: Technological antecedents and implications.,” MIS Quarterly, %1. kötet35, p. 831–858, 2011.

[12] J. D’Arcy, T. Herath és M. K. Shoss, „Understanding employee responses to stressful information security requirements: A coping perspective.,” Journal of Management Information Systems, %1. kötet31, p. 285–318, 2014.

[13] S. Tomoniko, „Anxiety at Teenagers' Fingertips.,” BU Journal of Graduate Studies in Education,, %1. kötet11(2), pp. 4-11, 2019.

[14] E. B. O’Day és R. G. Heimberg, „Social media use, social anxiety, and loneliness: A systematic review.,” Computers in Human Behavior Reports, %1. kötet3, p. 100070, 2021.

[15] E. Marzilli, L. Cerniglia, G. Ballarotto és S. Cimino, „Internet addiction among young adult university students: The complex interplay between family functioning, impulsivity, depression, and anxiety.,” International journal of environmental research and public health, %1. kötet17(21), p. 8231, 2020.

[16] Q. Tu, K. Wang és Q. Shu, „Computer-related technostress in China.,” Communications of the ACM, %1. kötet48(4), p. 77–81, 2005.

[17] T. N. Friemel, „The digital divide has grown old: Determinants of a digital divide among seniors.,” New Media & Society, %1. kötet18, p. 313–331, 2016.

[18] R. Shultz, H.-W. Wahl, J. T. Matthews, A. D. V. Dabbs, S. R. Beach és S. J. Czaja, „Advancing the aging and technology agenda in gerontology.," The Gerontologist, %1. kötet55, p. 724–734, 2015.

[19] C. Baham, P. Kalgotra, F. Nasirpouri Shadbad és R. Sharda, „Generational differences in handling technology interruptions: a qualitative study.," European Journal of Information Systems, pp. 1-21, 2022.

[20] R. Andrulli és R. Gerards, „How new ways of working during COVID-19 affect employee well-being via technostress, need for recovery, and work engagement.," Computers in Human Behavior, p. 107560, 2022.

[21] T. Spiess, C. Ploder, R. Bernsteiner és T. Dilger, „Techno-stress in the workplace: triggers, outcomes, and coping strategies with a special focus on generational differences.," International Journal of Web Engineering and Technology, %1. kötet16(3), pp. 217-234, 2021.

[22] E. Rohwer, J. C. Flöther, V. Harth és S. Mache, „Overcoming the "Dark Side" of Technology—A Scoping Review on Preventing and Coping with Work-Related Technostress.," International journal of environmental research and public health, %1. kötet19(6), p. 3625, 2022.

[23] M. S. Carlotto, G. Welter Wendt és A. P. Jones, „Technostress, career commitment, satisfaction with life, and work-family interaction among workers in information and communication technologies.," Actualidades en Psicología, %1. kötet31(122), pp. 91-102, 2017.

[24] B. &. S. M. Schoettle, „Motorists' Preferences for Different Levels of Vehicle Automation., Ann Arbor: University of Michigan Transportation Research Institute, 2015.

[25] Accenture, „Consumers in US and UK Frustrated with Intelligent Devices That Frequently Crash or Freeze New Accenture Survey Finds," 10 02 2011. [Online]. Available: http://newsroom.accenture.com/article_display.cfm?article_id=5146. [Hozzáférés dátuma: 31 08 2023].

[26] I. SAE, „U.S. DoT chooses SAE J3016 for vehicle-autonomy policy guidance," 20 09 2016. [Online]. Available: articles.sae.org/15021/. [Hozzáférés dátuma: 31 08 2023].

[27] S. o. S. f. F. a. C. A. b. C. o. H. Majesty, Convention on Road Traffic, England: England, 2018.

[28] Z. Enwemeka, „Consumers Don't Really Want Self-Driving Cars, MIT Study Finds.," 27 05 2017. [Online]. Available:

http://www.wbur.org/bostonomix/2017/05/25/mit-study-self-driving-cars . [Hozzáférés dátuma: 31 08 2023].

[29] Economist, „Look, no hands.," 20 04 2013. [Online]. Available: https://www.economist.com/special-report/2013/04/20/look-no-hands. [Hozzáférés dátuma: 31 08 2023].

[30] J. E. Vance, Capturing the Horizon: The Historical Geography of Transportation., New York: Harper and Row, 1986.

[31] D. Neil, „Who's Behind the Wheel? Nobody.," 24 09 2012. [Online]. Available: http://online.wsj.com/article/SB10000872396390443524904577651552635911824.html. [Hozzáférés dátuma: 31 08 2023].

[32] K. Fitchard, „Ford is ready for the autonomous car. Are drivers?," 9 04 2012. [Online]. Available: https://www.bloomberg.com/news/articles/2012-04-09/ford-is-ready-for-the-autonomous-car-dot-are-drivers#xj4y7vzkg. [Hozzáférés dátuma: 31 08 2023].

[33] MIT, „Why Self-Driving Cars Must Be Programmed to Kill," 22 10 2017. [Online]. Available: https://www.technologyreview.com/s/542626/why-self-driving-cars-must-be-programmed-to-kill/. [Hozzáférés dátuma: 31 08 2023].

[34] A. Shariff, J. F. Bonnefon és I. Rahwan, „Psychological roadblocks to the adoption of self-driving vehicles," Nature Human Behaviour, %1. kötet1(10), pp. 694-696, 2017.

[35] S. K. Khan, N. Shiwakoti, P. Stasinopoulos és Y. Chen, „Cyber-attacks in the next-generation cars, mitigation techniques, anticipated readiness and future directions.," Accident Analysis & Prevention, %1. kötet148, p. 105837, 2020.

[36] K. Lazányi, „Are we Ready for Self-Driving Cars-a Case of Principal-Agent Theory.," In 2018 IEEE 12th International Symposium on Applied Computational Intelligence and Informatics (SACI), pp. 251-254, 2018.

[37] P. Somkutas és Á. Kőhidi, „Az önvezető autó szoftvere magas szintű szellemi alkotás vagy kifinomult károkozó?," In Medias Res, %1. kötet6(2), pp. 232-269, 2017.

[38] J. I. Mezei és K. Lazányi, „Are we ready for smart transport? Analysis of attitude towards public transport in Budapest.," Interdisciplinary Description of Complex Systems: INDECS, %1. kötet, összesen: %216(3-A), pp. 369-375, 2018.

[39] L. M. Yvkoff, „Car buyers show interest in autonomous car tech.,” 27 04 2012. [Online]. Available: https://www.cnet.com/roadshow/news/many-car-buyers-show-interest-in-autonomous-car-tech/. [Hozzáférés dátuma: 31 08 2023].

[40] R. H. Wortham és A. Theodorou, „Robot transparency, trust and utility.,” Connection Science, %1. kötet29(3), pp. 242-248, 2017.

[41] I. Verdiesen, V. Dignum és I. Rahwan, „Design requirements for a moral machine for Autonomous Weapons.,” in In International Conference on Computer Safety, Reliability, and Security, Cham, Springer, 2018, pp. 494-506.

[42] B. &. S. M. Schoettle, A survey of public opinion about autonomous and self-driving vehicles in the US, the UK, and Australia., Ann Arbor: University of Michigan Transportation Research Institute., 2014.

[43] M. Schmidt, L. Frank és H. Gimpel, „How adolescents cope with technostress: a mixed-methods approach.,” International Journal of Electronic Commerce, %1. kötet25(2), pp. 154-180, 2021.

[44] G. Nimrod, „Technostress: measuring a new threat to well-being in later life.,” Aging & mental health, %1. kötet22(8), pp. 1086-1093, 2018.

[45] C. Miller és C. Valasek, „Remote exploitation of an unaltered passenger vehicle.,” Black Hat USA, %1. kötet2015(S 91), pp. 1-91, 2015.

[46] F. Longo, L. Nicoletti és A. Padovano, „Smart operators in industry 4.0: A human-centered approach to enhance operators’ capabilities and competencies within the new smart factory context.,” Computers & industrial engineering, %1. kötet113, pp. 144-159., 2017.

[47] G. La Torre, V. De Leonardis és M. Chiappetta, „Technostress: how does it affect the productivity and life of an individual? Results of an observational study.,” Public Health, %1. kötet189, pp. 60-65., 2020.

[48] M. H. R. &. d. W. J. C. Kyriakidis, „Public opinion on automated driving: Results of an international questionnaire among 5000 respondents,” Transportation research part F: traffic psychology and behaviour, %1. kötet32, pp. 127-140, 2015.

[49] M. König és L. Neumayr, „ Users’ resistance towards radical innovations: The case of the self-driving car.,” Transportation research part F: traffic psychology and behaviour, %1. kötet44, pp. 42-52., 2017.

[50] S. Koul és A. Eydgahi, „Utilizing technology acceptance model (TAM) for driverless car technology adoption.,” Journal of technology management & innovation, %1. kötet13(4), pp. 37-46, 2018.

[51] J. Koo, J. Kwac, W. Ju, M. Steinert, L. Leifer és C. Nass, „Why did my car just do that? Explaining semi-autonomous driving actions to improve driver understanding, trust, and performance.,” International Journal on Interactive Design and Manufacturing, %1. kötet9, pp. 269-275, 2014.

[52] N. Kettles és J. P. Van Belle, „Investigation into the antecedents of autonomous car acceptance using an enhanced UTAUT model.,” In 2019 International Conference on Advances in Big Data, Computing and Data Communication Systems (icABCD, pp. 1-6, 2019.

[53] X. Y. W. L. W. G. J. C. X. G. H. .. &. C. T. Jiang, „Factors Affecting the Acceptance and Willingness-to-Pay of End-Users,” A Survey Analysis on Automated Vehicles. Sustainability, %1. kötet13(23), p. 13272, 2021.

[54] D. M. Gromet, H. Kunreuther és R. P. Larrick, „Political ideology affects energy-efficiency attitudes and choices,” Proceedings of the National Academy of Sciences, %1. kötet110, pp. 9314-9319 , 2013.

[55] P. J. Denning és T. G. Lewis, „Technology adoption.,” Communications of the ACM, %1. kötet63(6), pp. 27-29, 2020.

[56] M. Bellone, A. Ismailogullari, T. Kantala, S. Mäkinen, R. M. Soe és M. Å. Kyyrö, „A cross-country comparison of user experience of public autonomous transport.,” European Transport Research Review, %1. kötet13(1), pp. 1-13., 2021.

[57] J. Adetunji, „Is there a moral centre in our brain?,” 16 09 2015. [Online]. Available: https://theconversation.com/is-there-a-moral-centre-in-our-brain-47483. [Hozzáférés dátuma: 31 08 2023].

[58] R. A. Acheampong és F. Cugurullo, „apturing the behavioural determinants behind the adoption of autonomous vehicles: Conceptual frameworks and measurement models to predict public transport, sharing and ownership trends of self-driving cars.,” Transportation research part F: traffic psychology and behaviour, %1. kötet62, pp. 349-375, 2019.

Vulnerability of the Global Food Supply Chain

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Abstract: We are probably at a significant turning point when we think about the long-term stability of the entire global food, agriculture and trade market. The vulnerability of the global food system has become particularly evident in the last few years due to major disruptions in food supply chains, which have caused profound shocks to the global food supply, affecting the poorest and most vulnerable populations the most. Prices may remain at historically high levels for the long term, further exacerbating food insecurity and inflation, which was already high due to the effects of the pandemic. The study reviews the main risk factors that can affect global food security due to the cascading effects of the pandemic, the Ukraine-Russian war and global warming.

Keywords: Food supply, Safety, Risk factors, Supply Chain, Ukraine conflict

1 Introduction

We are probably at a major turning point when we think about the long-term stability and security of the entire global food, agriculture and trade market. This turning point, however, is by no means a new one, but merely an acceleration of the cumulative effects of the past period by the Ukrainian-Russian conflict.

International cooperation on food security has long been of concern to the international community. The creation of the Food and Agriculture Organization (FAO) in 1943 was one of the first tangible results of global concerns about food security. The second turning point was the world food crisis of 1972-1974, which led the UN General Assembly to establish the International Emergency Food Reserve or IEFR. Between 2005 and the summer of 2008, wheat and maize prices tripled and rice prices increased fivefold, triggering food riots in almost two dozen countries and pushing a further 75 million people into poverty [1]. (Fig.1)

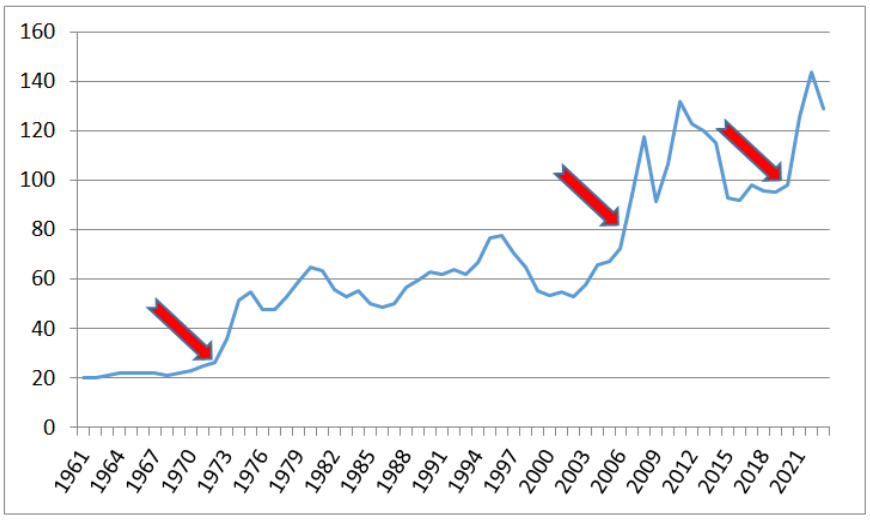

Figure 1
Food crises points, FAO Food Price Index (FFPI)

There has been some recovery in prices, but the underlying problems that triggered this latest crisis persist: low stocks, a growing population and flattening crop growth. The situation is exacerbated by climate change, with warmer production seasons, increasing water scarcity and increasingly extreme weather. These problems have not disappeared, but have been compounded in a short time. Our current food supply system is highly dependent on two factors: the global supply chain and modern high-yield production techniques.

Although intensive farming guarantees the highest yields, modern farming methods rely on the availability of sufficient quantities of cheap water and fertilizers. However, most fertilizers and pesticides are fossil fuel-based, and we also need fossil fuels to run modern machinery. In the summer of 2022, Europe experienced its worst drought in 500 years [2]. Nearly half a century of intensive irrigation, fertilization, pesticide use and monoculture has not been kind to soil and groundwater. According to a study by the Ukrainian Academy of Sciences, for example, more than 40% of all agricultural land in Ukraine could lose fertility [3]. And the growing demand for food, feed and bio-fuels has clearly become a major driver of tropical deforestation.

The vulnerability of the global logistics supply chain became clear in 2021-22, first due to closures, consumer panic buying and hoarding during the pandemic, followed by the problem of declining production rates due to restrictions, and finally the difficulties of restarting. During the Covid-19 pandemic, supply chains were exposed to unprecedented disruption, uncertainty and risk, highlighting the interdependence of the global system. The latest shocks, the war in Ukraine and sanctions against Russia, further weakened production routes that cut across multiple countries and were already severely disrupted by Covid-19 [4]. The UN

estimates that the number of food insecure people worldwide could be at a 15-year high as, in addition to the effects of the pandemic and climate change, the war in Ukraine has a major impact on global food security [5]. It is predicted that harvests will continue to decline in much of the world in the future, raising the specter of a perpetual food crisis.

Food security can be described in several ways. One such definition includes the challenges associated with adequately feeding populations in developing countries, both at the household and at the national or regional level, especially in times of external stress. In developed countries, food security at the household level is most commonly defined in relation to food affordability and access for low-income consumers. The traditional definition of food security is the FAO's 1996 definition: "Food security exists when all people have access at all times to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" [6]. The term can also be used in the context of national 'self-sufficiency', in terms of whether a country, such as Hungary, can meet its own food needs. The OECD defines food security as "the concept that does not support the opening of domestic markets to foreign agricultural products on the principle that a country should be self-sufficient to the maximum extent possible to meet its basic nutritional needs" [7].

1.1 The Russian-Ukrainian conflict

On 21 February 2022, the day after the Winter Olympics, Putin signs decrees recognizing the independence and sovereignty of the so-called Luhansk People's Republic (LNR) and Donetsk People's Republic (DNR) at a Kremlin ceremony and orders Russian troops to be sent to the separatist territories. Three days later, in the early morning, Russian troops cross the Ukrainian border and launch missiles at Ukrainian cities, airports and other strategic targets. Putin describes the invasion as a "special military operation". Russia's military attack on Ukraine has prompted other countries to impose extraordinary, coordinated economic sanctions against Russia (and to a lesser extent Belarus). The measures are aimed at restricting normal trade and financial links with Russia and potentially crippling its economy, all in the hope of deterring Putin from waging and then continuing a war. However, the scope and severity of these measures vary widely, and their impact on the Russian economy will only be felt in the long term (Russia was already subject to Western sanctions after the invasion and annexation of Crimea in 2014, which did not deter escalation). Moreover, sanctions have a serious impact on the economic activity of other countries [8].

The first strikes were directed against Ukraine's military infrastructure, airports, air defense facilities and other strategic targets, but when the expected military successes did not come, Russia switched to a scorched earth policy. Seaports were closed, Russian invaders targeted infrastructure, stole agricultural equipment and thousands of tons of grain from Ukrainian farmers in the occupied territories, and targeted food storage sites with artillery [9]. Russian attacks on key agricultural

infrastructure centers destroyed large quantities of food. The blockade of Ukrainian ports has stifled the country's exports, cutting off a key source of income and exacerbating a global food crisis that could force millions of people to migrate. Global food and energy prices have soared to record highs, with millions of tons of grain and vegetable oil stuck in Ukraine. Recent events in Syria have highlighted what the massive destruction of the Russian military could mean for Ukraine and the world. Syria's gross exports amounted to $11.9 billion in the year before the war, but will be a mere $0.8 billion in 2020 [10].

2 Methodology

For researchers with a broad perspective, especially when dealing with timely and changing topics, "grey literature" can be an important source of information. Grey literature is the set of materials and research produced by organizations outside traditional commercial or academic publication and dissemination channels [11]. I have delineated seven food supply chain risk groups that defined the scopes to be monitored in this study. I developed a tailored search plan through Google, targeted websites and news reports, supplemented with relevant peer-reviewed articles from e.g. Google Scholar, EBSCO and Researchgate databases. I used the following search terms: 'Ukraine', 'Russia', 'war', 'conflict', 'food security' as well as keywords for each of the identified broader areas. The searches were run between January and February of 2023.

3 Risk factors

The conflict threatens not only short-term but also long-term food security in several ways (Table 1).

Trade	a sharp and steep drop in shipments from both countries, shortages of goods
Price risk	steep increases in food, raw material and energy prices
Logistics	damage to roads, rail networks, sea ports, storage facilities
Cultivation and production	condition of crops in the soil, planting of next seasonal crops, field damage, water pollution, food processing, impacts on labor
Energy, energy carrier dependent	fuel, electricity, fertilizers, pesticides, lubricants

Financial	exchange rate fluctuations, significant devaluation of foreign currencies, insolvency, financing problems, reduced economic growth, transport insurance premiums
Political	land ownership issues

Table 1.
Risk factors (own editing)

3.1 Price risk

The USDA forecasts that Ukrainian wheat production will fall by 35% a year and corn production by more than 50%. Worldwide, 26 countries import at least half of their wheat from Russia and Ukraine. Indonesia receives 28%, Bangladesh 21%, while Egypt imports almost 80% of its wheat from Ukraine and Russia [12]. The main destinations for maize exports from Ukraine are countries with upper-middle economies such as China, the Netherlands and the Republic of Korea. Ukraine supplies 55.55% of China's maize imports [13]. Between 1993 and 2005, per capita pork consumption in the world's most populous country increased by 45%. Large-scale integrated industrial units depend on breeds fed a mixture of high-tech maize, soybean meal and supplements for rapid growth [2]. The situation is similar in the European Union. In the edible oil market, Ukraine and Russia are the world's largest exporters of sunflower seeds and oil, together accounting for more than 50% of world production (Table 2).

Commodity	Ukraine	Russian Federation	Belarus	Total
Wheat	10%	24%		34%
Maize	15%	2%		17%
Barley	13%	14%		27%
Sunflower oil	31%	24%		55%
Sunflower cake	61%	20%		81%
Finished Fertilizers		16%	6%	22%
Potash		21%	17.6%	39%

Table 2.
Percentage share of global exports 2021, Source: FAO

According to FAO simulations, the number of undernourished people globally could increase by 8-13 million in 2022/2023, with the largest increases in Asia-Pacific, sub-Saharan Africa, the Middle East and North Africa [15].

3.2 Inflationary pressures

As for maize, oilseeds and fertilisers, the effects of low stocks and high prices could spill over, pushing up the prices of other commodities. The FAO recently announced that the global food price index reached an all-time high in February, after rising steadily for most of last year (Figure 2) [16].

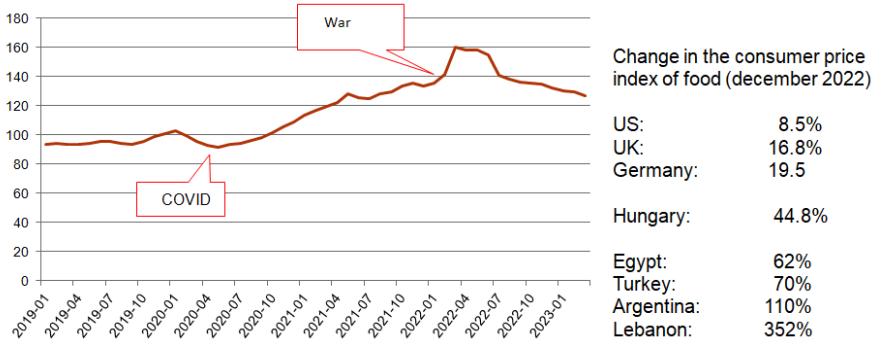

Figure 2

Food crises points, FAO Food Price Index (FFPI)

According to the World Bank's April 2022 "Commodity Market Outlook" report, the war in Ukraine has altered the global trading system, production and commodity consumption in such a way that prices could remain at historically high levels until the end of 2024, exacerbating food insecurity and inflation [17].

3.3 Supply Chain

Prior to the invasion, more than 90% of cereal and vegetable oil exports were made via sea routes. Russia blockaded Ukrainian ports in March and April. By mid-May, almost 70% of grain was being exported by rail, thanks to new rail transport corridors to the east of the country, but it is unlikely that Ukraine will be able to deliver all the grain the world was expecting, especially as the conflict could cause further damage to land transport infrastructure. The larger shipping companies suspended shipments to and from Ukraine and Russia, citing unpredictable operational consequences. The increase in insurance premiums for ships intending to dock in the Black Sea region could further exacerbate the already high cost of maritime transport [15].

3.4 Fossil Addiction

Russia plays a key role in the global energy market. Agriculture uses large amounts of energy directly in the form of fuel, gas and electricity, and indirectly through the

use of fertilizers, pesticides and lubricants. Russia is the number one, two and three exporter of fertilizers based on different bases. Along with Belarus, nearly 60% of EU fertilizer imports come from this region [21]. The current fertilizer shortages and high prices are a major concern, mainly due to the long-term decline in yields.

3.5 Outlook

Domestic food price inflation remains high around the world. However, FAO Food Price Index marks 12th consecutive monthly decrease ().

The National Oceanic and Atmospheric Association (NOAA) Climate Prediction Center has issued an El Niño Watch. El Niño likely to increase global average temperatures and alter rainfall patterns for 2023 and 2024, additionally could exacerbate the impacts of recent extreme weather events ().

Protectionism and food security concerns are on the rise. Following Russia's invasion of Ukraine, trade-related policies imposed by countries have surged. The global food crisis has been partially made worse by the growing number of food trade restrictions put in place by countries with a goal of increasing domestic supply and reducing prices.

Conclusions

The short-term solution to minimize disruption to global supply chains is obviously to find alternative sources of lost crops and raw materials and to try to reduce consumption. However, the current crisis also highlights the high dependency of most countries' food systems on imported inputs such as fossil fuels, fertilizers and feed, which confirms the need to fundamentally transform agriculture and food systems towards sustainability. Efforts should be made to promote new food production systems such as aquaponics and hydroponics, short supply chains and circular economies, although the benefits of these will undoubtedly only be felt in the long term.

References

[1] Bourne J. K. (2009) The End of Plenty - A special report on the global food crisis, National Geographic, June 2009. https://www.nationalgeographic.com/magazine/article/cheap-food (last accessed October 31, 2022)

[2] Ahmedzade, T., Horton J., Mwai, P. and Song, W. (2022): China, Europe, US drought: is 2022 the driest year recorded? BBC Reality Check & Visual Journalism, https://www.bbc.com/news/62751110 (retrieved Oct. 31, 2022)

[3] Maruniak E., Lisovskyi S., Holubtsov O., Chekhnii V., Farion Y.; Mykhailo A. (2021): Research into impacts of agricultural land concentration on ukrainian environment and society, Kyiv, Ukraine, pp.36.

[4] Ollagnier J. (2022) How to reinvent supply chains in a new global economic order, The World Economic Forum Annual Meeting: History at a Turning Point: Government Policies and Business Strategies, Davos, May 24, 2022 https://www.weforum.org/agenda/2022/05/reinvent-supply-chains-pandemic-ukraine/ (downloaded Oct. 31, 2022)

[5] FAO (2022): The State of Food Security and Nutrition in the World 2022: Repurposing food and agricultural policies to make healthy diets more affordable; FAO: Rome, Italy, 2022 DOI: 10.4060/cc0639en

[6] Food and Agriculture Organisation, FAO (1996): Rome Declaration on World Food Security, 13 November 1996, Rome, Italy, https://digitallibrary.un.org/record/195568 (retrieved Oct. 31, 2022)

[7] OECD (2002) OECD Glossary of Statistical Terms: Food Security. http://stats.oecd.org/glossary/detail.asp?ID=5006 (downloaded Oct. 31, 2022)

[8] Bown, C. P. Russia's war on Ukraine: a sanctions timeline, available at: https://www.piie.com/blogs/realtime-economics/russias-war-ukraine-sanctions-timeline (retrieved Oct. 31, 2022)

[9] Bogonos, M., Litvinov, V., Martyshev, P., Neyter, R., Nivievskyi, O., Piddubnyi, I., & Stolnikovich, H. (2022): Beyond survival: farming chronicles, outlook and strategies for Ukrainian agriculture following the 2022 Russian Invasion, 2022 Agricultural & Applied Economics Association Annual Meeting, Anaheim, CA; July 31-August 2

10] Observatory of Economic Complexity, OEC. https://oec.world/en/profile/country/syr (downloaded Oct. 31, 2022)

[11] 4th International Conference on Grey Literature, New Frontiers in Grey Literature, 4-5 October 1999, Washington DC, Asian Libraries, 8(7). DOI: 10.1108/al.1999.17308gab.010

[12] Griffith, C. (2022): Upset to Global Agricultural Trade? Long-Term Impacts of the Russia-Ukraine Conflict https://www.agweb.com/markets/world-markets/upset-global-agricultural-trade-long-term-impacts-russia-ukraine-conflict (downloaded Oct. 31, 2022)

[13] Nasir, M.A., Nugroho, A.D., Lakner, Z. (2022) Impact of the Russian-Ukrainian Conflict on Global Food Crops. Foods, 11(19):2979. DOI: 10.3390/foods11192979.

[14] EC (2022): Short-term outlook for EU agricultural markets, Autumn 2022. European Commission, DG Agriculture and Rural Development, Brussels.

https://agriculture.ec.europa.eu/data-and-analysis/markets/outlook/short-term_en (downloaded Oct. 31, 2022)

[15] Food and Agriculture Organisation, FAO (2022): The Importance of Ukraine and the Russian Federation for Global Agricultural Markets and the Risks Associated with the Current Conflict; FAO: Rome, Italy, 2022

[16] FAO (2022): FAO Food Price Index, https://www.fao.org/worldfoodsituation/foodpricesindex/en/.

[17] World Bank Group (2022) Commodity Markets Outlook: The Impact of the War in Ukraine on Commodity Markets, April 2022. World Bank, Washington, DC. https://openknowledge.worldbank.org/bitstream/handle/10986/37223/CMO-April-2022.pdf (retrieved Oct. 31, 2022)

[18] Hutson, L. (2022): Ukraine - the farming front line, Ministry of Agrarian Policy and Food of Ukraine, 29 April 2022, https://minagro.gov.ua/en/news/ukraine-farming-front-line (retrieved Oct. 31, 2022)

[19] GIEWS Country Brief Ukraine. https://www.fao.org/giews/countrybrief/country/UKR/pdf/UKR.pdf (retrieved Oct. 31, 2022)

[20] Pozniak, S. (2019): Chernozems of Ukraine: past, present and future perspectives Soil Science Annual, 70(3), 193-197. DOI: 10.2478/ssa-2019-0017

[21] Fertilizers Europe (2021): Fertilizer Industry Facts & Figures, Brussels, Belgium. https://www.fertilizerseurope.com/wp-content/uploads/2021/07/Industry-Facts-and-Figures-2021-1.pdf) (downloaded Oct. 31, 2022)