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Digitalization Level of Businesses in EU Countries in Terms of their Sustainability and Risk of Bankruptcy

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Abstract

Digitalization is one of the top priorities of the European Union. The concept of digitalization and sustainability of all spheres of society's life in EU countries is increasingly important and can represent a driving force for the development of their economies. As a result, the introduction of digitalization elements is necessary and important for the sustainable development of enterprises and the growth of their competitiveness. Due to the risk of possible bankruptcy, the digitalization of businesses and the use of digital tools by business employees have become a dominant topic in many EU countries, especially during the COVID-19 pandemic. The degree of digital adoption resulting from responses to COVID-19 varies across sectors and countries. The aim of this paper was to analyze the level and efficiency of the digitalization process of EU countries and their business environment based on selected indicators. The evaluation of digitalization elements implementation in EU countries and businesses was carried out for the years 2019-2021. The Malmquist index was used to assess the efficiency of the digitalization process of EU countries and their business environment. The results of the index confirmed the growth in the level and efficiency of ongoing digitalization processes within the EU countries. However, it is important to point out the fact that lagging countries are introducing digitalization elements, especially in the recent period, and the efficiency of their introduction is higher in these countries compared to more developed EU countries. This is due to the fact that developed countries have already introduced digitalization elements in most areas of life. The main contribution of the research is pointing out the need to evaluate the digitalization process not only static, based on the coverage of individual areas with digitalization elements, but also dynamically and thus evaluate the efficiency of their introduction.

Keywords: business, digitalization, efficiency, Malmquist index, sustainability
Jel codes: C44, M15, O33

1. Introduction

The COVID-19 pandemic caused the demise and bankruptcy of many businesses. The pandemic fully exposed those businesses that were already having problems before it, and caused a headache to those that, for various reasons, could not adapt promptly and flexibly to the situation. Today, however, we can state that especially businesses that rode on the wave of digitalization emerged victorious from the pandemic (Klimant, 2022). However, the Digital Economy and Society Index (DESI), which is published annually by the European Commission as part of the digital agenda, shows that Slovakia continues to lag behind other EU countries in the digitalization process. In 2021, it ranked 22nd. Larger multinational businesses are currently one of the most digitalized entities in Slovakia (European Commission, 2022). They are mainly interested in the collection and evaluation of data that hide the key to the improvement of the overall organization and management of the entity (and thus the savings). The digitalization of companies is mainly slowed down by their lack of information about the benefits it can bring them. Although the COVID-19 pandemic acted as the major driving force behind the digitalization, the war in Ukraine and the increase in energy prices changed the priorities of businesses. According to a survey by Soitron, 30% of Slovak companies have not dealt with the issue of digitalization yet. Based on the results of a survey by PwC and the magazine Forbes, Slovak managers are roughly 50% less concerned about digital technologies compared to businesses from abroad (Trend, 2016). However, if businesses want to stand up not only to domestic competition, but also to larger multinational corporations, they must introduce the key elements of digitalization and invest in digitalization processes as quickly as possible, despite the initial increased expenses. Digitalization using cloud technologies can be key in this regard. With their help, the business entity can comfortably use various advanced software applications, whether in the field of online sales, digital marketing, CRM (Customer Relationship Management) systems, when communicating with customers or with employees.

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A basic prerequisite for smooth running of digitalization is reliably functioning servers and adequate security. Thanks to digitalization, small and medium-sized companies gain access to such services that were only available to large corporations in the past. In addition, digitalization makes it possible for businesses to flexibly react to changes and use resources when and how necessary, with financial savings representing an interesting benefit (Trend, 2019). Digitalization is one of the trends that, when properly used and applied, will help streamline and reduce the company's expenses. However, many businesses in Slovakia adopt a conservative approach and are reluctant to change long-established processes. This is also one of the reasons why, despite the advantages of digitalization and the introduction of state support programs, the digitalization process in Slovakia is still not gathering pace it should have by now. The aim of the paper was to analyze the level of digitalization process in EU countries and their business environment and to calculate the efficiency of individual digitalization elements implementation. The partial aim was to point out that it is important to monitor not only the number of introduced digitalization elements, but also the efficiency of their use and implementation.

The remainder of the paper is structured as follows: Section 'Literature review' defines digitalization, briefly describes digitalization in selected industries within EU and studies the relationship between digitalisation and other important phenomena such as financial performance, risk of bankruptcy or sustainability. Section 'Data and methodology' specifies the source of the data and describes The Malmquist index used to assess the efficiency of the digitalization process of EU countries and their business environment. Section 'Results' offers the results of the change in efficiency over time in EU coutries and businesses calculated with the use of the Malmquist index and compares the development of the implementation of selected digitalization elements in Slovak businesses. Section 'Discussion and conclusions' offers a discussion about the digitalization process in EU countries and businesses and states conclusions, limitations and future research.

2. Literature Review

European industry is firmly committed to integrating the concept of digitalization into its production and organization in order to be more competitive in the context of globalization. This process was accelerated by the COVID-19 pandemic, which affected businesses in various industries. They were forced to implement new internal workflows and felt the pressure to offer products through digital channels. Businesses have gone through profound changes and have introduced solutions based on digital technologies in a very short time (Almeida et al., 2020). However, digitalisation is not about only technology adoption, rather, it is about fundamental change that occurs in "organisational strategy, business processes, organisational knowledge and the whole socio-technical organisational system" (Park and Saraf, 2016; In Alsufyani and Gill, 2022, p. 1). It is also confirmed by Federal ministry for Economic Affairs and Energy (2017; In Isensee et al., 2020, p. 2), which understands this term as „the transformation of business models as a result of fundamental changes to core internal processes, customer interfaces, products and services, as well as the use of information and communications technologies". Therefore, the application of digital technologies makes it possible to implement new processes within the entire value chain, through production and sales to services.

Digitalisation processes are more or less taking place in every industry. Digitalization in European airport industry was studied by Kovacikova et al. (2021). These authors used selected digitalization indices to compare selected Slovak airports with leaders in the field of digitalization. They revealed that „the application of the Airport 4.0 concept at Slovak airports does not include self-boarding, indoor navigation, biometric services, RFID baggage tags, self-baggage tagging, kiosk for lost luggage and airport apps for mobile devices" (Kovacikova et al. 2021, p. 1287). As the first step in the future, they suggest finishing the development of airport apps for mobile devices.

Riasanow, Galic and Böhm (2017) studied digital transformation in the automotive industry. They evolved generic value network for this industry with the use of 15 generic roles identified based on structured content analysis of 650 automotive organizations from the Crunchbase database. The network was validated by preliminary interviews with experts from the automotive industry. Based on the network the authors revealed that mobility service platforms and disruptive technology providers are entering the market and they therefore threaten the value creation of original equipment manufacturers from two sides at the same time. Pop (2020, p. 243) also studied the digitalization process in Romanian car company. They revealed that „when optimizing processes from the perspective of digitalization, the costs resulting from the implementation of Smart Production System will decrease and the degree of customer satisfaction, the quality of products but also the traceability will inevitably increase".

Barnewold and Lotermoser (2020) studied digitalisation in mining industry, Based on the resutls of their study they conclude that key technologies for mining industry are automation, robotics, internet of things, big data, real-time data, machine learning, artificial intelligence and 3D printing. They also draw attention to the fact that mining

operations with lower production rate do not introduce the available digital tools and hardware technologies to the same extent as larger ones.

The crucial question which should be examined in every industry is how the level of digitalization effects businesses` financial performance, respectively their risk of bankruptcy. According to Ionascu et al. (2021, p. 97) „research to provide empirical evidence on the consequences of digitalization on firm financial performance is scarce and in the exploratory phase, primarily due to difficulties in measuring the phenomenon of digitalization at the companies' level". For this reason, current knowledge about this issue is fragmented. The relationship between IT adoption, digitalization and financial performance studied Eller et al. (2020) who focused on examining the digitalization of SMEs. They revealed that IT adoption, employee skills and digital strategy significantly drive digitalization, and digitalization in turn drives SMEs` financial performance. They also identified IT as a key factor influencing financial performance through digitalization. Some authors view this issue through efficiency. According to Zeng et al. (2022) digitalization optimizes the production process and improves firm performance by enhancing production efficiency. Authors Zeng et al. (2022) also draw attention to the possible negative impact of digitization on financial performance, since digital technologies are associated with higher learning and management costs and can have a negative effect on financial performance. In this context, it should be noted that this negative effect would be rather short-term. Other authors focused on examining how digitalization in combination with other factors affects performance. Abou-foul et al. (2020) surveyed 185 U.S. and European manufacturing firms and concluded that digitalization together with servitization has a direct positive effect on a firm's financial performance. Forcadell et al. (2020) surveyed 112 global banks over the period 2003-2016. They confirmed that the combination of corporate sustainability and digitalization strategies contributes to banks'market performance and efficiency.

Research aimed at how the digitalisation affects businesses` risk of bankruptcy is even more scarced. Ulivi (2021) used regression analysis to examine the relationship between the Software Assets over Total Assets ratio and variable "result" constructed based on the Altman Z score. The analysis was conducted for Italian publicly listed companies. The results showed that the increase in this ratio lowers risk of bankruptcy in the short term. The analysis based on the Ohlson O score also confirmed that companies with a higher level of digital maturity have a lower possibility of being bankrupt. The relationship between digitalization and the risk of bankruptcy was marginally mentioned in the study by Zeng et al. (2022, p. 3) who argue that „digitalization reduces the impact of uncertainty on business operations, enabling firms to maintain efficient performance growth in the changing world".

Importat phenomenon which will play crucial role in the transformation of many industries in the next years and decades is sustainability. According to Elkington (2018; In Lichtenthaler, 2021, p. 67) „sustainability goes beyond conserving the environment and also involves economic and social factors, leading to the triple bottom line of financial, environmental, and social outcomes". The relationship between digitalization and sustainability is discussed to such an extent that a new term "digitainability" has recently been suggested. According to Gupta et al. (2020, p. 3) it refers to the „cross-fertilization between the processes of digitalization and sustainable development". Digitainability has been analysed in many studies (Stefanovic et al., 2021; Shashi, 2022), while the study by Saáry et al. (2022) studied digitainability in Slovak SMEs as well.

3. Data & Methodology

The data for the processing of the given empirical research can be divided into three areas of investigation. The first area is the process of introducing digitalization elements at the country level. The second area is the research of digitalization elements introduced in the businesses within EU countries, and the third area is the process of digitalization of individual industries within Slovakia. For the analysis of the digitalization process of the EU countries, criteria representing 4 areas of the digital compass were chosen, while their impact on GDP and unemployment rate was examined. The following inputs were used: Individuals' level of digital skills - Individuals with basic or above basic overall digital skills (all five component indicators are at basic or above basic level), Employed ICT specialists - Percentage of total employment, Household internet connection type: broadband - Percentage of households, Internet used - Percentage of individuals, Cloud computing services - Percentage of enterprises, Enterprises use DSL or other fixed broadband connection - Percentage of enterprises, Small enterprises (10-49 employees and self-employed persons), without financial sector, E-government activities - Internet use: interaction with public authorities - Percentage of individuals. GDP per capita and the unemployment rate were used as outputs. The data of EU-27 Member States as well as EU average were collected for the period 2019 – 2021. Within the second area of research, indicators related to the digitalization process at businesses` level were applied. These indicators represent the fields of E-commerce, Connections to the internet, Websites and use of

social media, E-business and ICT security. The following inputs were used: E-commerce sales, Use of computers and the internet by employees, Type of connections to the internet, Websites and functionalities, Use of mobile connections to the internet, Cloud computing services. GDP per capita and unemployment rate were used as outputs. The last group of data for the research is aimed at evaluating the process of digitalization of Slovak businesses. As part of this analysis, the following indicators were chosen: BIA - businesses with Internet access, BBC - businesses with broadband connection, BOW - businesses with their own website, OOB - online ordering or booking, ACPL - access to catalogs and price lists, COS – customization of online services, LBPSN - links to business profiles on social networks, USMB - use of social media in businesses, BBM - business blog or microblog, MCSW - multimedia containing shared websites (for example YouTube), WTSK - a wiki-based tool for sharing knowledge, BSGSI - businesses selling goods or services over the Internet.

Several methods can be used to estimate distance functions, which are the starting point for calculating TFP. Linear programming is most often used, especially the Data Envelopment Analysis (DEA) method proposed by Färe, Grosskopf, Norris and Zhang in 1994 (Fandel, 2002). The use of DEA models to calculate TFP is related to the assumption that homogeneous data are available over several periods. Calculating the change in efficiency requires solving four linear programming problems, assuming the use of technology with constant returns to scale (Fandel, 2002).

Suppose that each $DMU_j (j = 1,2,\dots,n)$ uses a vector of inputs $x_j^t = \left(x_{1j}^t, \dots, x_{mj}^t\right)$ to produce vector of outputs $y_j^t = \left(y_{1j}^t, \dots, y_{mj}^t\right)$ at each period of time $t, t = 1, \dots, T$. Efficiency of DMU_0 can change or the frontier can shift or both changes may occur in the same time. The Malmquist Productivity Index is than defined as follows (1) (Zhu, 2014):

$$MI_o = \left[\frac{\theta_o^t(x_o^t, y_o^t)}{\theta_o^t(x_o^{t+1}, y_o^{t+1})} \frac{\theta_o^{t+1}(x_o^t, y_o^t)}{\theta_o^{t+1}(x_o^{t+1}, y_o^{t+1})}\right]^{\frac{1}{2}} \quad (1)$$

where MI_0 measures the change in productivity between the periods t and $t+1$. $\theta_o^t(x_o^t, y_o^t)$ is calculated by comparing x_o^t to the EPF (Empirical Production Frontier) at time t with the use of input oriented CRS DEA model, while $x_o^t = (x_{1o}^t, \dots\dots\dots\dots x_{mo}^t)$ and $y_o^t = (y_{1o}^t, \dots\dots\dots\dots y_{so}^t)$ are the input and output vectors of DMU_0 among others. Similarly $\theta_o^{t+1}(x_o^{t+1}, y_o^{t+1})$ is calculated by comparing x_o^{t+1} to the EPF at time t+1, $\theta_o^{t+1}(x_o^t, y_o^t)$ by comparing x_o^t to the EPF at time $t+1$; and $\theta_o^t(x_o^{t+1}, y_o^{t+1})$ is calculated by comparing x_o^{t+1} to the EPF at time t applying input-oriented CRS DEA model.

This model is also available in its modified form (2) (Zhu, 2014):

$$MI_o = \frac{\theta_o^t(x_o^t, y_o^t)}{\theta_o^{t+1}(x_o^{t+1}, y_o^{t+1})} \times \left[\frac{\theta_o^{t+1}(x_o^{t+1}, y_o^{t+1})}{\theta_o^t(x_o^{t+1}, y_o^{t+1})} \frac{\theta_o^{t+1}(x_o^t, y_o^t)}{\theta_o^t(x_o^t, y_o^t)}\right]^{\frac{1}{2}} \quad (2)$$

According to Fandel (2002) the term (3) represents the change in technical efficiency, it is the efficiency known according to Farrell (1957). The change in efficiency is equivalent to the ratio of Farrell's efficiency at time t and at time $t+1$ (technical efficiency change between periods t and $t+1$). Usually, this term expresses the improvement, deterioration or stability of technical efficiency.

$$\frac{\theta_o^t(x_o^t, y_o^t)}{\theta_o^{t+1}(x_o^{t+1}, y_o^{t+1})} \quad (3)$$

The term (4) represents the frontier shift (FS) in the EPF between periods t and $t+1$ (Zhu, 2014).

$$\left[\frac{\theta_o^{t+1}(x_o^{t+1}, y_o^{t+1})}{\theta_o^t(x_o^{t+1}, y_o^{t+1})} \frac{\theta_o^{t+1}(x_o^t, y_o^t)}{\theta_o^t(x_o^t, y_o^t)}\right]^{\frac{1}{2}} \quad (4)$$

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The values of indicators can be interpreted as follows:

- $TECH > 1$ the efficiency of the DMS improved, it approached production possibility frontier, the decisions taken were correct,
- $TECH = 1$ the efficiency of the DMS did not change,
- $TECH < 1$ the efficiency of the DMS declined; the decisions taken were incorrect.

TECH informs about a change in technical efficiency but does not inform about a shift in production possibility frontier as a result of technological change. This is reported by frontier shift as follows:

- $FS > 1$ the efficiency increased and the frontier shifted outwards,
- $FS = 1$ efficiency frontier did not shift,
- $FS < 1$ the efficiency declined and the frontier shifted inwards. This index informs about the change within the entire EU.

4. Results

When comparing the results of the efficiency of digitalization elements implementation in the EU countries for the years 2020 and 2021, the best value of the Malmquist index (MI) achieved Germany, Finland, Sweden, Hungary, Latvia, Ireland and Malta. These countries achieved the value of MI above 1, which represents a process of efficient digital transformation. Other countries achieved the level of digital transformation efficiency below 1. Efficiency change reached a value above 1 in several countries. These countries use the already established digitalization elements more efficiently over time. Based on the MI results, it can be concluded that countries such as Hungary, Ireland, Romania, Luxembourg, Italy, Greece, Bulgaria achieved a technical efficiency change value of 1. It means that in these countries, the efficiency of the introduced digitalization elements is stable over the analyzed years. Based on the analysis of the results of countries in the given years, it can be concluded that the best results in frontier shift were recorded by Hungary and Ireland. Other countries reached the value of Frontier shift below 1, but their values remained above the level of 0.9. The only country that lags significantly behind in implemented technological changes is Greece.

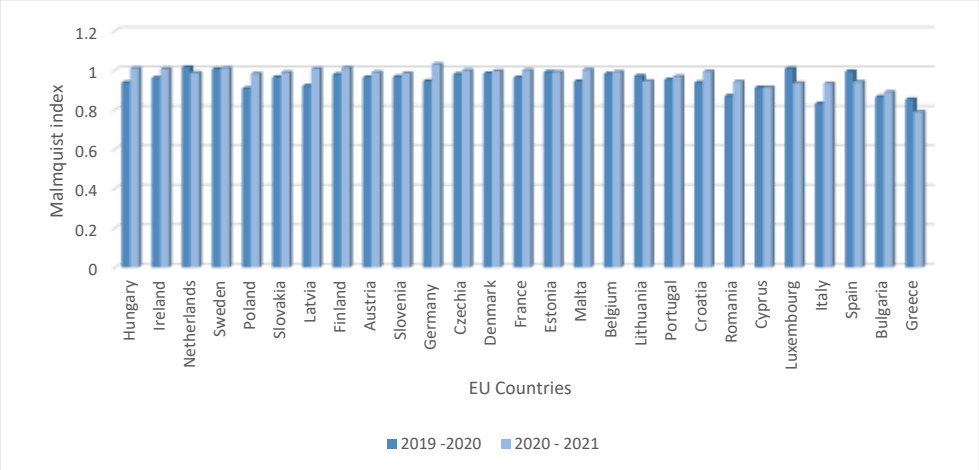
Table 1. Malmquist index 2020 - 2021

DMUs	**Malmquist Index**	**Efficiency Change**	**Frontier Shift**
Belgium	0.99084	1.04124	0.95160
Bulgaria	0.88841	1.00000	0.88841
Czechia	0.99860	1.03750	0.96251
Denmark	0.99542	1.03457	0.96217
Germany	1.02970	1.06554	0.96636
Estonia	0.98982	1.03211	0.95902
Ireland	1.00601	1.00000	1.00601
Greece	0.78842	1.00000	0.78842
Spain	0.94043	1.03592	0.90782
France	0.99910	1.03930	0.96132
Croatia	0.99290	1.05103	0.94469
Italy	0.93170	1.00000	0.93170
Cyprus	0.91209	0.97410	0.93634
Latvia	1.00644	1.03746	0.97010
Lithuania	0.94413	0.99803	0.94599
Luxembourg	0.93443	1.00000	0.93443
Hungary	1.00897	1.00000	1.00897
Malta	1.00200	1.04798	0.95613
Netherlands	0.98610	0.99833	0.98775
Austria	0.98857	1.02167	0.96761
Poland	0.98180	1.01048	0.97161
Portugal	0.96787	1.02409	0.94510
Romania	0.94140	1.00000	0.94140
Slovenia	0.98392	1.01749	0.96700

Slovakia	0.98830	1.01724	0.97155
Finland	1.01224	1.04512	0.96854
Sweden	1.01066	1.03858	0.97312

Source: processed by authors in software DEAFrontier

Graph 1 shows a comparison of the development of MI during the years 2019-2021. Based on the results we can say that efficiency of the introduction of digitalization elements has increased in almost every EU country.

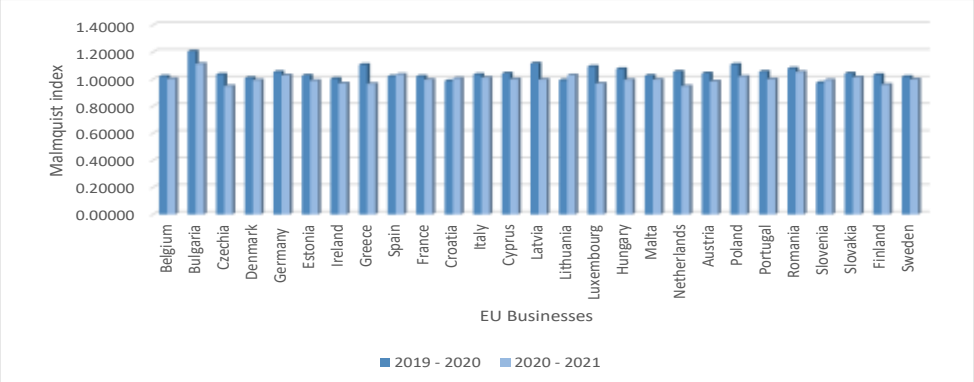


Graph 1. Comparison of the efficiency of digitalization elements introduction in EU countries

Source: Authors

The EU average of the MI index achieved 0.81 in the period 2019-2020 and 0.96 in the period 2020-2021. These results indicate an increase in the efficiency of the introduction of digitalization elements in EU countries. Slovakia moved from 12th place to 6th place in the analyzed period. A significant improvement of the index was achieved in the case of Hungary and Ireland. However, it is necessary to point out the fact that in the case of developed countries, which are leaders in the field of digitalization, the efficiency of digitalization element's introduction in recent years is lower, since in many areas they already reach 90-100% coverage of individual areas of society's life.

A comparison of the digitalization process in enterprises in EU countries is shown in graph 2. If we compare the averages of the EU countries in the given years, we can say that the efficiency of the digitalization process at the enterprise level decreased from 1.0291 to 1.0103. When analyzing efficiency of individual countries, it was found that there was a decrease in MI in most EU countries during the analyzed years.



Graph 2. Comparison of the efficiency of digitalization elements introduction in businesses in EU countries

Source: Authors

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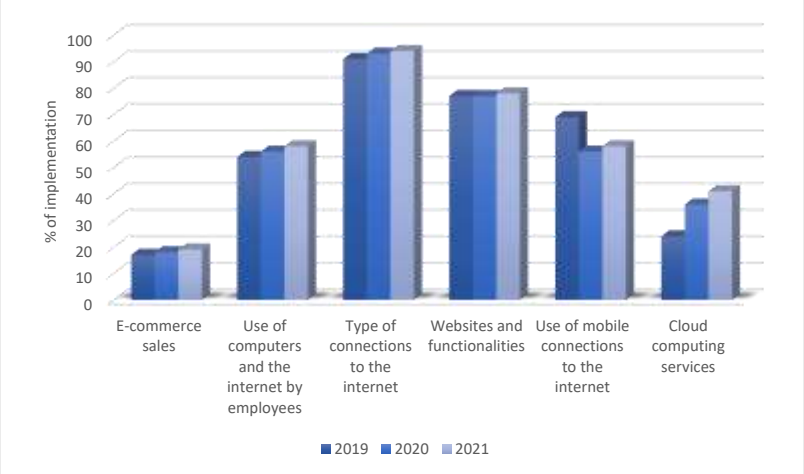
In 2021, a decrease in the efficiency of the use of already established digitalization elements in businesses was recorded in the Czechia, Estonia, Ireland, Greece, France, Croatia, Italy, Cyprus, Latvia, Malta, the Netherlands, Portugal, Slovenia and Finland. The best technical efficiency change was achieved by Lithuania and Sweden. Bulgaria, Greece and Czechia achieved the best frontier shift. We positively assess the fact that the number of companies that use cloud computing services has increased in almost every country.

The average introduction of individual digitalization elements in EU companies is shown in graph 3. Compared to previous years, Use of mobile connections to the internet lags behind, but on the other hand, the share of Cloud computing services is growing. This growth can be considered positive from the point of view of ensuring the competitiveness of businesses within the EU.



Graph 3. Development of selected digitalization elements of businesses in EU countries

Source: processed by authors based on Eurostat (2022)

The analysis of the digitalization of Slovak businesses was focused on selected indicators. Its results are processed in table 2. Businesses achieve good results in internet access, as most industries in Slovakia show a value of this element above 90%, while 95% of all businesses have this connection. In services (services, accommodation, catering) there is a smaller share of businesses with broadband connections. Businesses with their own website dominate information and communication industry but lag behind in Transport. Online ordering or booking is less established in the area of digitalization, from the point of view of industries, it is most established in Trade and least established in Industry. Access to catalogs and price lists is best implemented in Real estate and worst implemented in Professional, scientific and technical activities. Digitalization elements such as Customization of online services, “inks to business profiles on social networks, Business blog or microblog, Multimedia containing shared websites (YouTube), A wiki-based tool for sharing knowledge and businesses Selling services and products over the Internet are among the least established in Slovak businesses.

Table 2. The introduction of digitalization elements in Slovak businesses in 2021 (in %)

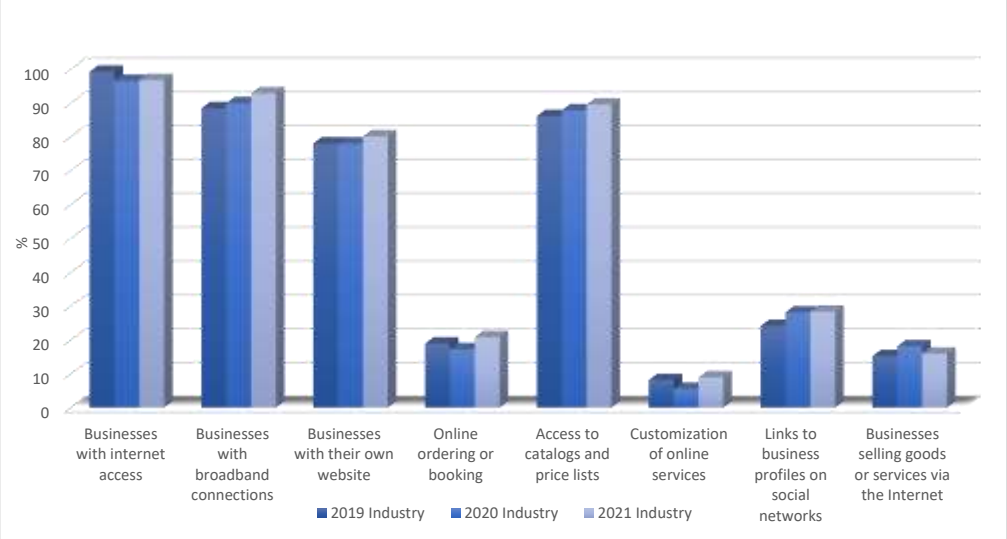
Indicator	Total	I	R	S	TRAD	TRAN	AF	IC	RE	PSTA	ASS
BIA	95	96.7	99.2	91.8	96.2	97	93.3	96.2	90.5	92.2	92.1
BBC	92	92.8	94.9	87.2	94.3	85.8	83.9	99.5	91.6	92.1	91.4
BOW	80	80.1	88.1	81.1	83.8	69	78.4	89	80.6	78.6	71.7
OOB	32	20.8	22.9	5.7	50.4	25.4	61.9	35.3	30.6	27.1	29.9
ACPL	90	89.5	83.4	93.1	91.9	87.9	92.4	90.5	93.5	86.3	87.6
COS	11	8.9	12.6	2.7	16.7	3.7	20.1	17.1	8.3	10.7	12.6
LBPSN	37	28.3	31	22	46.9	25.1	52.2	54.1	30.1	45.8	34.9
USMB	44	37.2	30	27.8	52.5	40.8	62.4	63.3	41.1	48.1	43.6
BBM	8	7	6.4	4.7	8.5	8.4	5.9	21.2	7.9	10.2	6.7
MCSW	20	17.5	10.7	7.8	25.9	13.5	28.6	38	23.8	23.3	15.1
WTSK	4.6	3.6	3.5	2.3	3.3	3.9	3.6	27.7	3.8	5.8	2.8
BSGSI	17	15.9	7.2	1	28.6	9.1	28.9	19.4	13.2	12.1	10

Source: processed by authors based on SUSR (2022)

Explanatory notes:

BIA - businesses with internet access
BBC - businesses with broadband connections
BOW - businesses with their own website
OOB - online ordering or booking
ACPL - access to catalogs and price lists
COS - customization of online services
LBPSN - links to business profiles on social networks
USMB - use of social media in businesses
BBM - business blog or microblog
MCSW - multimedia containing shared websites (for example YouTube)
WTSK - a wiki-based tool for sharing knowledge
BSGSI - businesses selling goods or services via the Internet
I - Industry
R - Recycling
S - Services
TRAD - Trade
TRAN - Transport
AF - Accommodation and food
IC - Information and communication
RE - Real estate
PSTA - Professional, scientific and technical activities
ASS - Administrative and supporting services

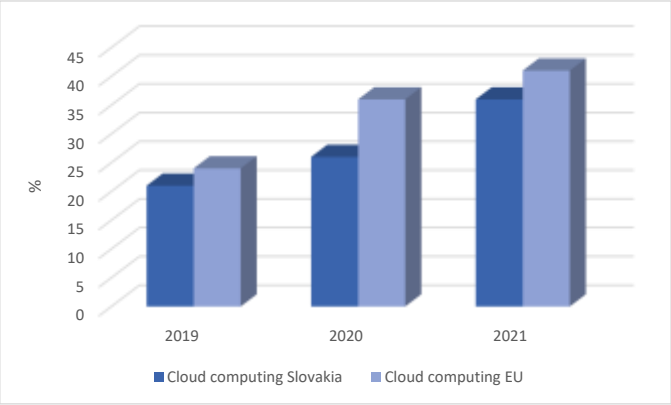
Graph 4 shows a comparison of the Slovak Industry for the years 2019-2021. The percentage of businesses with an Internet access decreased by 2.5% in 2021 compared to 2019. On the other hand, broadband connection was introduced by 4.4% more companies in the Industry than in 2019. The number of companies with their own website increased by 2%. The online ordering or booking indicator reached only 20.8% in 2021, which represents a very small share of enterprises compared to the leaders in the field of digitalization. A much larger number of businesses have access to catalogs and price lists via the Internet. Only 8% of enterprises in Slovak industry have the option to customize online services. However, what is very negative is the small number of companies that have established the possibility of selling products and services via the Internet, but in the case of industrial companies it is more or less logical. This element is more often used by service and trade enterprises. The use of social media in Industry, as well as business blog and microblog or the wiki-based tool cannot be compared over time, as there is a lack of data for these elements for 2019 and 2020.



Graph 4. Development of selected digitalization elements in Slovak industry

Source: processed by authors based on SUSR (2022)

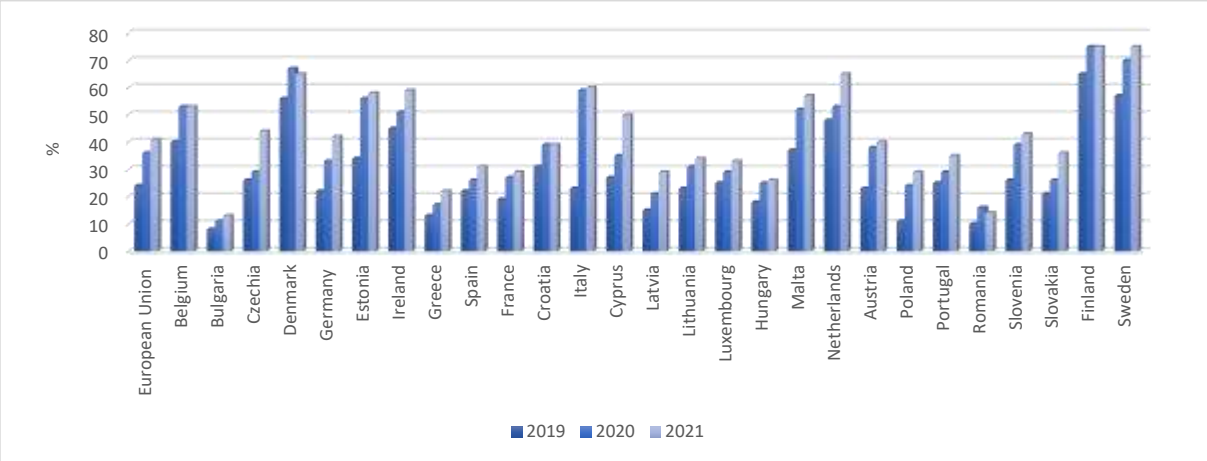
One of the most significant digitalization elements in businesses is the introduction of cloud computing services. The comparison of the introduction of this digitalization element in Slovakia with the EU average is shown in graph 5. The EU average is higher than the % of implementation of cloud computing services in Slovak businesses in each analyzed year.



Graph 5. Development of cloud computing services - comparison of Slovakia and the EU average

Source: processed by authors based on Eurostat (2022)

More detailed information about the application of cloud computing services is provided by graph 6, which compares the development of the implementation of this digitalization element in the period 2019-2021 for all EU countries.



Graph 6. Development of cloud computing services in EU countries

Source: processed by authors based on Eurostat (2022)

The leaders in this area are Finland, Sweden, Denmark, the Netherlands and Italy. These countries significantly exceed the EU average.

5. Discussion and conclusions

According to the reports submitted by the European Commission, it was found that businesses have made the most of digitalization and at the same time this process has had a significant impact on the economy of countries. Digitalization is also one of the driving factors behind an unexpected increase in GDP while keeping bankruptcy rates in some EU countries in check. According to the results of a survey by Delloite (2021), businesses have recently begun to pay more attention to the issue of digitalization and see this area as a prerequisite for their further growth (87% of businesses from 33 countries). Up to 69% of companies believe that the crisis has sped up the process of introducing digitalization elements into the business. According to Delloite, ecological sustainability is another important success factor (66% of the companies surveyed said so) (Deloitte, 2022). However, according to SoftServe's report, only 10-33% of businesses stated that they have completed their digitalization process (Economypedia, 2022). In this regard, Slovak companies lag behind the rest of the EU and the whole world. Slovakia ranks 23rd of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index. A year earlier (2021) it ranked 22nd. Slovakia is just below or around the EU average across the indicators for human capital. 55% of Slovaks have basic digital skills, which is slightly above the EU average of 54%. The proportion of ICT specialists in total employment is 4.2%, slightly below the EU average (4.3%). 16% of information and communications technology specialists are women compared with the EU average of 19%. Slovakia's e-commerce scores have fallen: 13% of SMEs sell online compared to 17% in 2020. 16% of Slovak enterprises used e-invoices in 2020 compared with 32% in the EU. Slovakia is below the EU average across the indicators for digital public services. The proportion of e-government users among internet users has decreased to 62% and is below the EU average of 64% European Commission (2022).

The results of the Statistical Office of the Slovak Republic for the year 2021 show interesting trends. The results show that only 28.6% of trade enterprises sell goods or services via the Internet. It is digitalization that will enable these businesses to survive in the current turbulent times. Features of online booking and ordering were found in 50.4% of trade enterprises surveyed and in 61.9% of accommodation and service-based businesses (SUSR, 2022). As for the industrial sector, despite digitalization efforts, it continues to face difficulties, especially because its nature requires employees to be present on-site. The manufacturing industry, despite being heavily automated, cannot do without employees being on site. In this sense, the manufacturing industry is on better terms with digitalization when compared to trade-oriented businesses (Economypedia, 2022). Slovak businesses, however, lag behind in the introduction of cloud computing services. The share of businesses that have already introduced cloud computing services amounted to only 36% in 2021. Compared to the EU average, it is 5% less. Slovakia lags significantly behind the leaders in the field, namely Finland and Sweden, as 75% of those companies have already introduced cloud computing services (data from Eurostat, 2022).

Surprisingly, businesses active in information and telecommunication business show extremely low digitalization rates. Europe-wise, only 30% of them are digitalized. It is very surprising that companies active in information and telecommunication business still do not have sufficient digital and technology infrastructure. One of the reasons might be insufficient resources, high costs associated with building and renovating technological infrastructure fit for the purpose.

Despite the fact that Slovakia ranks 22nd-23rd in terms of introducing individual elements of digitalization for the years 2021-2022, it can be concluded that the efficiency of the introduction of individual digitalization elements is quite satisfactory. Although the efficiency rate decreased during the years 2020-2021, the MI value of 1.01 indicates that the given process is still effective. Both the technical efficiency change, which reaches a value of 1, and frontier shift, which also reaches a value of 1, show a great promise. Given the above, it could be stated that it is important to monitor not only the % of enterprises that have introduced digitalization elements, but also the efficiency of their introduction and the efficiency with which they are being used.

One of the limits of the given research is the lack of data on the implementation of individual elements of digitalization (by countries as well as enterprises). Data is inconsistent and fragmented. For this reason, it is very difficult to provide a detailed evaluation of the digitalization process not only across the EU countries but also in Slovakia. Therefore, future research will strive to collect more detailed data by getting in touch with selected Slovak businesses.

In conclusion, it is necessary to state that the European Commission has identified that 21% of the total budgetary resources in the Slovakia's recovery plan are intended for measures that will support the country's digital transformation. These investments include support for electronic public administration, digital transformation of education and health care, as well as support for the improvement of digital technologies available to businesses, especially small and medium-sized enterprises. These resources will be of a significant benefit to small and medium-sized enterprises, as these may help lower the risk of bankruptcy.

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