DIGITALISATION IMPORTANCE AND INFLUENCE ON THE COMPETITIVENESS OF INDUSTRIAL ENTERPRISES IN THE TIME OF THE COVID-19 PANDEMIC

Pekarcikova M., Izarikova G., Trebuna P., Kliment M.*

Abstract: The presented article deals with the position of Slovakia among the V4 countries (Slovakia, Czech Republic, Poland, Hungary), according to the DESI index in selected indicators. Selected indicators of V4 countries were compared by the non-parametric form of ANOVA. When rejecting the null hypothesis of equality of mean values, pairs were subsequently identified between which there is a statistically significant difference. The article aimed to define specific differences and point out the possibilities of increasing competence in the given areas of the DESI index with emphasis on the V4 countries and the potential of digitization, which is gaining in importance in terms of the Covid-19 pandemic.

Keywords: digitalization, pandemic, DESI, competitiveness.

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Introduction

Every crisis shifts thinking and speed things up. The COVID -19 crisis is no exception. For companies, this means intensifying innovation potential and introducing more sophisticated and fully automated and robotic processes and systems.

This paper aims to evaluate this issue with the emphasis on the V4 countries (Slovakia, Czech Republic, Poland and Hungary). It is also important to consider the Covid-19 pandemic, which is a major accelerator of digital transformation. In the literature review, which is processed below, a knowledge gap was determined, especially in connection with a comprehensive view of the facts mentioned above. The ANOVA analysis performed in the article was based on available information processed through the DESI index. The aim was to reach a better understanding of the differences between the V4 countries and to propose recommendations that Slovakia should reach in connection with maintaining and increasing competitiveness.

The current time has been affected by the Covid-19 pandemic for more than a year. From various sources of professional literature, Sharma R. (2020), it can be stated that this pandemic will significantly affect the future direction of countries'

* **Miriam Pekarčíková** Doc. Ing., PhD., **Gabriela Ižaríková** Mgr., Phd., **Peter Trebuňa** prof. Ing., PhD., **Marek Kliment** Ing., PhD., Technical University of Kosice
Faculty of Mechanical Engineering
✉ corresponding author: miriam.pekarcikova@tuke.sk
✉ gabriela.izarikova@tuke.sk; peter.trebuna@tuke.sk; marek.kliment@tuke.sk

economies on a global scale. The question is which economies will have growth potential and which the other way around. Understanding the global environment at any given time will be essential. At present, it will be the definition of critical factors and rules that will be set in the post-pandemic world. A pandemic accelerates a wide turn inwardly of one's own country. The beginnings can be traced back to the global financial and economic crisis in 2008. It can be said that globalization is giving way to de-globalization, with cross-border flows of goods and money declining before the pandemic. It is interesting to note that the countries that have been most geared to global globalization, such as China and India, have understood the need for "self-sufficiency" of their own country because of the crisis, which is beginning to gain momentum, (Industry 5.0. What this approach is focused on, how it will be achieved and how it is already being implemented, 2021).

The extension of robotics is due to the Made in China 2025 initiative, and we will continue to see automation affect the area and potentially reduce the number of manufacturing jobs. Its main principles are that production should focus on innovation, emphasize quality over quantity, achieve green development, optimize the structure of Chinese industry, and develop human talent (Forrest, C, 2015). The goal of the Made in China 2025 initiative is comprehensively innovation of Chinese industry to be more efficient and integrated, to occupy the highest parts of global production chains. The plan sets a target to increase the domestic content of the main components and materials to 40% by 2020 and 70% by 2025 (Kennedy, S., 2015).

The impact of the Covid-19 pandemic has a global impact. In addition to the medical field, it also affected the economic area to a large extent. The global supply chain is experiencing a level of disruption that has never been seen before (Sharma R., 2020). The crisis is affecting a wide range of actors in the economic environment. It poses an existential threat to many manufacturers and service providers, even on a larger scale. Some companies stopped production altogether, some saw a significant drop in demand and some, on the contrary, saw a significant increase in demand. One of the possible solutions to this type of crisis can be found in the digitization of business processes.

Covid-19 pandemic also pointed to the need to increase digital communication and change the nature of work in various segments. For example, in the segment of education according (Habanik, J. et al., 2019) states that the communication technologies will increase the efficiency of education and education will use interactive models that will be more accessible to students and less time-consuming. In this way, digital, communication and other competencies of students will be increased, as they are already necessary even today. The introduction of artificial intelligence into the educational process will change its content and form. Great emphasis will be placed on the search for Big data, their processing and the

development of communication skills. This is related to the expected major social changes and also to the disappearance of the number of jobs that will be automated. Another of the authors (Luvsandavaajav, O., et al. 2021), specifies the potential of digitization in connection with higher education, where the authors see added value in the use of Big Data. In this case, it will be possible to talk about the so-called intelligent education. According to the authors, the aim of education is not to remember the facts, but to learn how to use ICT to search for sources of knowledge. Knowledge can quickly become obsolete because technology is changing so fast. However, the smart industry will speed up this process, so that traditional education will no longer be effective.

The Covid-19 pandemic had a serious impact on the global economy. Global intra-global mobility has decreased, leading to significant economic losses, especially in the tourism sector. Unprecedented global travel constraints are causing widespread disruption to economic activity. Travel bans, border closures and closures have stopped the tourism industry, they are a major contributor to China's GDP (Song, Y., et al., 2021). The study by Song, Y (2021) highlights recommendations for changes in laws and policies, which would create space for the implementation of investors in the tourism industry, e.g. through tax breaks, as well as fiscal, liquidity and health protection. The issue of digital green certificates proposed by the World Tourism Council and the European Tourism Council, which can help the tourism sector to recover losses and gain stability, is also contributing.

Authors (Nemteanu et al., 2021) processed the analysis about the influence of job insecurity and job instability on job satisfaction in Romania in the Covid-19 pandemic. They investigated specifically influence on General Job Satisfaction, Satisfaction with supervision and Satisfaction with promotion opportunities. Among other things, the authors indicate the potential for further research that could create a better picture for the area under study, namely the impact of variables such as work conditions, domain influence, organizational culture, wages, or other variables connected to job instability and job insecurity.

In the study of the authors (Ancillo, A. de L., et al., 2021) state that, although most companies were wary of teleworking. However, this pandemic forced a worldwide experiment, in the form of a mass home office. COVID-19 accelerated the introduction of new work and workplace models, which ultimately increased overall flexibility.

The importance of digitization for increasing competitiveness

The presentation of the Industry 4.0 concept in 2011 in Hanover was the response of German scientists and industrialists to the challenges of the European Union's research programs to the so-called Factory of the Future. A new platform has been set up to increase the competitiveness of German industry, without the need to relocate production to low-cost countries, while mobilizing research teams in European countries to become involved in this innovation movement. Until recently, the Industry 4.0 concept was a stimulating topic with huge potentials and advantages in terms of flexibility, variability and personalization of products. It

was generally considered by companies as a solution soon. At present, as the number of people diagnosed with coronavirus continues to grow, significantly reducing the workforce, it is gaining in importance (Chromjakova, F., 2018). Especially in the manufacturing sector, it has high potential. The outbreak of the corona crisis thus accelerates the adoption of Industry 4.0. Businesses in different sectors will thus reach a more sophisticated level of technology deployment and the Internet of Things (IoT) workflow faster. Some industry experts believe that Industry 4.0 has four central concepts that reflect the trend of automation, namely:
-intelligent manufacturing - Intelligent Manufacturing,
-Intelligent Factory,
-Dark Factory,
-industrial technology of the Internet of Things (IoT) - industry technology Internet of Things.
Industry can bring prosperity if it adapts to ever-changing challenges, which is only possible through constant innovation. Industry 4.0 is based on the idea of connecting the physical and virtual worlds through the cyber-physical system. The essence of this approach is interconnecting people, machines, and devices through the Internet of Things. Industry 5.0 complements the existing Industry 4.0 approach. The emphasis is specifically on research and innovation at the service with the transition to sustainability, human-centric, and resilient European industry. European industry can further increase its efficiency at different points in the value chain, increase the flexibility, agility, and leanness of its production systems to meet the rapidly changing demands of the global consumer, and will continue to be a global reference point for quality (Industry 5.0. What this approach is focused on, how it will be achieved and how it is already being implemented, 2021)
According to the Industry 5.0. What this approach is focused on, how it will be achieved and how it is already being implemented. (2021) „Participants agreed that Industry 5.0 should not be understood as a replacement nor an alternative to, but an evolution and logical continuation of the existing Industry 4.0 paradigm. As such, the concept of Industry 5.0 is not based on technologies but is centred around values, such as human-centricity, ecological or social benefits. This paradigm shift is based on the idea that technologies can be shaped towards supporting values, while the technological transformation can be designed according to the societal needs, not vice versa.“ The main features of goals, technological enablers, and challenges associated with the concept of Industry 5.0 are shown in Figure 1.

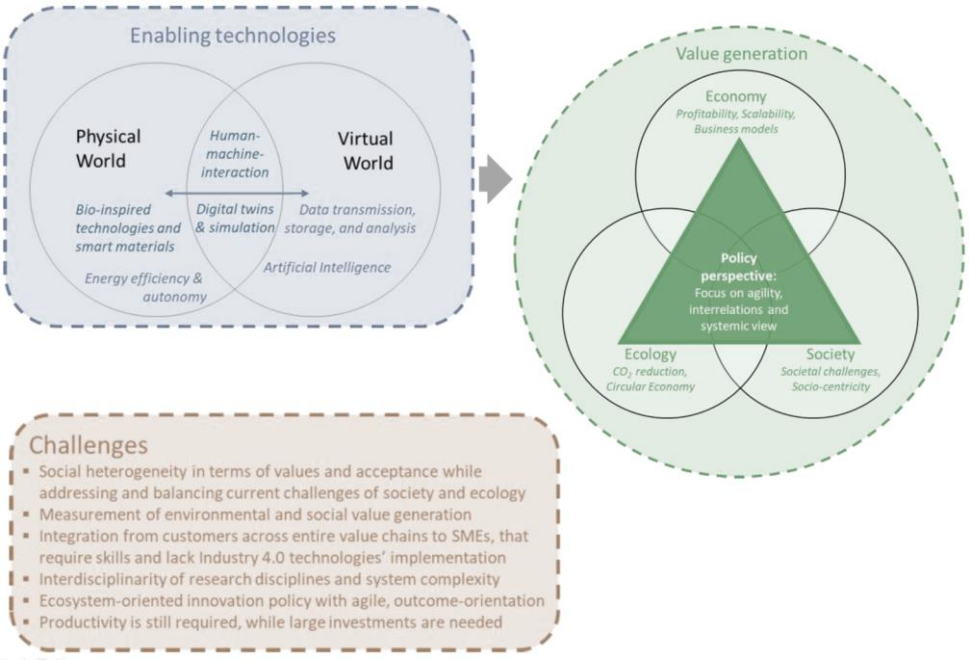

Figure 1: Framework of the concept of Industry.
(Industry 5.0. What this approach is focused on, how it will be achieved and how it is already being implemented, 2021).

The European Commission has defined the Industry 5.0 concept as follows, (Industry 5.0. What this approach is focused on, how it will be achieved and how it is already being implemented, 2021):

-Industry 5.0 provides a vision of an industry that aims beyond efficiency and productivity as the sole goals and reinforces the role and the contribution of industry to society.

-It places the well-being of the worker at the center of the production process and uses new technologies to provide prosperity beyond jobs and growth while respecting the production limits of the planet.

-It complements the existing "Industry 4.0" approach by specifically putting research and innovation at the service of the transition to a sustainable, human-centric and resilient European industry.

The importance of Dark Factory for the future of the industry

Futuristic factories will be fully automated and can operate without human power, resp. with a smaller workforce compared to current intelligent factories. They can eliminate almost 90% of the human workforce without compromising the production routine. Dark factories (where the lights are off) can work 24*7 with

automated robots. Productivity is increased and the error rate is eliminated to zero, (Griffiths, B, 2020).

An example of a Dark factory today is the Chinese company Changying Precision Technology Company; whose main focus is the assembly of mobile phones. This company is considered to be the first to use a dark factory model. The company employed 650 workers, currently employs 60. In total, they implemented 60 robotic arms, which eliminated 90% of the human workforce. Productivity increased by 250%, the error rate decreased by 80%. The company believes that the number of people can be reduced to 20 (Dark Factories for a Brighter Future! 2019).

Another successful example is Amazon. The largest online retailer has decided to increase the number of robotic workers by 50%. They already represent 45,000, which are spread over 20 different order fulfilment centres.

Automation and digitization are no longer goals, but the means for the next stage of business development towards a smart company and a Dark Factory. The transformation of an intelligent factory into a dark one can be considered an economic decision, (Grznar et al., 2020), Fusko, et al., 2018).

The importance of the DESI index in connection with the analysis of variance ANOVA

In February 2020, the EU Commission has published the vision of the digital transformation in the communication "Shaping Europe's digital future". This is a document that includes an inclusive use of technology that works for people and respects EU fundamental values.

Two pillars on which it is built a new digital strategy of the Commission are The White Paper on Artificial Intelligence and the European data strategy. In March 2020, the EU Commission published its new SME strategy for a sustainable and digital Europe. DESI will be used to monitor progress on the digitisation of SMEs on an annual basis (Digital Economy and Society Index, 2021).

Digital Economy and Society Index monitors Europe's overall digital performance and tracks the progress of EU countries regarding their digital competitiveness. It monitors the performance of member states across five main dimensions: Connectivity, Human Capital, Use of the Internet, Integration of Digital Technology, Digital Public Services. The DESI 2020 reports are based on data from 2019. The report covers 28 EU Member States, with the United Kingdom included in the DESI 2020 report (Digital Economy and Society Index (DESI), 2020).

The Digital Economy and Society Index (DESI) is a composite index published annually by the European Commission since 2014. It measures the progress made by the EU Member States in the digital economy and society and is a set of relevant indicators. DESI consists of five main policy areas, (DESI by components, 2021):

-Connectivity

-Human capital
-Using the Internet
-Integration of digital technologies
-Digital public services

In the graphical representation of the monitored indices, there are probably differences between the V4 countries. The nonparametric form of ANOVA is used for comparison. The Kruskal-Wallis test is a nonparametric alternative to a one-way ANOVA. The test does not require the data to be normal but instead uses the rank of the data values instead of the actual data values for the analysis. It is used for comparing two or more independent samples of equal or different sample sizes. The null hypothesis means the medians of all groups are equal, and the alternative hypothesis represents that at least one population median of one group is different from the population median of at least one other group. Results of ANOVA to test the equality of at least three group means indicate that not the entire group means are equal. However, ANOVA results do not identify which particular differences between pairs of means are significant. After ANOVA we use posthoc test. A post hoc test is used only after we find a statistically significant result and need to determine where our differences truly came from.

Results and Discussion

The calculation of the DESI score ranges from 0 to 1, the higher the score, the better the results in the surveyed country. Based on the calculated score, the countries are divided into four groups: with above-average dynamics, above-average with below-average dynamics, below-average with above-average dynamics and lagging behind below-average with below-average dynamics, which also includes Slovakia. The group of Visegrad Four countries (V4) is constantly below the EU average in the overall ranking of countries, with a significant distance from the leaderboard. The Czech Republic is the closest to the EU average from the V4, followed by the Slovak Republic. Until 2019, Hungary was placed behind the Slovak Republic, but in 2020 its overall score was higher. Over the period under review, the overall score of the Slovak Republic increased slightly, but due to the scores of other countries, we decreased in position. Based on data before the covid period, Slovakia's score increased slightly due to improvements in connectivity, internet use and digital public services. However, the improvement was not sufficient compared to the EU average and Slovakia decreased in the ranking of EU countries (2020-22, 2019-21, 2018-20th place). The growth coefficient of DESI SR and the average of EU countries is 1.06, see Figure 2.

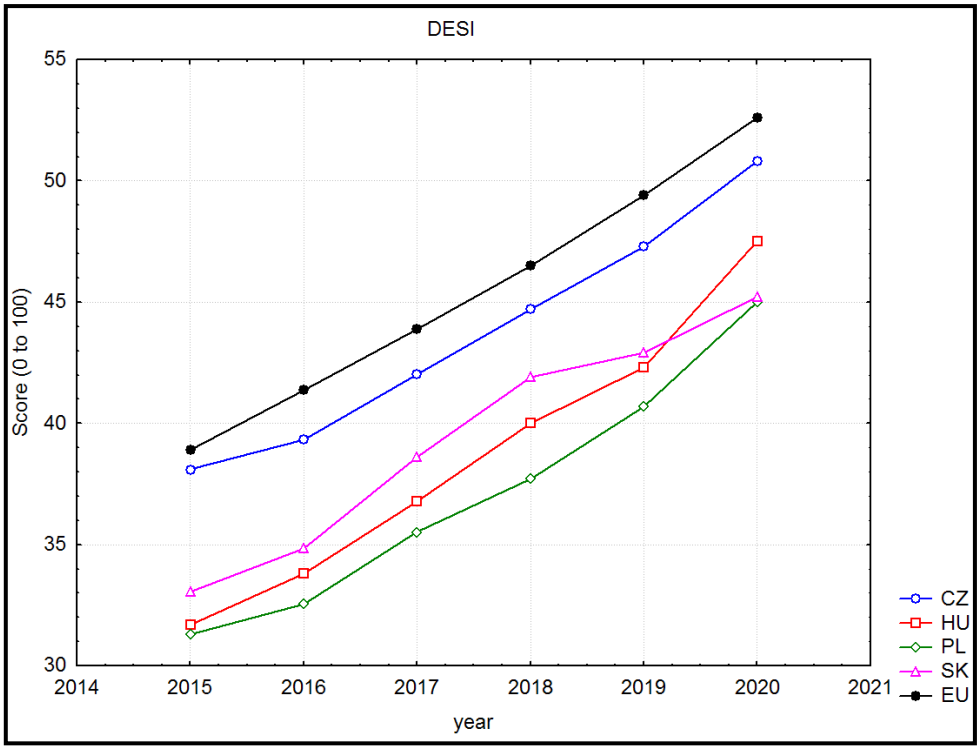

Figure 2: The coefficient of DESI V4 and EU.
(own research)

The area of digital technology integration is divided into seven sub-dimensions (4a1-4a4 and 4b1-4b3), indicators 4a1, 4a2, 4b3 are surveyed only in odd-numbered years. 4a3 only in even years.
In the area of digital technology integration, the Czech Republic has a higher score than the EU average, Slovakia is below its average. In the last year, its score has decreased to 32.6 compared to 33.1 in 2019. Slovakia does not reach the EU average in any of the sub-areas. (share of companies sharing electronic information 31% vs. 34%, use of social media 18% vs. 25%, analysis of big data by companies 9% vs. 12%, use of cloud technologies 14% vs. 18%).
In 2019, a new strategy for the digital transformation of Slovakia 2030 was adopted in Slovakia, the aim of which is to stimulate intelligent regional development. Slovak companies are in favour of the use of new technologies, but the index of the use of digital technologies indicates that Slovakia has a very low rate of digitization compared to the EU average. In 2020, the Czech Republic ranked 9th, the Slovak Republic 21st and PL and HU 25th and 26th. Hungary has remained one of the EU countries with the worst results in business in terms of digital integration (Digital success program 2.0., 2021). Although Poland has the lowest

score in the V4 countries, it is still growing during the period under review, while in other countries it shows a fluctuating character, see Figure 3.
ICT uptake is low in all indicators measured in this area. Poland is committed to advancing and investing in digital technologies. Poland launched several initiatives in 2019, including the Foundation for the Future Industrial Sector (Fundacja Platforma Przemysłu Przyszłości, the aim of which is to increase the competitiveness of entrepreneurs and support their digital transformation (Digital Success Programme. Cabinet Office of the Prime Minister, 2021).

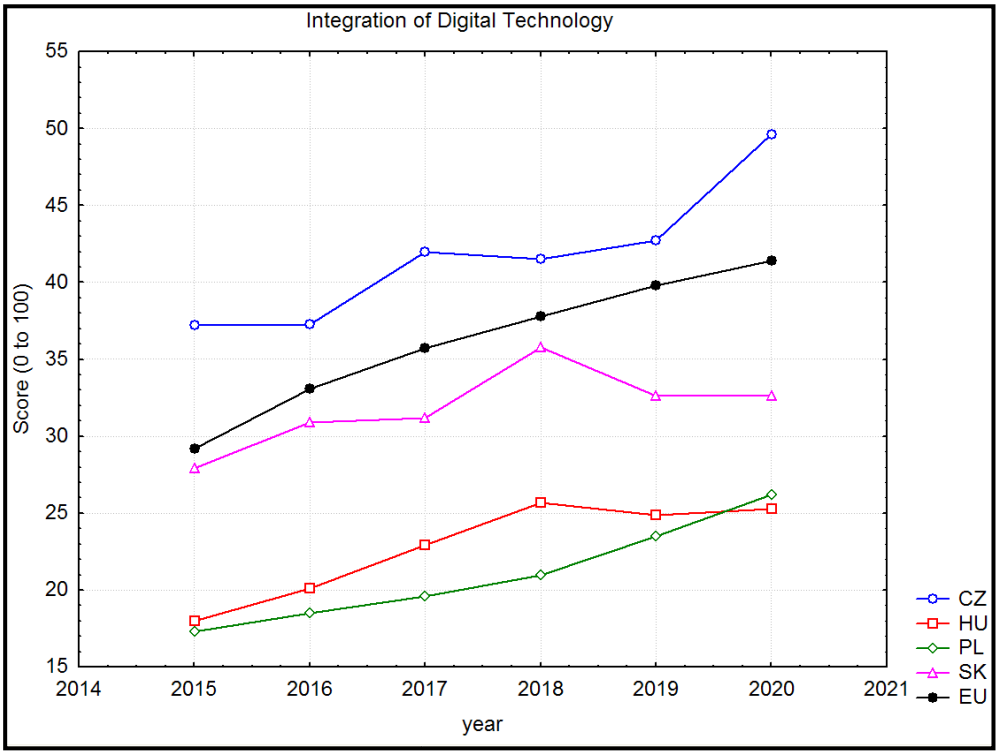

Figure 3: DESI: Integration of Digital Technology.
(own research)

Sub-dimension 4a: Enterprise Digitization

Indicator 4a1: Electronic Information Sharing

Long-term change is not visible in most of the countries under comparison, growth towards the EU average is very slow, and the results of individual countries are maintained at a comparable level. An exception may be the Czech Republic, which has been able to gradually increase the rate of use of software packages for enterprise resource planning and is moving up the rankings. In this area, all V4 countries are below the EU average, in 2015-2017 the Slovak Republic and the

Czech Republic achieved similar scores, but then the Czech Republic's score decreased and in 2020 it achieved a higher score than the Slovak Republic.
Hungary has achieved a score close to Slovakia in the last year, but Poland still has the worst score in the V4 countries in this area. Differences between V4 countries were also confirmed at the level of significance 0.05 by non-parametric form of Anova - Kruskal Wallis test (p = 0.0003), statistically significant differences were identified between pairs: CZ-PL (p = 0.0058), CZ-HU (p = 0.0000), SK-PL (p = 0.0006), HU-PL (p = 0.0001), HU-SK (p = 0.0000), see Figure 4.

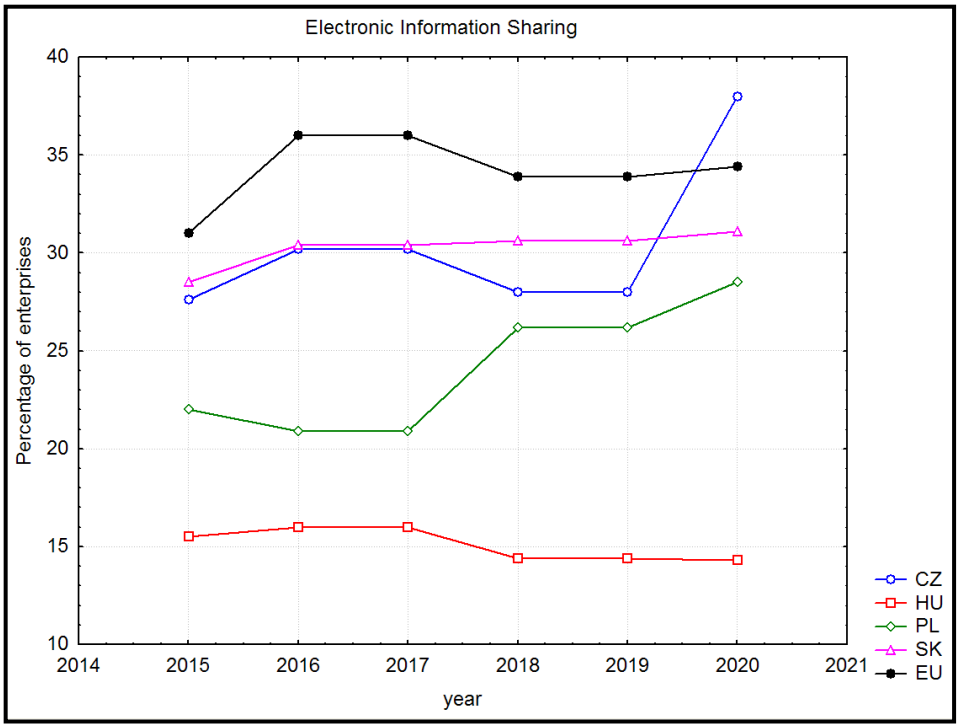

Figure 4: DESI: Electronic Information Sharing.
(own research)

Indicator 4a2: Social media

The level of use of social media by companies towards customers and business partners, as well as internally, among company employees, is below the EU average in all V4 countries and shows only a small increase. Until 2018, Slovakia's score increased, but then began to stagnate, on the contrary, in the Czech Republic and Poland, there has been a significant increase in the last year. Poland again has the worst score in this area. No statistically significant differences were confirmed in this area at the 0.05 significance level (p = 0.3212), see Figure 5.

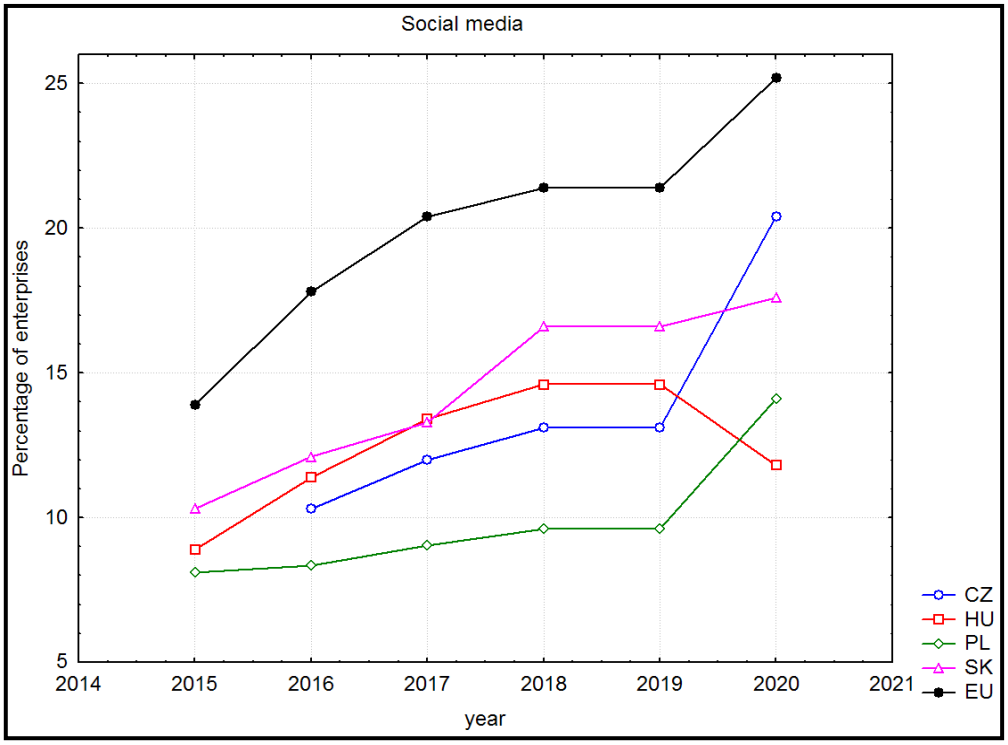

Figure 5: DESI: Social media. (own research)

Indicator 4a3: Big data

The rate of enterprises that use the analysis of large volumes of data in their business activity is generally low and has even decreased slightly compared to previous years in all V4 countries except Poland.

It is likely that companies either do not see the benefit of using big data or do not have access to the customer data itself, which could be analyzed. Neighbouring states neighbouring the Slovak Republic show comparable unfavourable scores as the Slovak Republic. Differences between V4 countries were also confirmed at the level of significance 0.05 by the non-parametric form of Anova - Kruskal Wallis test ($p = 0.0011$), statistically significant differences were identified between pairs: CZ-HU ($p = 0.0493$), CZ-SK ($p = 0.0437$), HU-SK ($p = 0.0002$), PL-SK ($p = 0.0006$), see Figure 6.

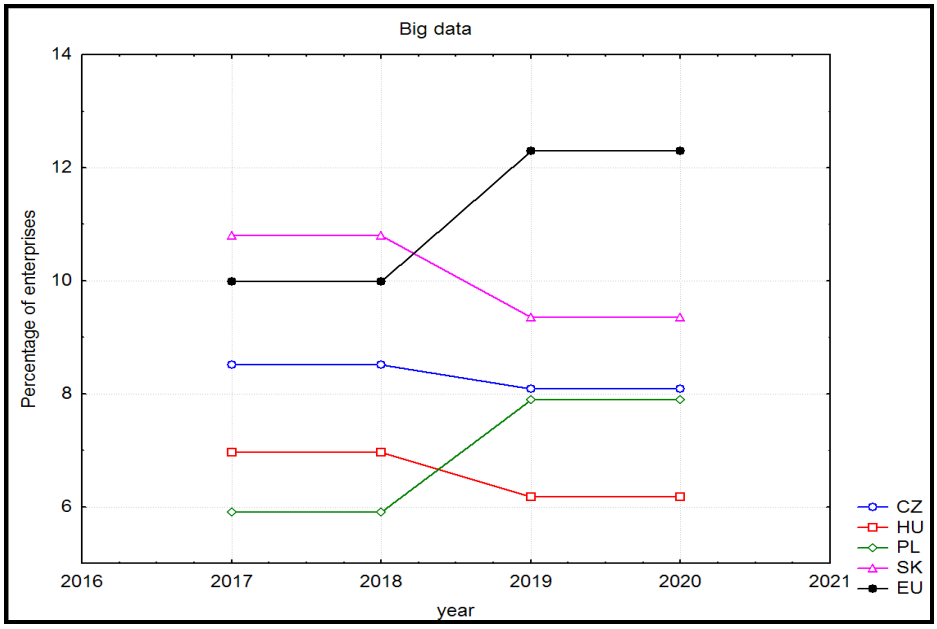

Figure 6: DESI: Big data. (own research)

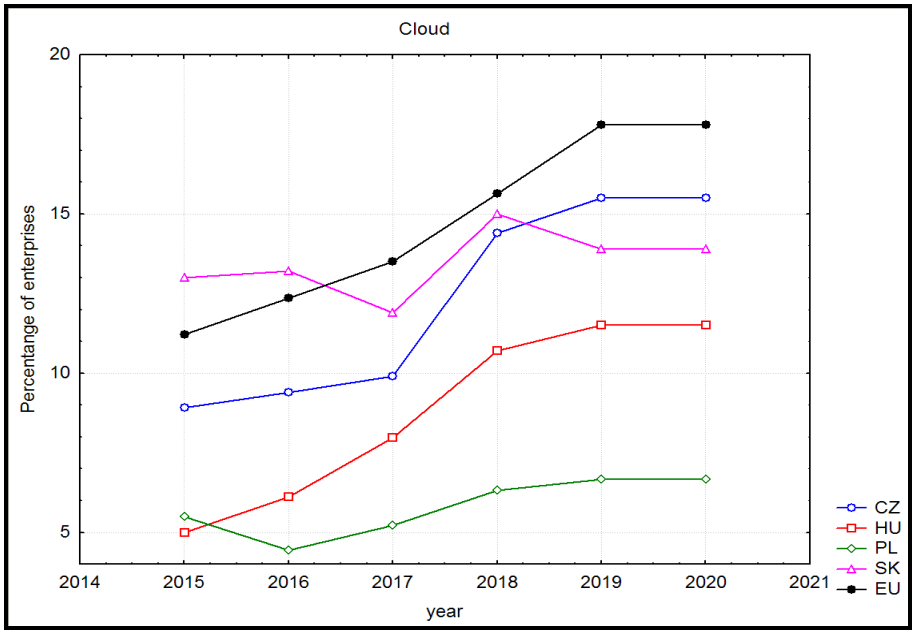

Figure 7: DESI: Cloud. (own research)

Indicator 4a3: Cloud

The use of Internet services for data storage and databases is also low efficiency among companies in the V4 countries. Finland and Ireland are significant leaders in the EU in the use of cloud services. The V4 countries show comparable unfavourable scores as the Slovak Republic. In the Czech Republic and Hungary, it has an increasing tendency, but in Slovakia, the score has a fluctuating character. Differences between V4 countries were also confirmed at the level of significance 0.05 by non-parametric form of Anova - Kruskal Wallis test ($p = 0.0019$), statistically significant differences were identified between pairs: CZ-PL ($p = 0.0008$), HU-SK ($p = 0.0161$), PL-SK ($p = 0.0001$), see Figure 7.

Based on the comparison of selected indicators, it can be stated that in the area of Indicator 4a1: Electronic Information Sharing and Indicator 4a2: Social media the Slovak Republic is at a good level compared to other V4 countries, but in the area of Indicator 4a3: Big data and 4a4 Cloud period (from 2018) to reduce the DESI index, given that it would be appropriate to address this area and seek to increase the number of companies that use the analysis of large volumes of data in their business activity and the expansion of cloud services.

At a time of industrial crisis, companies with an innovative approach and modern machinery and equipment were always more likely to continue their activities. In a sense, the crisis must be seen as a challenge and the need to invest in more sophisticated systems that mimic a higher level of automation and digitization of business processes and systems. The industry could work very efficiently by implementing the so-called Dark Factories. Fully automated factories mean production in a continuous process. Incorporating light switching methods into the floor plan saves costs, space and time (Griffiths, B., 2020). Research shows that a fully automated factory can increase productivity by up to 250% and reduce errors by 80%. According to a source Griffiths, B. (2020). within five to ten years, "industries around the world will turn into smart factories, and those who already operate a smart factory will certainly turn into fully automated" dark factories ".

Summary

The impact of the Covid-19 pandemic opens up new possibilities and opportunities in terms of accelerating digitization across industries. This is an opportunity for digital leaders to discover, test and implement innovative digital strategies to support digital transformation throughout the value chain, Industry 4.0 Boom Accelerated by Covid-19. (2020).

The following studies focus on maintenance, resp. building the competitiveness of companies today, which is marked not only by the proclaimed Covid-19 pandemic but also by rapid scientific and technical development, digitization, and optimization of the use of available natural, human and other resources in everyday life and business practice.

The authors Behun et al. (2020) point out the importance of the so-called sustainability, which makes sense in particular to the competitiveness of companies

from different industries, to ensure stable economic growth and a healthy environment.

According to the authors Simionescu et al. (2021), it is possible to state a significant impact of globalization and digitization in the time of the Covid-19 pandemic on global competitiveness. Digitization has facilitated access to local and international markets with a high degree of impact on competitiveness. The study points to the 12 pillars of the GCI/Global Competitive Index and The research hypothesis is that FDI/Foreign Direct Investment, innovation and human capital contribute to competitiveness growth. The authors Simionescu et al. (2021) declare in this study, that in the last 8 years, the competitiveness gap of EU countries in the context of the Europe 2020 Strategy shows, using the Global Competitive Index, that EU 10 (Austria, Belgium, Denmark, Finland, France, Germany, Luxemburg, the Netherlands, Sweden and the United Kingdom) are closer to the US, and that China and India registered very rapid growth and improvement of the GCI score. Based on Innovation criteria, Finland, Germany, Sweden, the Netherlands, Denmark, and the UK are the most innovative countries in the EU.

An interesting study by Ahmed et al. (2020) focuses on the study of impulse consumer purchases during the Covid-19 pandemic in large urban centres in the USA. The essence of the study is the issue of consumer behaviour in psychological pressure, which arose because of a pandemic, and whose risk is the lack of basic products in stores, resp. a limited supply of basic goods. However, a limitation of this study is the specificity of data collection, i.e., from US citizens who have been severely affected by coronavirus measures, therefore the results of the study cannot be generalized to another population in the world. Nevertheless, this study can be inspired to develop new strategies to increase market potential.

The Industry 4.0 concept, which was introduced in Hanover in 2011, is no longer the goal that companies want to achieve through the introduction of information and communication technologies, but a necessary platform for their future existence. Despite a time horizon of about 10 years, the implementation of the I4.0 concept is still in the preparation phase. It is important to emphasize the extension of the I4.0 concept to the I5.0 concept, with an emphasis on the person focused on the socio-centric perspective that needs to be addressed. Companies have to face a profound transformation, this must be seen as an opportunity, as it acts as a catalyst and accelerator of change through digital transformation. This will make employees, companies and workplaces more agile and dynamic than ever before.

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ZNACZENIE I WPŁYW CYFRYZACJI NA KONKURENCYJNOŚĆ PRZEDSIĘBIORSTW PRZEMYSŁOWYCH W CZASIE PANDEMII COVID-19

Streszczenie: Prezentowany artykuł dotyczy pozycji Słowacji wśród krajów V4 (Słowacja, Czechy, Polska, Węgry), według indeksu DESI w wybranych wskaźnikach. Wybrane wskaźniki krajów V4 porównano za pomocą nieparametrycznej postaci ANOVA. Odrzucając hipotezę zerową o równości wartości średnich, identyfikowano następnie pary, pomiędzy którymi występuje różnica istotna statystycznie. Celem artykułu było zdefiniowanie konkretnych różnic oraz wskazanie możliwości zwiększenia kompetencji w danych obszarach indeksu DESI ze szczególnym uwzględnieniem krajów V4 oraz potencjału cyfryzacji, która w warunkach pandemii Covid-19 zyskuje na znaczeniu.

Słowa kluczowe: cyfryzacja, pandemia, DESI, konkurencyjność.

COVID-19 大流行期间数字化对工业企业竞争力的重要性和影响

摘要：根据所选指标中的DESI指数，本文介绍了斯洛伐克在V4国家（斯洛伐克、捷克共和国、波兰、匈牙利）中的位置。V4国家的选定指标通过ANOVA的非参数形式进行比较。 当拒绝均值相等的零假设时，随后确定了在统计上存在显着差异的对。这篇文章旨在定义具体的差异，并指出在DESI指数的特定领域提高能力的可能性，重点是 V4 国家和数字化的潜力，这在 Covid-19 大流行方面变得越来越重要。

关键词：数字化、流行病、DESI、竞争力。