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Study of the Readiness and Conditions for Adaptation of the Foreign Countries Industrial Sector to the Digitalization of Business Processes

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Abstract:-This scientific article highlighted the role of digital transformation of companies, including in the post-pandemic period, which is characterized by the restructuring of business processes of enterprises, the active formation of new competitive advantages, including through the development, implementation and effective adaptation of various information and communication tools. Digitalization strategies by country and region of the world were presented and described in detail. The Enabling Digitalization Index (EDI), IMD Digital Competitiveness Ranking, performance indicators of digital technologies in Europe and the evolution of EU member states in the field of digital competitiveness within the framework of the DESI rating (The Digital Economy and Society Index) were studied and analyzed, leading countries were identified, and the level of readiness and adaptability of industrial enterprises operating on their territory to widespread digitalization of business processes was analyzed. The experience of Denmark and Estonia was separately studied as one of the fastest growing markets in the field of digitalization of industrial production and, in general, business. The results obtained as part of the analysis have a clear theoretical and practical significance for the subsequent development of tools and methods for assessing the level of digital readiness of industrial enterprises for the implementation and adaptation of digital ecosystems in their activities.

Keywords*: business processes, digital transformation of the industrial enterprise, digitalization of business processes, Industry 4.0.*

1. Introduction

In modern economic conditions, the issues of studying the digital readiness and adaptation of industrial enterprises to the widespread digitalization of business processes are becoming relevant, especially in terms of the selection of digital tools depending on the type of activity of the organization and the specifics of building a business structure, as well as within the framework of the implementation of digital platforms and ecosystems capable of ensure the smooth operation of all production cycles, effective communication between all divisions of the company, and also create competitive advantages that are necessary in an increasingly competitive environment. This trend is especially characteristic of the service sector and complex integrated structures - system-forming innovative-active industrial clusters operating on unified digital platforms of a new formation [1,2].

On the other hand, it is important to note that the COVID-19 coronavirus pandemic has demonstrated problems associated with the digital immaturity of a number of industrial enterprises across different economic sectors, which largely predetermined a more intensive transition of companies from automation to digitalization, which, on the one hand, corresponds to key trends of Industry 4.0. [3,4], but, on the other hand, it requires significant

investment resources due to the understanding of the importance of implementing and adapting digital technologies, which redefines the activity of companies in terms of revising their internal business strategies.

2. Literature Review

When researching issues related to studying the level of digital readiness of the industrial sector, according to the Web of Science database, the following key areas can be identified in the scientific community:

1. Assessment of the role of research institutes and organizations in the creation, implementation and adaptation of advanced digital tools in industry [5];

2. Research of tools, methods and approaches to the level of digital readiness of enterprises in the logistics and industrial sectors, as well as the relationship between multidimensional digital readiness and the results of digital transformation [6-11];

3. Studying the possibilities of digital readiness of economies for the development of entrepreneurship and studying its impact on the formation and activation of international economic flows [12-14];

4. Consideration of the relationship between the level of digital readiness of enterprises and the need to train employees of a new generation who are able to adapt to changing conditions and meet modern labor market requirements [15];

5. Development of qualitative and quantitative effective approaches and methods for studying the characteristics of the level of digital readiness of small and medium-sized enterprises [16-17].

At the same time, speaking about the issues of adaptation of the industrial sector to digital transformation, some of the main vectors of research by scientists are:

1. Study of the features of adaptation of digitalization tools in the activities of enterprises in various sectors of the economy [18];

2. Assessment of the degree of adaptation of personnel to the digitalization processes occurring at the enterprise, which in some cases can change the business structure of the company [19];

3. The specifics of adaptation of enterprises to the conditions of digitalization, including during the pandemic and post-pandemic periods [20-24].

Of course, the presented list of areas within the framework of the scientific issues under consideration is not final, however, the available publications provide a fairly comprehensive picture of key research trends.

3. Methods

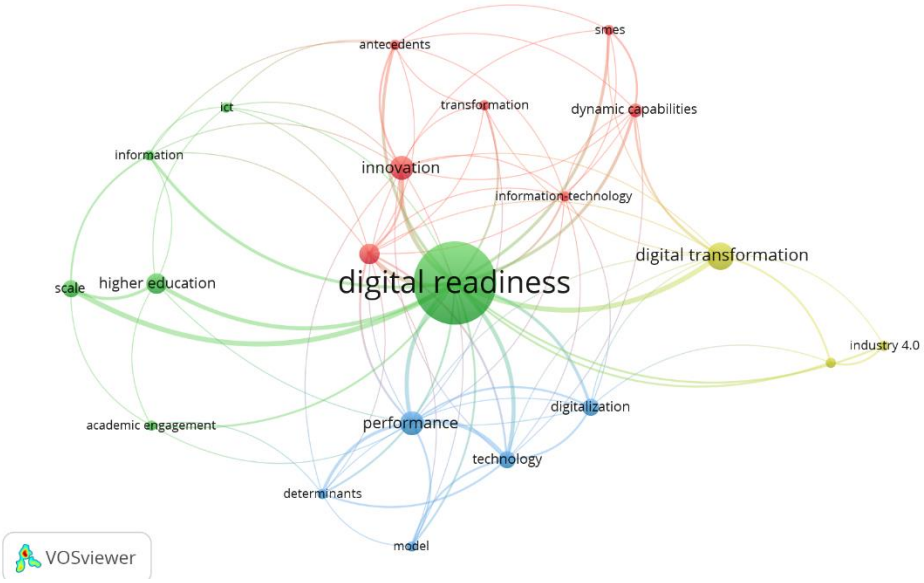
Within the framework of this scientific article, an *integrated approach* was used, which fully allowed us to explore the readiness and conditions for adaptation of the industrial sector to the digitalization of business processes, primarily through the use of the *method of scientometric analysis*, the results of which made it possible to identify key research trends in assessing the level of digital readiness and conditions for the adaptation of industrial enterprises and complex integrated structures (represented by industrial clusters) to the processes of digital transformation, and, secondly, thanks to the *content analysis method*, which made it possible, by assessing international ratings, to identify leading countries in matters of digital readiness for implementation and adaptation of various ICTs in economic sectors, and also consider a number of practical examples of such adaptation using the example of Denmark and Estonia.

It is also important to note that the scientometric analysis was carried out throughout the entire depth of the Web of Science database (Clarivate Analytics) using the following search formulas: “digital readiness” (176 publications were received); “adaptation” and “digitalization” (the final output was 487 works). Search terms: “All fields”.

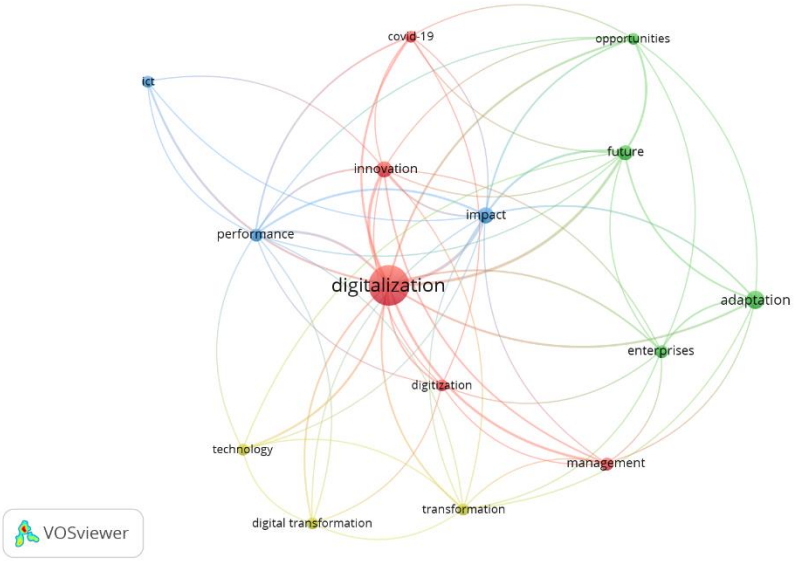
Further, for the graphical construction and analysis of cluster frames, the capabilities of the VOSviewer software product were used: in particular, the type of analysis is “Co-occurrence”, the analysis option is “all keywords”, the method of accounting for keywords is “full counting” (minimum number of occurrences of a keyword - 3).

4. Results

Within the framework of the presented search queries (“digital readiness” and ““adaptation” and “digitalization””), 176 and 487 articles were identified in the WoS scientific and technical database, respectively. Next, two sets of information were uploaded in “Plain text” format for constructing cluster frames and subsequent analysis in the VOSviewer program (Figure 1 (a,b)).



a) Cluster frames obtained as part of the search query “digital readiness” (based on the analysis of 176 publications)



b) Cluster frames obtained as part of the search query “adaptation” and “digitalization” (based on the analysis of 487 publications)

Figure 1. The results of the scientometric analysis

Note – compiled by the authors on the basis of a scientometric analysis.

According to the results presented above, in the context of 2 search queries, 4 thematic clusters were obtained, respectively, a brief description of which is presented in Table 1.

Table 1. Description of the clusters obtained during the scientometric analysis in the context of two search queries "digital readiness" (first) and "adaptation" and "digitalization" (second)

Thematic cluster number	Keywords characterizing the cluster	Brief description of the cluster
Formula for the search query "digital readiness"		
1	Dynamic capabilities, impact, information technology, innovation, SMES, transformation	This cluster reflects trends related to the study of the dynamic capabilities of small and medium-sized businesses in matters of innovative development and digital transformation to provide the necessary competitive advantages and achieve the required level of competitiveness.
2	Academic engagement, digital readiness, higher education, ICT, information, scale	The cluster is dedicated to studying the role of higher education facilities and the entire academic environment in the development, commercialization and adaptation of ICT in various sectors of the economy.
3	Determinants, digitalization, model, performance, technology	This thematic cluster reflects the main determinants of the development of adapted digital models and the possibilities of their adaptation in the activities of specific manufacturing enterprises.
4	Digital transformation, Industry 4.0, maturity model	The fourth cluster is related to the consideration of the relationship of the Fourth Industrial Revolution (Industry 4.0) with the main directions of digital transformation of the industrial sector and their impact on the life cycle of manufactured goods and services provided.
Formula for the search query "adaptation" and "digitalization"		
1	Covid-19, digitalization, digitization, innovation, management	Publications of the first cluster interconnect the issues of effective management of digital transformations in an enterprise with the phenomena of the post-pandemic period.
2	Adaptation, enterprises, future, opportunities	The articles forming the second cluster reflect aspects of the immediate and future adaptation of industrial structures to digital transformation.
3	ICT, impact, performance	The third cluster is related to the impact of ICT on production activities.
4	Digital transformation, technology, transformation	This cluster is dedicated to the study of the theoretical and practical foundations of digital transformation and the directions of digital transformation taking place in the industrial sector.
Note – compiled by the authors on the basis of a scientometric analysis.		

Thus, the conducted scientometric analysis made it possible to identify 8 current key scientific trends (according to the constructed cluster frames) as part of a study of issues devoted to studying the level of digital readiness and the conditions for adaptation of the industrial sector to the digitalization of business processes. At the same time, it is important to note that one of the most important and current trends is also the transition of a number of

industrial productions and complex integrated structures (primarily system-forming innovative-active industrial clusters) to the customization of production, which is a current trend that can create unconditional competitive advantages, and also respond to consumer requests as efficiently as possible.

Next, we will consider examples of international ratings that allow us to talk about the degree of digital readiness of countries for the implementation of ICT and the active transition to a digital economy.

The Euler Hermes Enabling Digitalization Index (EDI) measures the flexibility of countries regarding their adaptation to digitalization processes.

According to this ranking, the USA, Germany and the Netherlands were among the top three EDI 2018 leaders out of 115 countries represented. The Netherlands and Switzerland took 3rd and 4th places respectively.

Significant improvements compared to 2017 are observed in Thailand (+5 positions), India and Indonesia (+4 positions).

In 2021-2022, the following trends were noted in the ranking: the USA, Germany and Denmark form the top three countries in terms of digitalization opportunities, while China reaches 4th place, demonstrating the improvement in its position.

The report also reflected that economies with a high degree of digitalization are better able to withstand the economic shock caused by Covid-19 [25].

The IMD World Competitiveness Ranking is an annual global study and accompanying ranking of the world's countries in terms of economic competitiveness, which takes into account the following 4 indicators: the state of the economy, government efficiency, the state of the business environment and infrastructure. In 2023, with the addition of Kuwait to the 2023 rankings, the list expanded to 64 countries. The leaders of the ranking are the USA, the Netherlands, Singapore, Denmark and Switzerland.

Kazakhstan is in 34th place in the presented ranking (out of 64 countries), having received 71.84 points from experts.

According to the “Business Flexibility” criterion, the country ranks 5th, but at the same time, it should be noted that Kazakhstan continues to lead in such a subfactor as “Training and Education” (sub criterion “Women with degrees” - 1st place) [26].The following index, “The Digital Economy and Society Index” (DESI), characterizes the level of the digital economy in European Union countries. The four main indicators of this index include the following: the availability of broadband connectivity, the prevalence of digital skills among the population, the integration of digital technologies, digital public services for the population and businesses. The TOP-10 countries according to this ranking in 2022, included the following states: Finland, Denmark, the Netherlands, Sweden, Ireland, Malta, Spain, Luxembourg, Estonia, Austria, with the average level across the EU reaching 52% [27].

It is important to note that the research conducted by the authors made it possible to identify the following strategies for the digitalization of industrial enterprises that are being implemented in foreign countries:

1. *Internet of Things (IoT):* Industrial plants are deploying networks of IoT sensors and devices to collect data about manufacturing processes, equipment, and operating conditions. This allows you to collect more information about production in real time and optimize processes.

2. *Data analytics and machine learning* are used to process collected data and identify patterns, optimize production processes, predict equipment failures, and optimize inventory.

3. *Digital twins:* Creating digital models of real objects, processes or systems allows businesses to virtually simulate, test and optimize production processes, which helps reduce costs and increase efficiency.

4. *Cloud technologies:* The use of cloud services for storing, processing and analyzing data allows businesses to share information and resources more efficiently, and scale their processes without significant investment in IT infrastructure.

5. *Digital Automation and Robotization:* Automation of production processes using robots and automated systems helps increase productivity, reduce labor costs and improve product quality, as well as effectively implement digital factories that can function by integrating machines, people and big data into within a single digital ecosystem. As a rule, she not only supervises and analyzes data, but also accumulates experience and learns.

6. *Blockchain and cryptography:* use of these technologies to ensure security and transparency of supply chains, trace the origin of products, and effectively manage contracts and financial transactions.

7. *Digital transformation of culture and business processes:* preparing, training and retraining personnel in new digital skills, revising business processes taking into account the capabilities of digital technologies and creating flexible organizational structures that can adapt and meet all the requirements arising in the context of digital transformation.

These strategies are often combined and adapted depending on the specific needs and conditions of each industrial enterprise/integrated industrial structure (industrial cluster).

One of the leading countries in matters of successful digitalization, development of the digital economy and digital governments are *Denmark and Estonia*, presented in the ratings described above.

The Danish Government, Danish Regions and Local Government Denmark will launch a new joint public digital strategy for 2022-2025 [28].

The Estonian Digital Agenda 2030 was adopted by Ministry of Economic Affairs and Communications of Estonia in 2021. It includes a vision and an action plan concerning the development of the Estonian economy, state and society with the help of digital technology in the next decade. The main directions of the State Program are the following: digital government, connectivity, cyber security and expectations in connection with other development plans [29]. Thanks to the successful implementation of key programs and strategies, these countries are able to successfully implement issues of digital transformation of all sectors of the economy.

Summarizing all of the above, based on the analysis, we can identify *the following key conditions for the readiness and adaptation of the industrial sector to the digitalization of business processes, characteristic of a number of foreign countries:*

1. Development of digital infrastructure and access to technology;

2. Availability of the required amount of investment and effective financing;

3. Training of new personnel and development of IT education;

4. Effective government regulation and support, including through various government programs and digitalization projects;

5. The readiness of enterprises to change culture and management practices towards more flexible, innovative and adaptive models is also important for the successful digitalization of business processes.

6. Ensuring the security and protection of data confidentiality, which is especially relevant given the growth of cyber threats and regulatory pressure.

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5. Discussions

As before, in the academic environment, the issues of assessing the digital readiness of industrial enterprises for digital transformation remain incompletely studied: in particular, a single block of assessments has not been formed, a unified approach has not been identified, and an adaptive methodology has not been developed. There is also a lack of a comprehensive understanding of the concepts that reflect the issues of implementation and

adaptation by the industrial sector of unified digital platforms and digital ecosystems, which serve as a critical component of building a new type of factory - digital. In this regard, further directions of the authors' research will be related to the development of tools for assessing the level of digital readiness of industrial enterprises in Kazakhstan for the implementation and adaptation of digital ecosystems, as well as the development of an effective organizational and managerial mechanism for their adaptation into the structure of business processes.

6. Conclusion

The study made it possible to identify key trends in studying the level of readiness and conditions for adaptation of industrial enterprises in foreign countries to the digitalization of business processes within the framework of scientometric analysis, as well as through content analysis; In addition, world rankings were reviewed to judge the level of digital competitiveness and readiness of countries for digital transformation and adaptation of the main trends of Industry 4.0.

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