



VECTORS OF AUTOMATIZATION OF KNOWLEDGE AND INFORMATION SYSTEMS MANAGEMENT IN THE DIGITAL ECONOMY

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ABSTRACT

In this research, we study the types and features of digital automatized solutions which are connected with knowledge and information systems management in various sectors of the economy. It is demonstrated that at the current stage of the formation of the digital economy, there have formed various directions (vectors) that cover e-commerce, high-tech industry, logistics, transport, etc. Despite many advantages of automatization in the considered directions, there are still problems with adapting ICTs and a global threat of the growth of unemployment. A comprehensive solution to this problem will determine the further socioeconomic development of countries.

The objective of this research is to systematise the key directions (vectors) of automatization in the management of knowledge and information systems in the conditions of digitalization of economic sectors and infrastructure.

The methodological framework of this research is comprised of frame analysis, statistical method, and trend method. The scientific novelty of this research is connected with the substantiation of perspectives of further development of automatized digital solutions in the digital economy given the existing social threats.



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1. INTRODUCTION

The digital economy reflects economic reality, the evolution of which involves using electronic tools in most processes and interrelations. However, traditional practices and approaches still play their role in its development. At the current stage of society's development, no country in the world ensured a full transition to digitalization in the main spheres and

infrastructures. This is due to a wide range of factors, the key of which include traditions and experience of using regular methods and tools; unpreparedness of population and consumers for the use of ICT due to insufficient level of knowledge and skills; low quality of infrastructure (low Internet speed, absence of Internet coverage in certain territories). Low digital readiness of the population is a barrier to the implementation of national electronic trade and educational platforms.

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Insufficient digital readiness of business does not facilitate the growth of productiveness in the main spheres, for various innovative opportunities are lost, which would have allowed saving resources (labour, energy, material, and financial). A large negative role in mastering digital tools belongs to the absence of knowledge about their advantages. Accordingly, insufficient implementation of digitalization in all countries of the world is due to the fact that people who require it for improvement of effectiveness in certain spheres do not know enough about the existing opportunities. If the government takes measures for the propaganda of advantages in this sphere, the subjects of business, science, education, and technology can improve their knowledge about new chances and opportunities.

Capabilities of the automatization of the management of knowledge and information systems are one of such opportunities. It ensures the functioning of the processes of production, logistics, services, and implementation of R&D, as well as the creation, promotion, and further production of knowledge in education. The sphere of automatization has various vectors of integration at the level of different sectors of the economy and infrastructures.

The objective of this research lies in the systematisation of the main vectors of automatization of the management of knowledge and information systems in the conditions of digitalization of the economy and infrastructure. For this, we have to establish vectors of the considered type that are oriented towards the implementation in various sectors and characterise the specifics of the formation of the vectors through their use in the basis of certain ICT in countries and economic sectors.

2. EXPERIMENTAL SECTION

This research on the features of the formation of ICT that ensure automatization of various processes in knowledge and information systems management in business, science, education, and life activities involves the application of a range of methods.

Frame analysis allows us to use assessment frameworks of effectiveness to establish the influence of certain types of ICT on the efficiency of economic and competitive growth. The statistical method is used to select official economic and technological data of the considered countries and companies. The trend method is utilised to establish a list of ICT that ensure automatization of the management of knowledge and information systems.

In this research, we use statistical and analytical materials, which include, among others, the following. Gao et al. (2020) presented a comparison of the effectiveness of using chatbots and the work of bank

employees to ensure the service of customer support in Spanish banks. It was shown that consumers are more satisfied with the functioning of chatbots during the resolution of routine and standard tasks, which do not require specialised knowledge. In this case, there is no influence of human factor. The focus on the provision of services by bank employees does not always satisfy clients, because human personnel sometimes make mistakes during standard tasks. The authors state that traditional issues dominate in the provision of services of customer support in Spanish banks. These issues can be solved by chatbots. It is proven that to raise the customer capital of banks, there is a need for mass implementation of chatbots, which can work 24/7.

Calder et al. (2023) assessed the connection between the indicator of a company's capital brand and customer capital and analysed the modelling of the variable of the latter – the level of customer support and services. The authors prove that the implementation of a standardised model of provision of the given variable with the use of automatized chatbots allows achieving equal levels of the growth of customer capital and brand capital.

Zhang et al. (2024) conduct a complex analysis of factual theoretical and empirical materials on the design, organisation, and functioning of business chatbots and provide offers on the improvement of the architecture of these digital solutions. Special attention should be paid to the issue of improving the organisation of ICT data exploitation given the key problem – precise generation of questions and answers in communication with clients. This determines the level of effectiveness of the interaction (growth of product sales and support in the resolution of customers' problems in the service sphere). Ding et al. (2023) elaborated on the pros and cons of digital transformation and automatization of the processing industry in Chinese provinces in the context of improving production and preserving the population's employment in 2011-2022. We should note the authors' contribution to the determination of the level of effect for each direction (support for employment and growth of high-tech production) and the authors' statements on the insufficiency of the government's efforts in the sphere of supporting employees, who were fired because of production automatization and on the possibility of quick employment in new spheres in the territories that have a high level of digital and professional readiness of labour resources.

Bălan (2023) dwelt on the new capabilities of chatbots in the management of information and communication processes in the business environment. The authors conducted a comprehensive literature review in the sphere of theoretical substantiation of the use of chatbots and distinguished a problem of insufficient understanding of humans by chatbots. The author also emphasized the conceptualization of customer chatbot communication in the context of the focus on the achievement of goals and chatbots' competencies.

Burkhanov et al. (2022) perform a factor analysis of the formation of economic sustainability of companies of the chemical industry in Uzbekistan and present problems and directions for its increase in the conditions of digitalization of the main processes. The authors focus on the necessity of creating a favourable infrastructure for implementing ICT, which includes good Internet coverage and speed. Improvement of this factor is of primary importance for the growth of the sector's productiveness.

Gonzales (2024) presents a study of the preconditions (the COVID-19 pandemic, high workload of medical personnel) for the development of nursing assistant robots and considers the key functions and capabilities of this idea in the conditions of medical establishments.

3. RESULTS

The main priority of this research is the determination of the key vectors (directions) for sectorial automatization in the sphere of digital management of knowledge and information systems. These vectors of automatization are presented at the level of the corresponding adapted sectorial ICT.

One of the directions of this category is digital solutions that are connected with automatized customer support: online support robots (company chatbots); voice robots of companies' hotlines; automatized e-mail management; and automatized databases of companies. Based on the study of the analytical materials (Acquire, 2021; Zendesk.nl, 2023; Intelligence Partner, 2020), we establish the mechanism of the functioning of companies' automatized chatbots:

- Customer visits the company's website;
- Customer forms an application in the chatbot regarding a certain problem;
- If the question concerns qualities and advantages of products (services), the customer receives a link to information about the required aspects;
- If the customer receives all answers to his questions, he's offered to automatically make an order;
- Using basic content analysis, AI determines the key aspect of the application and recommends the customer options for the resolution of the problem;
- If the customer cannot solve his problem based on the presented recommendations, the chatbot forms an application for further communication with the company's employees;
- Then the company employee receives information on the results of customer–chatbot communication, and the unsolved question is dealt with.

The world leadership in production and servicing ICT that ensures automatized customer support belongs to IBM, Microsoft, Amazon, Google, Iflytek, and Oracle (LinkedIn, 2024a). We collected and systematised materials on the advantages in this sphere (Intelligence Partner, 2020):

- Support of 100 % personalised communications with customers 24/7. This allows keeping current customers and attracting new ones;
- Reduction of expenditures for employee wages. By 2022, all companies that use chatbots in their economic activities were able to save USD 8 billion. At present, there is no precise information on the volumes of economy by companies and in the context of economy/wages proportion. We can assume that if the calculations are done for traditional companies with 8-10-hour work days, specialists' wages for overtime can be considered economy. Intelligence Partner (2020) states that the refusal of live phone communication with customers and implementation of chatbots allows achieving savings of $\frac{3}{4}$ of the volume of a company's employee wages (by the example of Spanish and Portuguese Internet stores);
- An increase in customer satisfaction due to solving issues in servicing and purchase of products (services). The growth of this indicator allows the company to reach an increase in the value of customer capital (Gao et al., 2020). Researchers prove that the implementation of automatization systems of customer support (with the use of chatbots) allows achieving 100 % of the quality of customer services within company standards and avoiding mistakes in the interaction. Intelligence Partner (2020) confirms (with 74 % probability) the validity of the achievement of this result, based on the materials of a survey among managers of the main service companies of Spain in the sphere of sales and maintenance of household appliances and computer equipment;
- Reduction of the level of exploitation expenses of companies for the organisation of interaction with customers. Companies in the sphere of sales and maintenance of equipment and technologies (example of large trade platforms in Spain) use chatbots and thus stop applying such services as queries in social networks, communication with the help of e-mail, and services through phone communication. Refusal of communication with customers via telephone enables companies to save 33 % of exploitation expenses.

Based on the analysis of empirical materials on the use of chatbots in the activities of the key trade platforms in Portugal and Spain (Conforama, Decathlon, Ticketline, Leroy Merlin, El Corte Inglés, Continente, Olx, Worten, Aliexpress, Fnac, Ikea, eBay, and Amazon), we establish the peculiarities of customers who are oriented towards the application of this ICT in the interaction. These are as follows:

- 1) Women are more oriented towards the receipt of consultations and resolution of issues on the purchase of goods (clothing, footwear, accessories, equipment, food products, etc.) with the use of chatbots. The share of women among chatbot users is more than 60 %;
- 2) Around 50 % of online stores' chatbot users have higher education. Accordingly, the implementation of this type of ICT is relevant for countries with a dominant population with higher education;

3) The sectorial structure of purchases performed via chatbots in Spanish and Portuguese chatbots includes purchases of tourist services, hospitality services, products and services in the sphere of sports, food products, restaurant products and services, and food delivery (20 %); ICT (21.4 %); clothing, footwear, accessories, etc. (24.3 %). Other products and services account for 34.3 %. Such sectorial structure could be peculiar, to a different extent, to most countries of Europe. This conclusion can be made based on the level of GDP per capita in the two considered countries and the level of their digitalization (including the population's readiness for innovations).

Another important direction (vector) of automatization of the management of knowledge and information systems in the digital economy and infrastructural support is the implementation of automatized digital solutions in industrial, construction, logistics, transport, agricultural, and medical equipment. Automatization of equipment can be based on such technologies, which ensure knowledge and information systems management, such as robotics, AI, wireless communications, GPS, video cameras, sensors, machine equipment, etc. (Seif, 2024). Automatization of equipment facilitates the achievement of the necessary level of safety of processes, which cannot be reached in the conditions of the use of only human resources; reduction of expenses of materials (resources) compared to their management without automatization (due to pre-programmed volume of spending materials and absence of defects); growth of quality and productiveness; an increase in eco-friendliness and energy efficiency.

Infrastructural automatized solutions in medicine and social care include assistant robots, which perform routine operations connected with registration, remote diagnostics, and contact diagnostics. After the COVID-19 pandemic, the use of such types of robots is especially relevant for ensuring the safety of patients and medical personnel (Gonzales, 2024).

Let us consider the features of the effectiveness of using ICT that ensure automatization of production by the example of Germany's industry.

Analysis of the statistical data by Statista (2023) showed that products (services) of the sector of automatization in Germany in 2022 reached the peak of its growth over 2011-2022. In 2011, this indicator equalled EUR 47.9 billion, in 2015 – EUR 49.3 billion, in 2018 – EUR 54.7 billion, in 2020 – EUR 47.6 billion, in 2021 – EUR 52.3 billion, and in 2022 – EUR 58.5 billion. It can be assumed that the growth of offer in the market of automatization (including in the industrial sphere)

ensures the improvement of quality and effectiveness of production, raising its competitiveness. In this case, automatization is used in knowledge and information systems management of high-tech productions in Germany. Over 2011-2021, the level of value-added of medium-tech and high-tech productions in the total volume of the processing industry of the country grew only by 2 %, equalling 61 % in 2022 (The World Bank, 2023). At that, there are positive dynamics of the two variables, which points to the necessity of implementing automatization in knowledge and information systems management of productions.

There are fully automatized productions in Germany. One of these is a factory of BMW Group (Regensburg), which is the only production in the world to have 100 % automatization and digitalization of all processes of marking, processing, and inspection of painted surfaces of cars, manufactured by the company (BMWGroup, 2024). Since March 2022, the factory performed a transition to 100 % automatization of these processes. Automatization is based on AI technology and built-in software for all three processes. A part of AI technology is defectometry, which ensures maximum detection of defects in painting and surface machining on vehicles. Due to high automatization and the focus on quality, BMW cars are not observed in multiple complaints of defects and mass car recalls (Lemonlawnow, 2023). However, the open corporate data of BMWGroup does not contain information on the quantitative factors of the advantages of implementing automatization apart from the indication of high-quality indicators.

We should mention the efforts of the Japanese car industry in the sphere of automatization and digitalization of the main processes. An example of this is Toyota Material Handling (part of Toyota Industries corporation). The company not only implements automatization in production but also ensures the automatization of products, facilitating productiveness and quality of application in various sectors. The company's production capacities are located in Europe. The company manufactures a line of car products in the sphere of loading and unloading works under the title Autopilot (Toyota-forklifts.is, 2024). Table 1 presents a comparative analysis of the advantages of this line and traditional types of similar products, equipped with the automatization of processes from a rival (the company Kion Group AG (Germany)). We selected the companies Toyota Material Handling and Kion Group AG because they are ranked 1st and 2nd in the world ranking of lifting equipment as a result of 2023 (Linkedin, 2024b).

Table 1. Comparative characteristics of automatized car lifting equipment of Autopilot (Toyota Material Handling) and equipment of the rival company

	Company/equipment	Description
1	2	3
1	Toyota Material Handling	
1.1	Loading-unloading equipment Autopilot	<p>Possibility of full automatization of storage.</p> <p>List of equipment of the line: heavy haulers (TAE500), stackers with counterweights (OAE120CB), reach trucks (RAE160-250), stackers (SAE160), and pallet trucks (LAE250).</p> <p>Advantages:</p> <ul style="list-style-type: none"> - Possibility of using in all possible spheres of loading and unloading cargos of various categories; - Precise navigation system, realised through adaptive and high-precision navigation technologies. This allows for complex storage operations in various conditions and in an environment that is not fit for storing; - Safety and precision of work with pallets, due to in-built cameras and load sensors; - Constant connection between the equipment and managers. This includes constant monitoring of operations in real-time and recording of all operations. This is done due to software developed by the company; - Quick and smart charting of the equipment. Energy saving of 30 %, zero CO2 emissions.
2	Kion Group AG	
2.1	Loading and unloading equipment	<p>The potential of the equipment: full automatized storage management.</p> <p>The set includes four electric forklifts with counterweights Linde E30, E20, and E25, with 2-3 tonnes of load capacity. This equipment has a system of help, with in-built load positioning and diagram of load; electrohydraulic steering; information system of knowledge management to prevent collision with any other objects (GPS, HD cameras, and special sensors); transfer of data on the processes in real-time (5G technology); quick charging of the equipment with zero emissions</p>

Source: Compiled by the authors based on Toyota-forklifts.is (2024) and Kion-Group (2024)

The two compared automatized systems of storage management have a wide range of technical, economic, and environmental advantages. As for the loading-unloading equipment of Autopilot (Toyota Material Handling), we should note clear exploitation characteristics as to the level of energy saving (which is absent in Kion Group AG). On the whole, the two companies are oriented towards full automatization of loading and unloading operations in various conditions and sectors. Effects from the automatization processes are achieved due to the mentioned in-built digital technologies of knowledge and information systems management. The products of the two analysed companies have a common feature: they could be used in case of full automatization and with the involvement of operators (in case of serious failures of software and blackouts).

To support competitive positions in the market, global brands (including the analysed companies Toyota Material Handling and Kion Group AG) strive towards creating ICT and equipment that conform to the market expectations that are formed at each stage of digitalization. In the case of lifting equipment, we may note almost identical consumer and exploitation characteristics of the two companies' products. If the company creates new digital or technical solutions for automatization, rival companies (including due to commercial intelligence) introduce analogue products in the markets, which are similar to novel products by their

exploitation qualities. Accordingly, at the current stage, it is possible to ensure the growth of quality and efficiency of products (services) in various sectors due to constantly improved technological solutions.

We should note such direction (vector) of automatization of the management of knowledge and information systems as tools for documenting databases, which are based on AI technology. Digital solutions of this category are applied by a wide range of users in various sectors. Analysis of the data by Colins (2024) allows distinguishing the list of the main tools of this type with the highest world ranking, namely:

- ApexSQL Doc – digital solution with the following parameters: four settings; the maximum simplicity in the application; five forms of document presentation; and three systems of database management. The cost of a license for this ICT is USD 729.5 per year;
- Redgate SQL Doc – digital solution with the following parameters: four forms of document presentation; four settings; and one system of database management. The cost is USD 279 per user;
- Dataedo – digital solution with the possibility of adaptation with four systems of database management; four forms of document presentation; maximum simplicity of application four settings. The price starts from USD 18,000 per three users;
- Dbdocs – digital solution with the following parameters: three systems of database management;

three settings of ICT; and one form of document presentation. The price is USD 720 per three projects; - DbForge Edge – digital solution with four settings, three forms of document presentation, and four systems of database management. The price starts from USD 699.95 for the license.

The above digital solutions of automatized documenting databases, which are connected with knowledge and information systems management, facilitate the creation of new products (services) in the sphere of information and communication technologies and the resolution of complex tasks in the sphere of corporate management. Implementation of such systems allows the possibility of transition to electronic document turnover, which saves resources, protects the ecosystem (prevention of massive felling of trees), etc.

4. DISCUSSION

In this research, we analysed the types, features, and advantages of the directions (vectors) of automatization of the management of knowledge and information systems in the digital economy. We distinguished three main vectors, though new ones continue to develop, including modified ones, which include a wide range of digital solutions. The considered vectors were selected because they are relevant and can be adapted for use in various sectors of the economy and infrastructure.

The first considered vector is chatbots, which ensure automatized customer support. Their application is a promising vector in the improvement of the communication component in companies' activities, which ensures servicing products that are sold by companies via their websites. To raise the level of effectiveness of using chatbots, it is possible to introduce innovations for AI's better understanding of the customer. This is connected with a perspective of improvement of information bases of developers in the context of possible reactions of consumers (Zhang, et al., 2024). Implementation of these innovations will help solve the problem of business chatbots, which consists in the generation of the most optimal answer to customers.

The second considered vector is automatized digital solutions, integrated into equipment which is used in various sectors of the economy and life activities. The analysed advantages of implementing such solutions in the equipment for storage involve the possibility of reduction of expenditures for labour resources and energy and the positive influence on climate preservation. The analysed examples from the German

car-building industry show that implementation of the studied digital automatized solutions allows achieving such a level of product quality that cannot be ensured in case of focus on the use of labour resources. Accordingly, further development of Industry 4.0 can be oriented towards maximum automatization which is based on digital solutions for support of the main processes.

As for the third considered vector (tools of automatization of databases documenting, based on AI technology), their further sectorial adaptation could be recommended. This may contribute to the creation of innovative digital solutions in various spheres of economic and technological activities and an increase in the level of automatization of business processes. The effectiveness of sectorial adaptation of digital automatized solutions depends on favourable infrastructural support in the sphere of improvement of communication services (Internet coverage and signal quality in various regions and territories).

5. CONCLUSION

It is possible to state that the implementation of new digital vectors of automatization at the level of the main sectors of the economy and in the spheres of R&D and education is a precondition for an increase in productiveness and growth of quality. An increase in automatized digital solutions may lead to the problem of the dismissal of employees who perform routine or sometimes sophisticated tasks. Reduction in employment in these spheres requires acceleration of efforts at the level of the government, business environment, and education. Solutions in this direction must be formed and realised based on the complex policy, coordinated at all levels. If there is no coordinated policy for regulating the problem of unemployment growth due to the mass implementation of automatized information and communication technologies and equipment, there will be continued growth of social tension and problems with an increase in social expenditures of the government due to personnel cuts.

A promising direction for the automatization of knowledge and information systems management in the digital economy is the creation of new automatized digital platforms for retraining personnel within certain regions and territories. Accordingly, such digital automatized solutions can be created by the initiatives of the government and given trends of the current market.

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