



INVESTMENTS IN THE DEVELOPMENT OF THE DIGITAL ECONOMY AS A DRIVER OF CHANGES IN INFORMATION SYSTEMS MANAGEMENT

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ABSTRACT

This work presents a study of the processes of digitalization of the economy in the context of assessing the role of investments in the development of digital technologies as the key drivers of the development of information systems management. Theoretical aspects of the formation and development of information systems are considered, their classification and general characteristics are given, general trends of transformation of information systems under the influence of digital technologies are established, and directions and volumes of investments in the digital economy from the position of their impact on the development of information systems are determined.

The research methodology is based on the systemic approach and is characterised by the "blurring of the boundaries" of certain research spheres within such concepts as "digital economy", "information system", and "venture investment and start-ups". The methodological tools of this study include analysis and synthesis, specific historical methods, expert analyses, observation, and generalisation.

This research is a stage in substantiating the connection between the factors of investments in the digital economy and the reflection of their impact on the management and development of information systems. The empirical study of the connection between the considered processes and justification of the key trends and directions for their development form a theoretical basis for mathematical models that are aimed at determining concrete sets of factors of investment effect on the designated range of the elements of the digital economy with further reflection of this effect in the form of economic results of companies' activities.



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1. INTRODUCTION

Information systems play an important role in managing companies and public processes. At present, they help satisfy a large number of administrative, business, and

even personal needs. These systems underwent a long stage of formation and development. Since the middle of the 20th century, the role in economic and social processes has been growing constantly. Very often, this was connected with innovations and technical solutions

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that can improve one or several components of such systems (infrastructure, processes, speed and channels of information transfer, etc.). As of now, the main changes in information systems are ensured through digital transformation.

The digital economy is the main driver of innovative changes and development in different spheres of human life. It introduces changes in business processes and transforms procedures of the interaction of humans and information and technologies. When information data becomes almost the main asset of companies, digital technologies are the chief factor in the competitiveness and effectiveness of management. In these conditions, the influence of digital technologies on information systems management constantly grows and determines the economic effectiveness of digital solutions.

Thus, investing in technologies of blockchain, artificial intelligence, machine learning, virtual and augmented reality, cloud technologies, automatization, robotization, etc. must be assessed not only from the position of perspective and advantages they offer but also from the position of their investment attractiveness. Thus, evaluation of the influence of investments in digital technologies and the digital economy on the whole, from the position of their influence on changes in information systems management, is an important scientific task. Solving this task will allow substantiating the key directions for investing, which can ensure the largest economic and technological return, determining the advantages and risks of different investment tools and isolated digital technologies, and studying the adaptability and suitability of each information system to digitalization.

2. EXPERIMENTAL SECTION

Assessment of the influence of one phenomenon on another is always complex and has many aspects. It requires the development and use of a complex methodology, which is based on theoretical justification of the possible presence of such connection, analysis of processes and phenomena that have to be in a certain degree of dependence, empirical research with the formulation of the corresponding theories and hypotheses, and development of a mathematical model that reflects the structure, strength, and level of connection between the studied factors and allows predicting the changes in the result depending on a change in a certain factor.

The theoretical basis of studying the influence of investments in the development of the digital economy and digital technologies from the position of their impact on changes in the development of information systems and improvement of their management is formed by the system and interdisciplinary approaches, which allow combining the conceptual provisions of different spheres and combining their interconnection in

the context of each separate study. Thus, the components of theoretical substantiation of the problem are provisions belonging to different scientific spheres, including general philosophical, dialectical, and ideological, as well as special socioeconomic, technical & technological, computer, etc. A specific feature of each of these spheres is the absence of a clear boundary of its theoretical provisions, which is manifested in the “blurring of boundaries” of the economy, technologies, and information (digital economy), economy, investment and technologies (venture investment and start-ups), management, cybernetics, and technologies (information systems), etc.

Thus, the general methodology of this research is formed by integrated definitions, which combine theoretical and practical foundations of different scientific spheres. This ability forms innovative and creative potential due to which the digital economy penetrates all spheres of public life, offers new opportunities for the formation of competitive advantages, and ensures a constant increase in the level of investment attractiveness of different innovative solutions, including information systems management.

Relying on the above methodological principles, it is necessary to pay attention to the absence of a clear methodological apparatus that can solve the declared problems. To solve interdisciplinary tasks, an optimal option is the use of flexible and general scientific approaches that allow operating different information, including digital factual data and expert information. According to this, the methodology of this research is comprised of the following: specific historical method, which allows determining the periods and stages of the development of information systems and revealing the key trends of the modern stage of their transformation based on digital technologies; analysis and synthesis, which allow considering these processes through the development of certain elements of information systems (humans, processes, technologies, infrastructure, etc.); expert analysis, which involves surveys or generalisation of expert opinions and positions. The methods of observation, generalisation, and comparison are also used. These are general scientific methods and means that can draw a connection between different processes and phenomena in the context of the designated problem.

The evolution of information systems and their effect on the digital transformation of organisations is the object of many studies in scientific and expert literature. The considered literary and expert sources, as well as statistical information, could be divided according to the following directions:

- Study and generalisation of the development of information systems and description of their influence on an organisation's competitiveness (Kadry, 2014), determination of factors affecting the evolution of information systems,

including business and technological processes (Sahid et al., 2020);

- Determination of the role of information systems in economy's digital transformation economy, analysis of their perception of digital transformation and changes in business processes (Pekes, 2023; Talet, 2022);
- Study of the influence of investments in information and communication technologies on economic growth and digitalization (International Monetary Fund, 2023; The Economist Intelligence Unit, 2020);
- Analysis of narrow spheres of digital transformation and the role of information systems in these processes from the position of the development of the green economy (Ergasheva et al., 2023) or marketing (Irpan et al., 2021);
- Assessment of real trends in the sphere of IT and digital transformation, determination of direction and risks for such changes from the position of information systems (McKinsey & Company, 2023; KPMG, 2023; Gartner, 2024);
- Analysis of current information about global trends in the sphere of digital technologies and investment (World Bank, 2024; UNCTAD, 2023; UNESCAP, 2021).

The main goal of this research is to develop and generalise the theoretical and empirical view of processes that characterise investing in digital technologies and the digital economy from the position of their effect on the development and management of information systems. This goal is achieved due to its division into several tasks, which involve the identification of information systems as separate elements of technological progress and factors of economic development; the determination of the possibility for the influence of the digital economy elements on these information systems; the study of the volumes and processes of investing in the digital economy from the position of their impact on the transformation of information systems and their development. The goal and tasks of this research allow designating assumptions and hypotheses, which are as follows:

H1: Information systems depend on the development of digital technologies;

H2: Investing in digital technologies influences, to a large extent, the state of development of information systems and their elements.

3. RESULTS

Relying on the system approach, information systems could be defined as any ordered totality of elements with the involvement of information technologies. From the position of economic processes, information systems are most often considered in the context of informatisation of economic or managerial processes

and consist of processes, labour, material, and financial resources, and a certain programme block, which ensures the processing of information according to the system's tasks. The basis of information systems is information computer technologies. All other elements are integrated around them, and they perform the main tasks of such systems: collection, processing, analytics, and dissemination of data, and others.

Information systems have become inseparable components of public and economic processes. When using any app on the smartphone, reading news online, or even paying for coffee, we use information systems. To acquire its modern status of popular and accessible services, information systems had to go a long way in evolution. Three main stages of this evolution are distinguished (Sahid et al., 2020):

- Information systems of the 1st generation allow automatization of the simplest manual operation and facilitate an increase in organisational effectiveness and productiveness;
- Information systems of the 2nd generation were aimed at information management, which was not limited by its collection and storage. As a result of their actions, information became structured, scalable, and accessible for joint use;
- Information systems of the 3rd generation were formed based on the Internet, which ensured their global dissemination and lifted most of the restrictions on information turnover. This generation of information systems is connected with the development of new business models, based on information, and the use in the management of digital technologies.

A specific feature of the digital age is the dissemination of digital devices. They are used to solve everyday tasks, purchases, collection of information, business processes, public administration, etc. In the conditions of digitalization, almost every device can collect, process, and transfer information to special servers. Most of this information can be processed and structured and be applicable for resolution of diverse managerial problems, for example:

- Studying the market's demands for goods and services;
- Determining the level of satisfaction with goods and services;
- Mapping of routes of consumers' movement;
- Identifying social problems and needs;
- Tracking the trajectory of movement of the management object, etc.

Information systems are most often used in the economy to support corporate or organisational management are computerized systems of information processing (El-Ebiary et al., 2023). Transformation of the institutional paradigm of economic systems in the

conditions of digitalization ensures a close integration of digital technologies into all processes. The basic among these are blockchain, artificial intelligence, machine learning, Big Data, cloud technologies,

robotization and automatization, virtual and augmented reality, the Internet of Things, cyber security, etc. (table 1).

Table 1. Influence of digital technologies on information systems

Type of digital technologies	Their influence on information systems
Blockchain	Distributed database technology protects from unsanctioned access to information, ensures transparency, trackability, and security of financial and personal data in information systems, and offers additional opportunities for the conclusion of contracts and interaction of economic agents.
AI and machine learning	Help in recognition, formalisation, and processing of non-digital and non-textual data; are used for communication and in decision-making; offer additional opportunities for automatization and robotization of processes
Big Data	The main tool for the collection, structuring, and processing of large arrays of structured and non-structured data from different sources
Cloud technologies	Allows storing data, performing calculations, and conducting business processes without the use of local programmes, which raises accessibility of the data and allows connecting workplaces around the world
Robotization and automatization	Used at production lines to raise precision and reliability of operations, replacing human labour in routine operations and business processes
Virtual and augmented reality	Offer alternative opportunities for the stimulation and visualisation of data and processes, help in training and marketing, and raise the level of information accessibility for users
Internet of Things	Network of connected sensors and data, which allows for effective collection and exchange of information
Cyber security	Collection of software and technical systems, which protect information from loss, damage, or theft

Source: Made by the authors based on Pekes (2023), Talet (2022), and The Economist Intelligence Unit (2020)

Information systems play a strategic role in the economy and continue developing. They gradually integrate new digital technologies, which are often the main drivers of effective changes. The most popular information systems are as follows:

- Office information systems, which simplify work that is connected with the organisation of work time, communications, document turnover, etc.;
- Transaction processing systems – systems that generate and process data that emerge in the process of operational activities, they include the systems of financial accounting, stock management, etc.;
- Management Information Systems are aimed at the generation and processing of information for further use in management. They offer information in the form of reports for monitoring the situation and managerial decision-making at different levels of management;
- Decision Support Systems, which allow, based on internal and external data, considering alternative options of decisions and operating algorithms and criteria that determine conditions of rationality and effectiveness of a certain decision;
- Expert Systems – a special type of information system, which recognises, stores, and imitates the processes of human thinking in the context of managerial decision-making;
- Integrated Information Systems – these are most of the current information systems, for

very often they combine the features of office and transaction systems, information management systems, etc. (Kadry, 2014).

Active penetration of digital systems in information technologies is considered an objective factor that has not only a long-term innovative perspective but can bring economic or social effects today. According to the World Bank, investments in the sector of information technologies accelerate the development of the economy, forming new jobs and raising GDP. Between 2020 and 2022, when the total growth of the world economy was 5.1 %, the growth of the IT sector equalled 8.0 %. In the sphere of employment, these indicators were +1.2 % for the economy on the whole and 6.7 % in the IT sector. However, the proportion was different in the global context. More than 70 % of created value added of It services accounted for the six largest economies of the world. The regional leader in digitalization in this period was East Asia and Pacific, in which the share of companies that invested in digital solutions grew from 13.3 % in April-August 2020 to 53.9 % in June-December 2022. In Europe and Central Asia, the share of such companies grew from 16.3 % to 29.4 % in the same period (World Bank, 2024).

Investments in the digital economy offer substantial changes for information systems. These changes are connected with the development of the corresponding infrastructure (high-speed Internet, devices, sensors, and systems of information collection), an increase in the level of the population's digital literacy, cyber security, creation of services to meet society's demands (marketplaces, online banks, e-government, etc.),

development of the AI and robotization systems, etc. Digital technologies, together with an increase in digital content, led to the quick development of information processes in the economy. Despite the fact whether the organisation is transformed officially or not, it must react to the digitalization of public and economic processes, implementing elements of digital governance or reporting, publishing information about itself on social networks, etc. Conscious development of information systems based on digital technologies allows supporting or raising competitiveness. Investments in information systems, IT infrastructure, or digital technologies form the potential for quick and more effective development of organisations in quickly changing conditions (Talet, 2022).

According to KPMG (2023), investments in digital technologies are returned for most companies. 63 % of the respondents in 2023 said that the use of digital technologies over the last two years allows them to raise the level of their effectiveness. Most of the respondents state that such investments facilitate an increase in profit by more than 10 %. All types of digital technologies

positively influence the profitability and productiveness of the organization. It is best seen in data analytics, which was mentioned by 66 % of the respondents, cyber security (64 %), cloud technologies (64 %), and AI with automatization (63 %).

The above processes characterise the attractiveness of investments in digital technologies. This forms an entire investment market, within which start-ups are financed, mergers and acquisitions of technological companies take place, investors are attracted to companies, etc. Attractiveness and return on investment in this case are the main drivers of an increase in the volume of innovation.

As of 2022 (McKinsey & Company, 2023), investing in the following main directions and technologies changes the very architecture of information systems and expands the opportunities for their use: investing in the development of AI and machine learning, digital transformation, new business models, communications, and leading engineering solutions (Table 2).

Table 2. The volume of investments in digital technologies and their influence on information systems and the effectiveness of companies as of 2022

Type of technologies	Equity investment	Direction of investments and their influence on companies' effectiveness
Investments in AI and machine learning		
Applied AI	\$ 6 billion	Development of the possibility to receive, process, and use information based on computer vision or natural language processing, support for automatization of processes, and expansion of capabilities in the sphere of decision-making
Industrializing machine learning	\$ 3 billion	Scaling applications in machine learning, helps in the transition from start-ups to active business products, raises labour productiveness
Generative AI	\$ 5 billion	Used by companies primarily as a supplementary tool in decision support
Next-generation software development	\$ 2 billion	Simplification of complex tasks in programming, large potential for growth of productivity and wide capabilities for scaling
Investments in digital transformation and new business models		
Trust architectures and digital identity	\$ 47 billion	A new level of digital risk management, protection of assets and acceleration of innovations
Web3	\$ 62 billion	Development of blockchain technologies in different spheres, including new business models, new methods of data protection, etc. Better protection and transparency in the sphere of data management
Investments in computing infrastructure and communications		
Advanced connectivity	\$ 118 billion	Expansion of opportunities of connection due to low-orbit connection (LEO) and private 5G networks. An increase in data transfer and data reliability, new opportunities in the sphere of automatization of processes, smart production, etc.
Immersive-reality technologies	\$ 16 billion	Development of capabilities of alternate, virtual, and mixed reality (AR, VR, MR); large potential in the sphere of consumer service and corporate scenarios
Investments in leading engineering solutions		
Cloud and edge computing	\$ 84 billion	Combination of cloud and edge capabilities for the computer infrastructure and data. Aimed at national data sovereignty and confidentiality
Quantum technologies	\$ 2 billion	Capabilities of quantum mechanics to solve applied tasks connected with calculations, sensors, etc.

Source: Made by the authors based on McKinsey & Company (2023)

Investing in the mentioned directions reflects the general specifics of information systems, which include human, programme, and infrastructural elements and information. According to this, human skills in information systems are increasingly subject to

automatization and replacement with AI. Technologies in the sphere of the formation of new business models cover a higher level of security of data transfer and use. Development of infrastructure is associated with the acceleration of data transfer and the formation of new

opportunities for their positioning and interpretation in space.

Apart from the mentioned directions for investing, large investments in the digital economy are placed in the following sectors:

- Technologies of mobility (\$ 194 billion) – autonomous driving, electrification of transport, mobile connection, etc.;
- Bioengineering (\$ 43 billion) – the use of digital technologies in biological processes;
- Space technologies (\$ 43 billion) – aimed at the reduction of cost and size of components, technologies of remote probing and analytics.

Another direction for investing in digital technologies is the development of renewable energy (\$ 288 billion) and other climate technologies (\$ 86 billion). The main effects of the digitalization of these spheres are an increase in the productiveness of alternative energy sources, growth of the level of monitoring of the environment, saving resources, etc.

Investments in the digital economy cover different aspects of the development of information systems management. They are implemented within different projects and form a substantial financial flow, which can sustain further development of the digital economy and information systems in the long term. The profitability of such investment is an additional factor in their growth in the future, which forms a multiplication effect and allows looking at the perspectives of development and management of information systems in the conditions of the digital economy with optimism.

4. DISCUSSION

Assessment of investment processes in the sphere of the digital economy from the position of their influence on information systems is complex and has many levels. It cannot be thoroughly studied in one work. Moreover, even in the case of complex and large-scale studies, many problems of the considered topic will remain not fully covered. This is primarily due to the quick dynamics of digital transformation. Against this background, each study of the influence of investing in digital solutions on the development of information systems will require constant support for relevance given new data and conditions. Besides, due to its novelty, the issue of methodological agreement of processes that take place in the economy and investing, digital sphere and information and computer systems are not yet sufficiently solved to make unambiguous justified conclusions.

Another aspect that requires thorough discussion and research, is the influence of digital technologies on sustainable development. In this context, most attention is paid to the issue of using digital solutions within information systems that are aimed at monitoring, analysis, and resolution of problems of climate change,

ensuring inclusiveness in all spheres of human life, and improvement of the level of food support and education in the most vulnerable regions of the world. Current trends demonstrate that for most countries with low income, digitalization is still inaccessible.

Against the background of active development and integration of digital services and solutions in information systems at different levels, the problems of ethics and their safe use become relevant. These issues include technological unemployment, caused by the dismissal of employees because of automatization or robotization of processes; compliance with copyright in case of the use of AI; formation of the information culture of “post-truth”, which erases boundaries between true and false information, etc. In the sphere of the digital economy, the issue of security also becomes more important, given an increase in digital technologies’ ability to imitate aspects of personal identification (voice, image, signal, etc.).

This research contains empirical conclusions and generalisations on the determination of volume and assessment of the theoretical effect of investments in digital technologies on the state of the development and management of information systems. Further prospects for the research include mathematical substantiation and confirmation of the presence or absence of such influence, as well as its strength and intensity. In this context, it is important to study how exactly investment sources and processes make the largest effect on information systems and how this is reflected in the indicators of companies or governments’ activities. It is also advisable to dwell on the factor conditions of supporting such influence, which could be different depending on economies and regions.

5. CONCLUSION

Information systems – as factors of the development of the economy and public processes – went through a long evolution of their development. At present, they are actively used in different spheres of public life, including business processes, public administration, household issues, etc. The structure of information systems defines their dependence on different components, among which the main ones are processes, people, programmes, technologies, and information. According to this, the development of each of these components can be considered a factor in the improvement of the information system. Thus, the creation of the Internet, personal computers, and pocket gadgets and the development of programming languages became important drivers of information systems’ development and active dissemination in different spheres.

At present, the main drivers of information systems’ development are digital technologies, which are formed and developed in the conditions of the digital economy. Its economic component determines its integration into

the global market, together with investment processes. According to this, information systems and digital technologies, aimed at their improvement, are assessed from the position of economic and investment attractiveness. Expert evaluations and sociological surveys demonstrate a rather high level of profitability of investments in digital technologies. The perspectives on the attractiveness of such investments are much higher. This leads to the growth of investment flows, which are aimed at the implementation of digital technologies in the economy and information systems management.

This allows confirming the hypotheses on the dependence of information systems on the development of digital technologies and substantiation of the positive influence of investing in the digital economy on information systems management in modern conditions. The main directions of investing in the digital economy, aimed at the development of information systems, are the development of AI and machine learning, the development of new business models based on information systems, the implementation of digital transformation and systems of communications and infrastructure, and search for a new direction for technological development of the mankind in the long-term.

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