Digital Transformation in Project Management

Liubava Chernova[1], Iryna Zhuravel[1], Evgeniy Trushliakov[1], Anatoliy Zubarev[1] and Inna Maister[1]

[1]Admiral Makarov National University of Shipbuilding, Heroiv Ukrainy Avenue 9, Mykolayiv, 54025, Ukraine

Abstract

The article is about how digital transformation converts the strategic vision of enterprise management, and the management competence of personnel with acquired digital skills and thinking to implement the necessary operational processes. The article discusses the technologies of digitalization of enterprises with the changes that these technologies have made to project management. The transformations of the IT structure, which acts as a platform for digital transformation, are considered. An example of an enterprise management model is given, where the digitalization of project management is aimed at increasing the efficiency of the project with the possibility of automation management decision-making and acquiring high-tech competitive advantages.

Keywords

Digital transformation, project management, enterprise digitalization technologies, IT structure

1. Introduction

Digital data, unlike analogue data, can be used (stored, processed, tracked, duplicated) without degradation in quality, at very high speeds and with negligible marginal costs. Such features of digital data are one of the factors contributing to the development of digital technologies and a by-product of their use. Due to the ubiquity of mobile consumer technologies and the increase in time spent online, the world has seen an unprecedented increase in the amount of created, copied and consumed data over the past ten years. The total amount of created, recorded, copied and consumed worldwide data has grown from 2 zettabytes in 2010 to 64.2 zettabytes in 2020 and is projected to rapidly increase to over 180 zettabytes in 2025 (1 ZB = 1012 GB). According to forecasts, in line with significant data growth, the installed base of data storage capacity is projected to increase at a compound annual growth rate (CAGR) of 19.2 per cent between 2020 and 2025. However, data itself is not necessarily valuable. It becomes valuable only to the extent that it's used to improve social and economic processes, organizational and management methods.

2. The phenomenon of digital transformation

Much of the value of digital data comes from its non-competitive and reusable nature, which leads to economies of scale and increased coverage. The same lines of code that underlie a given piece of software can be reproduced and installed on millions of digital devices at almost zero cost to the developer. Data collected by one enterprise and organized into databases can be reused for various purposes as by that same enterprise as by others if they have access to such databases. Thus, the initial investment in data collection represents a sunk cost that can be amortized through use in many different ways and by many users, stimulating innovation and allowing the

creation of new data services, which are unexpected for those who originally collected the data [1].

Data analytics is necessary to extract information from data sets and create value. With the advent of "big data" (available in a variety of formats and at very high speeds), it is becoming increasingly important for organizations to create capabilities to obtain information, generate knowledge and support decision-making. This includes both setting up the technology needed to collect, store and protect data, as well as ensuring the human resources for managing the data using software, artificial intelligence and visualization tools.

Digital transformation is a process that covers both technological, cultural and social aspects. It builds on the opportunities that technological advancements provide to redefine the way of interaction, the way organizations operate, and the way people build trust, store information, create value and transact. Eventually, it provides opportunities for businesses to innovate. It is multidisciplinary by its nature and can't be boiled down to any single component or application area.

Successful digital transformation requires not only technological modernization but also a strategic vision of management competence of personnel equipped with the appropriate digital skills and mindset to implement all operational processes.

In enterprise management, technological changes provide the opportunity for companies to move beyond the simple introduction of digital tools to improve existing operations, and instead, innovate to create new digital products, develop value chains and fundamentally transform existing projects to achieve complete digital transformation.

3. Enterprise digitalization technologies

Digital technologies can change the way goods and services are produced, introduce innovations and interact with other companies, employees, and consumers. They bring a wide range of benefits to the enterprise activity and, eventually, huge potential for increasing enterprise productivity.

Digital tools and techniques help organizations to improve product design, optimize production processes, attract new customers and develop relationships with suppliers throughout the value chain. They also help create more flexible business models through lower costs for main assets (for example, cloud computing offers access to data storage and its processing as necessary) and workforce (artificial intelligence permits businesses to automate increasingly complex tasks). In the case of online platforms such as Google, Amazon or Kickstarter, digital technologies allow enterprises to perform key business functions (e.g. marketing, sales, financing) while obtaining significant positive network effects and access to global markets [2].
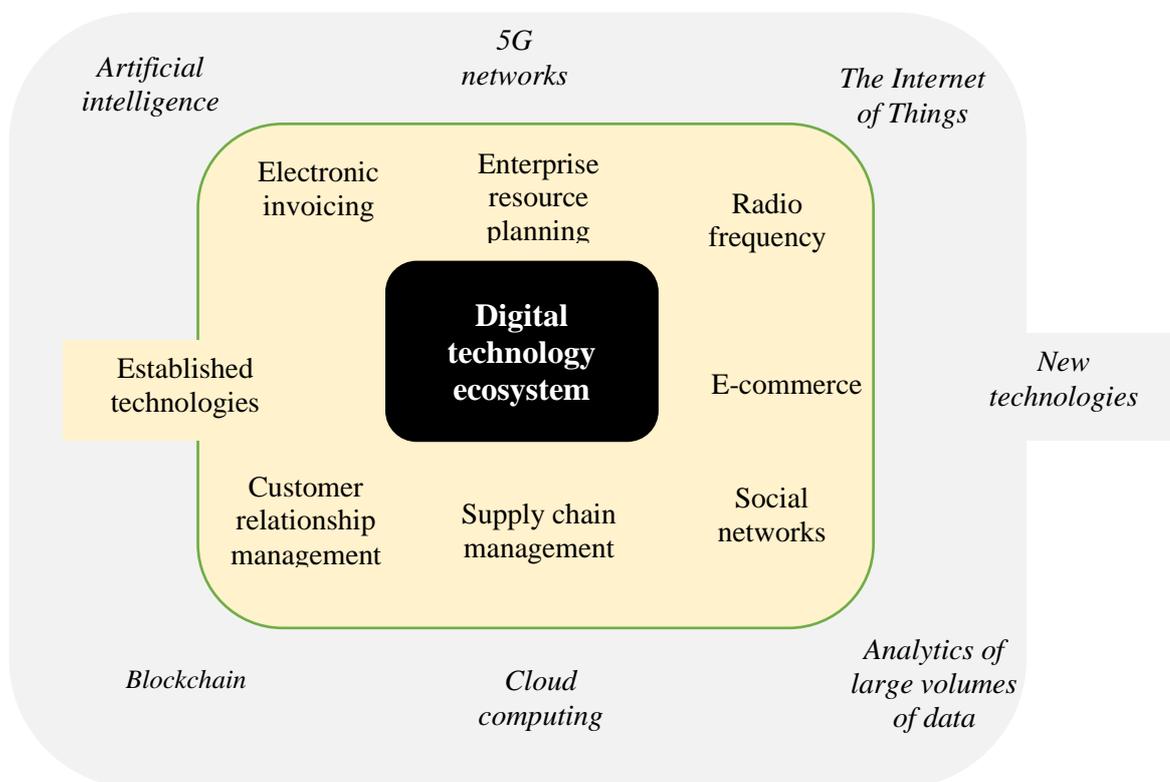
The digital technology ecosystem (Figure 1) is evolving rapidly. Some of these can be considered as "established" tools with proven application areas and known business value, while others are considered as "new technologies" underlying the current wave of digital transformation.

Established technologies:
- Enterprise resource planning (ERP) systems are software tools for integrating and managing internal and external information flows, from material and human resources to finance, accounting and sales. Such a tool automates planning, inventory, purchasing and other business functions, thereby increasing the efficiency of back-office and strategic planning tasks.
- Radio frequency identification (RFID) technologies provide short-range communications and are used for product identification, industrial production monitoring and control, supply chain and inventory tracking, or in payment applications (for example, tolls or transit payments). The use of RFID tools helps improve production and logistics efficiency.
- Customer relationship management (CRM) and supply chain management (SCM) software are used to manage a business's interactions with customers, employees and

suppliers. CRM and SCM improve the integration of the front office and supply chain, optimizing inventory management processes and reducing production turnaround time.

- Social networks are Internet applications for connecting, creating and sharing content online with customers, suppliers or partners, or within an enterprise. The use of social networks by companies develops external communication, including the image and marketing of enterprises, responding to customer opinions, feedback and questions, and hiring employees.

- E-commerce is the sale or purchase of goods or services conducted over computer networks using methods specifically designed for receiving or placing orders (for example, web pages, extranets, or electronic data interchange). E-commerce lets businesses to expand their customer and supplier base and reach markets beyond traditional physical boundaries.

- Electronic invoicing is a form of invoicing in which transactional documents such as purchase orders and payment terms are transmitted digitally and in a standardized format to the relevant parties. Electronic invoices allow to meet regulatory requirements by default and help enhance the integration of accounting systems, eventually reducing the administrative burden on businesses.

Figure 1: The digital technology ecosystem

New technologies:

- 5G networks represent the next generation of wireless technology that provides up to 200 times faster connections than the widely used nowadays 4G networks and is expected to cause a wave of software and hardware innovation across all sectors. 5G networks will increase bandwidth for more reliable and faster communication between machines and will connect tens of billions of communication devices, machines and objects to the Internet.

- The Internet of Things (IoT) covers devices whose state can be changed via the Internet, with or without the active participation of individuals. It includes objects and sensors that collect and exchange data with each other and with people, for example, from devices for

monitoring the working state of equipment to advanced device areas such as autonomous vehicles.

- Analytics refers to the use of various methods and tools to analyze large volumes of data that are generated as a result of the increasing digitization of content, greater monitoring of human activities and the spread of the Internet of Things. This technology can be used to establish relationships, dependencies, and predict outcomes and behaviour. For example, retailers use big data analytics on a regular basis to make personalized offers to customers based on their interests as determined by their web browsing and purchasing behaviour.

- Cloud computing is a service that is accessed via the Internet. Cloud computing offers flexible access to additional computing power, storage capacity, databases and software online at a rate that meets a business's short-term needs. Cloud computing minimizes technology upgrade costs, freeing businesses from upfront hardware and software investments and recurring maintenance, IT and certification costs.

- Artificial intelligence (AI) refers to the ability of machines and systems to acquire and apply knowledge and implement intelligent behaviour. It involves performing a wide range of cognitive tasks, such as perception, processing spoken language, making inferences, learning, decision-making, and demonstrating the ability to move and manipulate objects appropriately. Progress in the application of AI is driven by machine learning (where machines make decisions based on probability functions learned from experience), which allows to create the new types of software and robots that are widely used in industry, for example, to automate routine tasks.

- Blockchain is a distributed ledger that is maintained and stored on a network of computers. The network regularly updates the registry at all sites where it exists, so all copies of it are always identical. This means that records are visible and verifiable to everyone on the network, which eliminates the need for intermediaries for authentication. Thus, this technology provides "trust by default" and the ability to reduce transaction costs by eliminating the need for intermediaries to securely value transfer or sign legal agreements.

The digital technologies described above hold significant potential for improving enterprise productivity and eventually improving living standards. Despite the fact that the full impact of new "general purpose" technologies such as artificial intelligence on productivity has not yet been fully realized, extensive literature demonstrates a positive correlation between the adoption of established digital tools and enterprise productivity. For example, a recent preliminary estimate based on firm-level data from EU countries suggests that a 10 percentage point growth of the share of enterprises using cloud computing in an industry would lead to an average increase in the productivity of enterprises in the same industry by 2.3% for 3 years.

The channels through which digitalization can improve the performance of enterprises are varied. For example, advanced data analytics can reveal hidden patterns and optimize the selection of suppliers, as well as conduct more productive negotiations with them and reduce logistics costs; enterprise resource planning software permit to manage reserves just-in-time and reduce warehouse costs; manufacturing plants can improve the quality of their products at a lower cost by using automation, RFID sensors, and predictive algorithms in quality control, a highly labour-intensive aspect of manufacturing operations. When it comes to marketing and sales, businesses can leverage digital solutions to better understand customers by analyzing their online shopping behaviour, preferences and social media usage patterns, and then use the findings to create more effective marketing messages and increase sales.

Businesses operating in different countries and industries vary significantly in their use of digital technologies. For example, businesses in sectors such as agriculture and real estate consistently demonstrate lower rates of digital adoption than businesses in telecommunications and IT services, reducing the overall impact of digital technology on overall productivity [4,13].

The average picture hides a widening gap in productivity between "leading" and "lagging" enterprises. While a small proportion of high-performing enterprises show significant productivity growth, most enterprises' productivity growth remains stagnant, a trend that is particularly pronounced in sectors used digital technology intensively. Digitalization apparently

contributed to this trend, as the most productive businesses are also more likely to adopt new technologies and take advantage of them.

4. Digital technologies in project management

Digital technologies are characterized by a high complementarity of capabilities and assets of enterprises (for example, technical and managerial skills, and financial capabilities), facilitating the effective redistribution of resources within an industry and between different industries. Disadvantages or delays associated with these complementary factors could slow the diffusion of digital technologies and delay related productivity growth.

Project management is a management activity whose ultimate goal is to achieve a sustainable economic position, affecting all organization staff and all functional areas to achieve the company's goals.

Project management provides increasing the efficiency of resource use, complying with and reducing project implementation deadlines, it helps to ensure the achievement of planned results, with transparency, validity and timeliness of decisions made, and increase the level of interaction of all participants in the process.

Digital transformation has brought significant changes to the project management process. Firstly, digital tools allowed project team members to exchange views asynchronously, which increased the speed of communication, efficiency and productivity of managers [5]. Secondly, the role of project managers has changed; there is no rigid hierarchy; with the help of digital methodologies, flexible project management is being introduced, which makes it possible to create self-organizing project management. Thirdly, with the advent of digital transformation, the time frame for project management has changed; project managers pay more attention to strategic tasks than to processing work. The fourth point concerns the digitization of work processes, which helps to obtain additional data that is necessary to control and quantify the work performed. And fifthly, project teams have become more decentralized, digital platforms have made it possible to introduce a remote work format, which is especially important in conditions of territorial remoteness.

The introduction of computer technologies makes it possible to quickly develop and implement projects, which has made it possible to use flexible approaches to a greater extent. They also influenced the development of artificial intelligence, which significantly increased the productivity of computing operations without human intervention. However, with such efficiency and effectiveness of the use of digital technologies, one should not forget about information security. Now it is necessary to create a digital infrastructure to protect the personal data of citizens, businesses and authorities.

It is necessary to create a favourable legal regime, and special normative regulation, for the use of digital technologies in the economic activities of business entities, so that on their basis it would be possible to carry out project management using modern technologies and introduce them into the country's economy. It is necessary to develop research competencies and technological groundwork, which must be entrusted to universities and research organizations.

As a result, a new ecosystem would be ready to provide the building of end-to-end projects in the field of the digital economy with high commercialization potential.

Digital transformation has launched a new approach to project management, and its benefits can be highlighted. Thus, in the process of digitalization in the field of project management, more effective strategic interaction between organizations can be formed due to the formation of network interaction, digital platforms will allow real-time interaction and communication, which increases the productivity and efficiency of interaction between project team members, while interaction within the project team leads to a greater responsibility among team members and helps create an environment conducive to collaboration and creativity.

Digitalization of project management makes it possible to integrate companies from various sectors of the national economy; project managers become strategic leaders. Since digital

transformation helps managers to apply modern technologies in data analysis, and make decisions quickly, easily and effectively, the effectiveness of projects increases accordingly.

5. Transformation of the enterprise IT structure during digital transformation

Support for the IT management model is provided by the enterprise IT infrastructure, which includes many elements: activity models, technical and communication tools, databases, information exchange models, application solutions, information services systems, data management and protection tools, etc. This is a platform without which a business will not be able to function effectively in the digital world. The success of the business depends on how effectively the information support processes within the company and how external communications with clients and suppliers are structured. It is on the creation, management and formation of a development strategy for an IT structure that corresponds to the business strategy that the main attention is directed during the digital transformation of an enterprise, and therefore it is necessary to know its current state. The IT structure is based on modern information and communication technologies, digital platforms, network solutions, etc. and ensures the efficient functioning of a variety of IT solutions that support the business. This is a very complex system that must be organized, regulated, properly operated and protected at all stages of its life cycle. The creation, maintenance and operation of such a complex infrastructure require not only serious costs but also a lot of preparatory and ongoing work, including the introduction of quality management standards and best practices, the development of an IT structure development strategy and the implementation of engineering and technical activities aimed at its changes, as well as constant monitoring and control of its condition and assessment of the effectiveness of service support for the business model. The task of assessing the current state of the IT structure and making forecasts for its implementation is called the task of information monitoring, and periodic monitoring and analysis of the state of individual elements is called information audit. The most difficult area in the monitoring and audit system is the IT architecture and its compliance with the goals and current tasks of the enterprise.

Careful documentation of the IT architecture to some extent facilitates the monitoring process but does not completely solve the problem of assessing its current compliance with the business architecture. Modern methods of monitoring and auditing elements of corporate IT architecture are based on a number of standards, approaches, concepts, methodologies, best practices and tools, the use of which allows for constant monitoring and analysis of its condition. An audit of each element of the IT architecture during monitoring requires unique techniques and tools. In the process of establishing an IT structure, information resources are threatened with distortion for various reasons. For each component of the IT structure, there are many informational and operational risks and threats that must be taken into account when building a system for protecting corporate information. These risks and threats can be effectively managed only by building an information security system that covers all components. It gives the possibility to highlight security as an independent element of the IT structure. If the IT structure is considered as a platform for digital transformation, then most of the listed problems have been solved to some degree. Taking into account the development strategy for the enterprise's business model created as a result of the analysis, it is also necessary to formulate a strategy for the development of the IT structure. However, before starting digital transformation, it is necessary to assess the existing capabilities and state of the IT structure, analyze its compliance with current business needs and evaluate the possibilities of its implementation in accordance with the developed strategy. This becomes the most important problem when preparing for the implementation of enterprise digital transformation projects.

There are such critical areas in the information service system as reliability and performance of the technological architecture, compliance of the information systems architecture with business goals and objectives, and also high-quality protection of corporate data from external and internal threats [6]. These are the most important areas of enterprise digital transformation.

That are these elements of the IT structure that primarily face constant monitoring and periodic audits, since failures or inoperability in this part of the architecture lead to either a decrease in the quality of services or the impossibility of providing them to the business. The main goal of an IT structure audit is to assess its compliance with the requirements for changes in business architecture in terms of ensuring full support for the system of business processes in accordance with the regulations for their implementation, and the availability of the necessary application solutions and data.

To achieve the goals of digital transformation, it is often not enough to create and change your own IT structure, which ensures internal management and interaction with the outside world; it's necessary to change the processes of partners, suppliers and consumers. So, an integrated approach is required for the use of information technology in all processes of the company, not only internally, but also in interaction with the outside world, customers, partners and the state. The development of information infrastructure, as well as the reliability and safety of the functioning of all its elements, largely guarantees the efficiency of information processes in the management system and ensures the success of enterprise digital transformation projects.

Analysis of the IT structure in the process of digital transformation often reveals new business opportunities that arise as a result of the rapid development of IT [15], proposing new business models based on the use of data analytics and new network technologies. Throughout the implementation of digital transformation projects, the organization of an information monitoring and audit system of the IT structure will be the most important condition for ensuring business continuity and an important element of the information security policy. Systematic monitoring of the state of objects, phenomena, processes and incidents in all elements of the IT structure in order to assess their condition, ensures control, forecasting and the formation of decisions on the necessary impacts. Activities of information monitoring and audit of corporate IT architecture are possible only on the basis of a clearly organized and regulated information management system at the enterprise.

Information management is the most important part of the enterprise management system, ensuring the achievement of the organization's goals in its core activities through the effective and coordinated management of all enterprise resources based on their information reflection. The main goal of information management is to ensure the effective development of an organization by regulating various types of its information activities [7,12]. To achieve these goals, any enterprise creates an information service, the main task of which is to reliably provide information services to users.

It is the enterprise information service that becomes the support in the implementation of any IT projects, including digital transformation projects. The activities of the information service must be subject to certain rules for the execution of work processes, and be strictly regulated and well organized. The conditions for access to information resources, the procedure for responding to user requests, interaction with service consumers, conditions for the provision of information services, actions in emergency situations, etc. must be clearly defined.

One of the most important tasks is also the management of a complex of technical resources, its maintenance and development. An analysis of the materials obtained during the monitoring of the activities of the information service will allow us to draw conclusions about the quality of information support of the business management system and outline directions for its improvement. The reliability and security of the functioning of all elements of the corporate IT structure largely guarantee the efficiency of information processes in the management system and ensure the success of enterprise digital transformation projects.

6. Conditional project model in the digital transformation of an enterprise

Currently, design organizations are actively implementing changes in digital infrastructure. An example is digital visualization tools, which are necessary at all stages of the project life cycle. They are concerned not only with the visual component of the final product (which is used

especially actively in agile approaches), but also help to visualize the connections between the structural divisions of the project organization, contractors, and outsourcers. Digital infrastructure is also represented by complex cloud solutions, this tool concerns the storage, and transmission of large amounts of data and its security.

In project management, there is also a redistribution of competencies. It mostly relates to the project manager and work package leaders. Knowledge of the subject area of the project, so-called hard skills, and digital technologies (artificial intelligence, robotization of business processes) are taken over. Competencies in the field of control and monitoring are also being replaced by new digital infrastructure tools, specialized frameworks, and built-in tasks in software. They help to save time on tracking the schedule, transferring information to responsible persons, forecasting risks, and much more. Thus, the main roles of the project manager such as coordinator, moderator, and leader come to the fore.
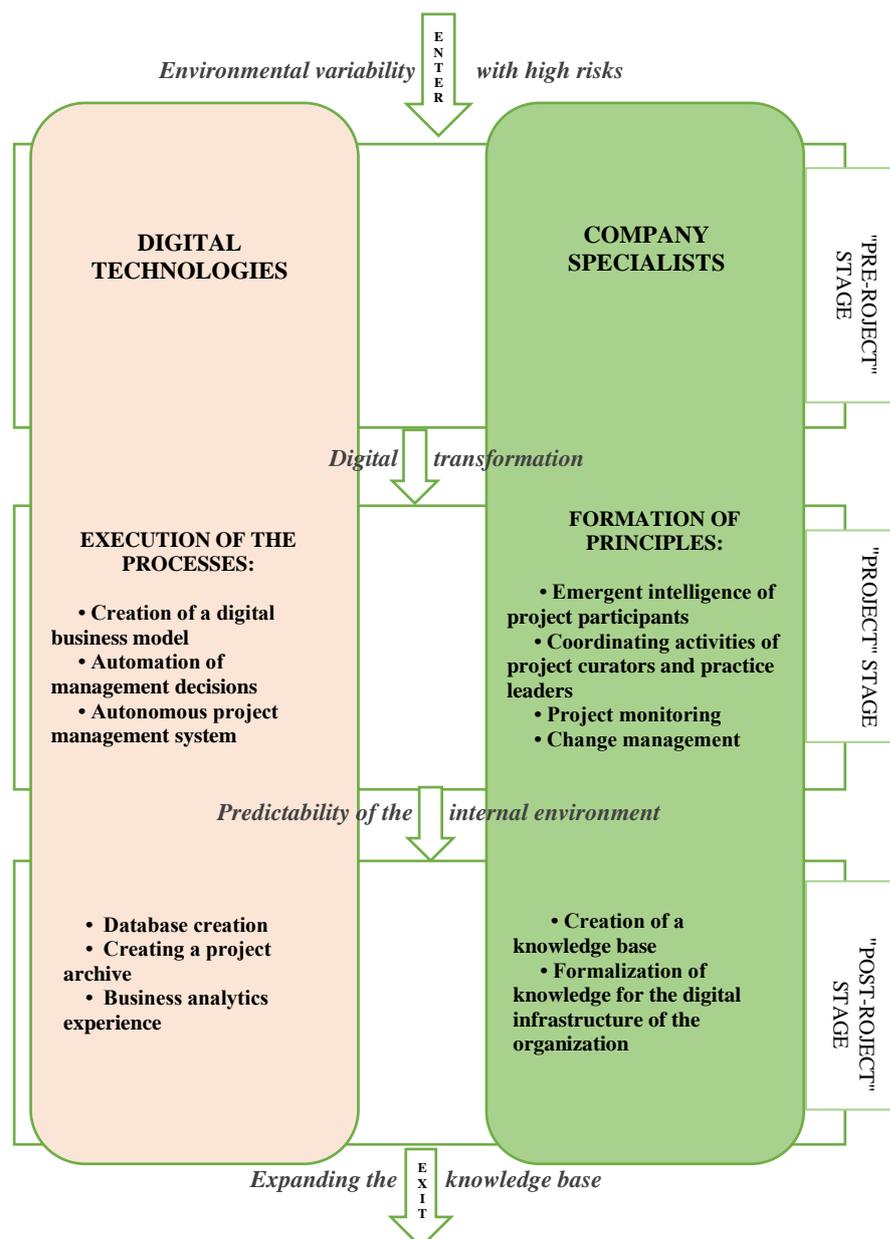
Figure 2: An example of an enterprise management model for digital transformation

Digital management in projects concerns not only organizational changes but also the transformation of the project itself [8]. The new generation of consumers is becoming selective

and demanding in meeting their personal expectations. With the use of digital management tools, the final product becomes more personalized. For example, big data analysis can be used to create innovative offers with unique properties, so the consumer can receive those product characteristics that are important to him. It is important to emphasize here that the introduction of digital management also works to decrease the cost of project development. Human resources are freed up and the time required to make changes to the project is reduced.

The use of digital management contributes not only to maintaining existing competitive advantages but also to acquiring new, high-tech ones.

During the digital transformation of an enterprise, there is a redistribution of functionality and a separation of the competencies of digital tools (technologies) and the competencies of the project manager and project team, i.e. implementation of digital management in the activities of the enterprise. A project management model in the context of digital transformation may look like this. This model is based on the division of competencies for digital technologies (managed subsystem) and for project stakeholders (control subsystem).

The model is presented in two planes: "digital resources" and "human resources" of the company (Figure 2).

Changes in mostly these resources will occur.

Within the framework of trends of project management development and updated international standards, the concept of a project is considered in a more meaningful form, with special attention paid to the pre-project and post-project stages [9].

The three main stages of project implementation are the pre-project stage (extended project initiation stage), the project stage, and the post-project stage (operation stage). Before the start of design work, it is assumed that the company is already using new digital technologies, and employees have the necessary skills to work with them. To increase the efficiency of project implementation within the building of a digital business model of a project organization, the following stages of transformation are performed: automation of making managerial decisions management; autonomous project management system.

The main vector for the development of digitalization at the project stage is the implementation of process activities. At the same time, the main priority for people will be the formation of work principles - interaction within the project team, communications with stakeholders and relationships with consumers.

Due to the shift in focus of activity and the potential liberation from routine, caused by processes, the competencies of the project manager also change. They are presented in the corresponding field. The process of forming principles of activity is characterized by the concept of "emergent intelligence". The term is interpreted as a certain state of project participants, in which they represent an integral system aimed at the successful implementation of the project, and possessing properties that its components did not previously possess. Obviously, in practice, these properties will relate to the area of solving intellectual problems in project management. Today this term is quite applicable to project teams, but its extension to all stakeholders of the project still encounters a number of barriers [14]. There must be a restructuring of collective behaviour so that customers, contractors, and sponsors are ready for changes in the project and are willing to sacrifice their personal interests in order to obtain high results and successful completion of the project. In other words, all participants must be willing to compose this system.

The post-project stage also seems to be more prolonged; it includes not only tracking the further life of the project (its operation, payback, and other indicators) but also processing information on the project and subsequent conclusions.

Digital resources are responsible for creating a database, creating a project archive and experience analytics. Previously, this functionality was performed by the project manager or the Competence Center. After completion of the project, the design organization receives a knowledge base, which today is the main value in the market. The principle of redistribution of competencies, a shifted focus on the ability to coordinate and integrate the project team by the manager, is supported by updated international project management standards.

Digital transformation has a significant impact not only on the technologies used, but also affects strategies, processes, customer relations, and interaction with employees. In this context,

the impact of digital transformation on project management is also non-negotiable. However, a fairly wide range of such impacts can be identified: from expanding the scope of project activities as a result of the implementation of transformation processes to changes in project management methodology, in particular, the role of flexible approaches is increasing. Digital technologies are radically changing the role and process of project implementation. Agility is not only becoming the preferred approach in software development, agile methods are becoming more commonplace, offering impetus for the hybridization of project management methodologies across organizations. In addition, digital transformation is causing changes in project management processes. Mobile hardware, cloud computing, or integrated software are typically used for data storage, automated information retrieval, and prototyping and simulation functions. In this area, communications in project teams and contacts with customers or recipients of the project product are changing, for example, thanks to cloud technologies. As a result of digitalization and access to large amounts of data, the decision-making process, its speed and quality are changing. IT systems and project management applications can significantly impact all of the above characteristics, allowing project managers to focus on goals rather than day-to-day operations, reducing planning and control time, reducing decision-making, providing better access to resources and the ability to reduce costs.

The impact of digital transformation on project management results is significant:

- improved productivity: digital tools allow you to automate routine tasks, optimize the use of resources and simplify management processes;
- more accurate planning and risk management: digital tools enable more accurate project planning, resource accounting, scheduling and budgeting;
- improved communication and collaboration: digital tools provide more effective and transparent interaction between project participants;
- improved control and monitoring: digital tools allow you to continuously track project progress, collect and analyze data on task completion, costs, resources and deadlines;
- improved analytics and data-driven decision-making: digital transformation allows to collect, analyze and interpret large volumes of data related to project management;
- enhanced quality management: digital tools enable better control and management of project quality.

7. Conclusion

The topic of digital transformation is relevant in all sectors of the economy, the public sector and private business. The effectiveness of introducing digital technologies into the process and project activities of companies has become obvious. Positive data on the use of new tools provide impetus for theoretical study and practical use. However, digital transformation is not happening everywhere. There are the following reasons: lack of understanding of the algorithm for disseminating digital technologies into an already established organizational system; unpreparedness of management for a global restructuring of business processes; lack of qualified personnel to configure software products and train staff; and employee resistance.

Thus, to eliminate the identified problems, it is necessary to develop methodological approaches to digital management, provide practical tools, and regulations for the gradual expansion of the presence of digital transformations in the company. Today this is the most important task not only for project management practitioners but also for the entire scientific community of the industry.

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