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ОГЛАВЛЕНИЕ

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APPLICATION OF DIGITAL TRANSFORMATION TECHNOLOGIES IN INCREASING THE SUSTAINABILITY OF THE ENTERPRISE
ПРИМЕНЕНИЕ ТЕХНОЛОГИЙ ЦИФРОВОЙ ТРАНСФОРМАЦИИ В ПОВЫШЕНИИ УСТОЙЧИВОСТИ ПРЕДПРИЯТИЯ

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Abstract. In the article, the application of digital transformation technologies in increasing the sustainability of the enterprise was considered. In the conditions of application of digital innovative technologies in all spheres of society, Artificial Intelligence, Internet of Things, etc. It has been shown that the development of the high technology sector is one of the important issues. In accordance with the conditions of the digital economy, the characteristics of increasing the stability of enterprises based on the digital platform have been determined. A conceptual development model of improving the sustainable information support of the enterprise based on the TOGAF standard was proposed. Many scientific research works on the mentioned problems have been analyzed and problems have been identified. A conceptual model of the formation of sustainable activity of the enterprise has been developed. With the application of digital transformation technologies, the conceptual model of increasing the stability and competitiveness of the enterprise was developed, and the directions for increasing its sustainable activity were determined. Features of the application of the best industrial digital technologies in the operation of their enterprises are given. The concept of the architecture of the information support system was developed, and the features of the development of the enterprise architecture concept were determined based on the TOGAF standard. Based on the TOGAF standard concept of enterprise architecture, the structural components and stages are given and the advantages of the TOGAF standard are explained. The directions for the development of the application of digital transformation technologies in the Industry 4.0 platform to increase the sustainability of the enterprise were determined and some recommendations were given to increase their level of development.

Аннотация. В статье рассмотрено применение технологий цифровой трансформации в повышении устойчивости предприятия. В условиях применения цифровых инновационных технологий во всех сферах жизни общества, искусственного интеллекта, Интернета вещей и др. Показано, что развитие сектора высоких технологий является одним из важных вопросов. В соответствии с

условиями цифровой экономики определены характеристики повышения устойчивости предприятий на базе цифровой платформы. Предложена концептуальная модель развития совершенствования устойчивого информационного обеспечения предприятия на основе стандарта TOGAF. Проанализированы многие научные исследования по указанным проблемам и выявлены проблемы. Разработана rонцептуальная модель формирования устойчивой деятельности предприятия. С применением технологий цифровой трансформации разработана концептуальная модель повышения устойчивости и конкурентоспособности предприятия, а также определены направления повышения его устойчивой деятельности. Приведены особенности применения лучших промышленных цифровых технологий в работе своих предприятий. Разработана концепция архитектуры системы информационного обеспечения и определены особенности разработки концепции архитектуры предприятия на основе стандарта TOGAF. На основе стандартной концепции архитектуры предприятия TOGAF приводятся структурные компоненты и этапы, а также объясняются преимущества стандарта TOGAF. Определены направления развития применения технологий цифровой трансформации в платформе Индустрии 4.0 для повышения устойчивости предприятий и даны некоторые рекомендации по повышению уровня их развития.

Keywords: digital transformation technologies, digital innovation, artificial intelligence, digital twin, enterprise architecture concept, TOGAF standard, Industry platform.

Ключевые слова: технологии цифровой трансформации, цифровые инновации, искусственный интеллект, цифровой двойник, концепция архитектуры предприятия, стандарт TOGAF, платформа Индустрия 4.0.

Introduction.

The application of digital innovative technologies in all areas of society is one of the main development trends of the advanced countries of the world. With the dynamic development of digital transformation technologies, the digital economy is forming and developing[1]. This makes further development of the high technology sector one of the important issues in the conditions of digital transformations [2]. The rapid development of the ICT infrastructure and the increasing potential of the ICT industry are key issues for the digitalization of the economy (https://president.az/articles/22382).For the effective operation of enterprises, the importance of improving regulatory mechanisms in the field of information technology development and forming a normal competitive environment is extremely important. Implementation of the mentioned problems is considered one of the main goals (https://president.az/articles/53407).Complex applications of artificial intelligence, the Internet of Things (IoT), 5G, robotization, Big Data, and cloud technologies in various fields, as well as in increasing the stability of the information support system of the innovative enterprise, are considered promising development directions. The development of digital technologies changes the approaches to it enterprise

management. The application of digital transformation technologies in increasing the stability of the enterprise and improving the quality of management decisions on its activity is currently gaining momentum. The development of modern enterprises in accordance with the conditions of the digital economy makes the issue of studying the problems of sustainable information provision and the formation of a dynamic development model based on a digital platform urgent [3].

In recent years, many countries have formulated production development strategies such as "Industry 4.0", "National Industrial Strategy 2030", "Europe 2020 Strategy", and "Advanced Manufacturing" of the United States, China 2025 [4].

Therefore, turning Smart production into the main direction of the Industrial Revolution and ensuring sustainable human development is considered one of the main issues. Special attention is paid to the fact that green development is one of the most important components of the concept of sustainable development. In this regard, it should be noted that for the development of information security systems of enterprises, directions for improving their innovative activities based on the technologies of the Industry 4.0 platform should be developed.

Many research works have been carried out on the considered problems. Conceptual approaches and various models were proposed in those studies. In [5] developed a conceptual model of the formation of competitiveness of high-tech enterprises in the context of digital transformation. The proposed model is based on the formation of a decentralized ecosystem model in a single distributed digital space based on the methodology of management, planning, monitoring, and change management. Using the DEMATEL approach, the competitive advantage criteria of science, technology parks, and incubators were analyzed, and the relationship between the competitive advantage criteria was studied [6]. The main factors affecting competitive advantage were implemented in the form of a DEMATEL questionnaire and compiled by experts. The results of the survey were modeled by means of a software package [7] considered an analytical approach to forecasting the competitiveness of industrial enterprises. Competitiveness based on the approach is based on energy, transport costs, market capacity of products produced by enterprises, etc. analyzed on the basis of several factors. The main goal here was to formulate an approach that allows taking into account the maximum possible number of factors. Another study is devoted to the analysis of indicators of sustainable development of small enterprises [8]. The sphere of small enterprises is characterized by rapid changes in revenue volume indicators, the transformation of new workplaces, large and medium-sized companies, etc. has such characteristics.

In order to effectively manage the activities of innovative enterprises, in the "Enterprise of the Future" Concept adopted by the European Union Commission (http://www.ec.europe.eu), as well as with the European Single Digital Market proposed by the European Union in the context of the Eastern Partnership (https://eufordigital. eu/discover-eu/eu-digital-single-market/) many recommendations on expanding links should also be taken into account. The process of development of the model for determining and increasing the efficiency level of the activity of innovative enterprises, the architectural-technological structure model of its effective information provision, the *The Open Group Architecture Framework (TOGAF)* [9] of

the general architecture concept of the enterprise, as well as the development of information provision "Innovation Management Evaluation" improvement based on ISO international standards is one of the urgent issues of the modern era [10]. In order to implement the solution to the indicated problems, many recommendations should be taken into account in terms of improving the information support system of enterprises' management activities based on the TOGAF standard. For this reason, the presented article focused on the importance of determining the prospects of applying digital transformation technologies in increasing the sustainability of the enterprise.

Formation of sustainable activity of the enterprise. As a result of the formation of the Global Information Society, the increase in the level of competitiveness has led to significant changes in the activities of production/service companies [5].Since the fourth industrial revolution, many past concepts have been reworked: business models, collaboration, user interfaces, value chains, and even the traditional automation pyramid have now undergone major changes. In order to remain competitive, enterprises must constantly improve the efficiency and performance of production processes. Increasing digitization, awareness, and global initiatives influence the high-tech industry to transition toward sustainable development. Digital transformation is one of the most important components of future product development. Minimizing the human factor in many production and logistics processes with the widespread use of data and digital models will have a positive impact on the quality of management decisions. Digital transformation of business processes and business models is a necessary stage in the development of the high-tech industry. Based on the development and application of digital platforms, the high-tech industry should become a digital industry. The development and implementation of digital twins, the implementation of the transition to cyber-physical systems, and the digital form of the interaction of enterprises create new tasks that require a quick, effective solution of a production and management nature [11]. Digital transformation is the application of modern digital technologies to the business processes of the enterprise at all levels. This approach involves not only the installation of modern hardware or software but also fundamental changes in management approaches. Digital transformation is fully expressed through the use of the potential of digital technologies in decision-making approaches [5].

The degree of application of digitalization elements in the enterprise is one of the main criteria for increasing its technological maturity level. One of the forms of implementation of the concept of Industry 4.0 envisages an intelligent production system formed by the adoption of new models, new forms, and new methodologies necessary to transform the structure of the traditional production system into an intelligent system. It includes the following categories: 1) intelligent design, 2) intelligent machines, 3) intelligent monitoring, 4) intelligent management, and 5) intelligent planning**.**

The concept of managing the development of high-tech enterprises in the context of digital transformation. The formation of management principles for the operation of a high-tech enterprise in the context of digital transformation based on Industry 4.0 technologies is an important stage in the creation of a methodology and management system in the relevant field. In order to study the methodological aspects

of process management, the main principles of the management and development of high-tech enterprises in the conditions of digital transformation were defined in the following directions [5].

General principles. The principle of a systematic approach implies that the planning and implementation of digital transformation processes should be systematic. The principle of sustainability, the principle of adaptive management, the principle of innovation and progress, the principle of openness and standardization. Organizational and economic principles: Mature digital environment, virtualization, prioritization and targeting, ecosystem management model, and principles of synergy effect.

Manufacturing and technological principles: Platform, design, intellectualization, big data analytics, and integration principles.

A conceptual model of improving the sustainability and competitiveness of the enterprise by applying digital transformation technologies can be proposed as shown in Figure 1.

The mechanism of implementation of the digital transformation strategy may consist of the following main components:

1) formulation and adoption of targeted programs to increase the level of digital maturity and efficiency of high-tech enterprises;

2) formation of a modern system of digital standards and technologies;

3) implementation of digital transformation projects, expansion of the experience of using modern digital technologies in the modernization and reconstruction of the main funds;

4) training and motivation of personnel in terms of digitization.

The digital transformation of the enterprise includes several directions. The following can be attributed to them [5]: 1)application of modern technologies and equipment or software to business processes; 2)formation of the offer of new digital or digital products and services; 3)fundamental changes in approaches to enterprise and personnel management; 4)transformation of means of interaction within the enterprise, relations between employees; 5)establishing external communications through digital communication channels, etc.

Directions for increasing the sustainable activity of enterprises in the conditions of digital transformation. It is necessary to pay attention to some indicators that characterize the innovation activity of enterprises in the digital economy [12]: 1)digital systems that make up the digital platform of the enterprise, 2)equipment and systems equipped with Internet of Things (IoT) sensors, 3)employees connected to a single enterprise system through mobile platforms, 4)technical personnel who can use augmented reality tools, 5)the enterprise level of robotization and digitalization, etc.The application of the best industrial digital technologies in the activity of industrial innovative enterprises is also a very important issue

(https://issek.hse.ru/news/494926896.html). In modern industrial enterprises, the latest digital technologies are rapidly applied (table 1).

Table 1. Application of the best industrial digital technologies in the activity of industrial innovation enterprises *(https://issek.hse.ru/news/494926896.html).*

Rating	Digital technologies	Significance index
1.	Industrial robots	1
2.	Artificial intelligence	0,86
3.	Machine learning	0,68
4.	Digital prototyping	0,56
5.	Sensors	0,42
6.	Wireless technologies	0,3
7.	Blockchain technologies	0,21
8.	Big Data	0,2
9.	Virtual and augmented reality	0,12
10.	Product as a service	0,09
11.	Computer (machine) vision	0,03
12.	Smart contracts	0,03
13.	Industrial Internet of Things	0,03
14.	Digital twins	0,02
15.	Smart factories and plants	0,01

The concept of the architecture of the enterprise's information support system. The concept of information support architecture describes the creation of opportunities for rapid decision-making and dissemination of information inside and outside the organization using information technologies. It can be said that information architecture is a mirror image or mirror image of business architecture. Business architecture addresses the question of who will do what, taking into account the shared vision, goals, and strategies, and information architecture, what information should be provided for the implementation of these processes by the executives? answers questions such as Information architecture includes models describing information processing processes, information value chains, main information objects related to business events, information flows, and information management principles [13].

In the process of developing the architectural-technological structure model of the information provision of enterprises, it is necessary to take into account the strategy of the enterprise's architecture as a basis. Enterprise architecture is a defined approach or method for analyzing, designing, planning, and implementing enterprise activities, using a consistent approach at all times for the successful development and execution of an appropriate strategy. Enterprise architecture applies architecture principles and practices to guide organizations through the technology changes needed to implement their business process and information strategies. These practices help identify, motivate, and achieve change using various aspects of the enterprise, understand the strategic intent of the business, and then drive better business performance in everything from business processes to supporting technology, partner relationships,

and infrastructure. Enterprise architecture [9, 14] is the organization of a system based on principles that govern the relationships of its components with each other and with the environment, and with their design and evolution (https://www.archimetric.com/what-is-togaf/).

Features of the development of the enterprise architecture concept based on The Open Group Architecture Framework. TOGAF standard, which is one of the main concepts of enterprise architecture, is 1)business architecture; 2)data architecture; 3)software architecture; 4)technological architecture, etc. consists of structural components such as [1, 9].

The TOGAF standard uses an iterative methodology to describe the stages of architectural transformation under the influence of internal and external factors. Based on the TOGAF standard approach, the stages of enterprise architecture are 1) Vision enterprise architecture; 2) Business architecture; 3) Information systems architecture; 4) Technology architecture; 5) Features and solutions; 6) Transition planning; 7) Application management; 8) Enterprise architecture change management, etc. can be entered. This technology Architecture Development Method (ADM) is called. Before starting the implementation of the iterative methodology, experts formulate the basic principles for the development of the enterprise architecture. In the "Enterprise Vision Architecture" stage, the architectural concept is developed and approved, and the main activities are planned for the transformation of the existing Enterprise Architecture into the target according to the developed vision. With the help of SWOT analysis, the differences between the "as is" and "to be" models are determined. Then, in the "Possibilities and solutions" stage, the convergence paths of the models are defined. In the Transition Planning phase, a detailed plan is developed for the transition to the new model. In the "execution management" stage, the compliance of the results of the project implementation with the transformation plans of the existing enterprise architecture is monitored. A similar problem is solved in the "Enterprise Architecture Change Management" phase: Changes to the Enterprise Architecture are coordinated and managed. At all these stages, the requirements are constantly managed, which allows for taking into account the interests of all interested parties [1].

The Open Group Architecture structure is based on four interrelated levels [9, 13, 14]: 1)Business architecture defines the organization's business strategy, management, organization, and core business processes. 2)Information architecture describes the organization's logical and physical information assets structure and related information management resources. 3)The architecture of applications provides frameworks of services to be presented as business functions for the integration of individual systems to be applied, the interaction between application systems, and their relations with the main business processes of the organization. 4)The technical or technology architecture describes the hardware, software, and network infrastructure needed to support the deployment of key, mission-critical applications. The Open Group Architecture Platform was developed by the Open Group based on the Technical Architecture Framework for Information Management and the Integration Architecture structure. As of 2016, the Open Group Architecture Platform is reported to be used by 80% of Global 50 companies and 60% of Fortune 500 companies.

The Open Group Architecture Framework has the following advantages [9, 14]: 1) It provides a comprehensive checklist of design deliverables; 2) Promotes better integration of work products if adopted within the enterprise; 3) It provides a detailed open standard for how design should be described.

Conclusion

In modern times, the application of digital innovative technologies in all areas of society is one of the main development trends of the advanced countries of the world. In the conditions of digital transformations, Artificial Intelligence, Internet of Things, Big Data, etc. the development of the high technologies sector is one of the urgent issues. Increasing the stability of enterprises in the digital platform environment, as well as developing a conceptual development model for improving its sustainable information provision based on modern digital platforms is of particular importance. For this reason, an analysis of the indicated problems, a determination of its prospective development directions, and an analysis of various works in this field have been attempted. The enterprise architecture concept should be developed based on the TOGAF standard of the enterprise's modern information security system. Based on the concept of TOGAF, ISO international standards of the enterprise, development directions should be determined and suggestions for its improvement should be developed. Proposals and recommendations of scientific and practical importance should be developed on the application of digital transformation technologies to increase the sustainability of the enterprise on the Industry 4.0 platform. In conclusion, it can be noted that the application of digital transformation technologies in increasing the sustainability of the enterprise, and its improvement on the Industry 4.0 platform can give a serious boost to increasing the sustainability of the digital economy, and create a basis for making appropriate management decisions for the application of digital technologies in the development of the economy.

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АНАЛИЗ ИНСТРУМЕНТОВ РАЗРАБОТКИ ПРОГРАММНЫХ ПРОДУКТОВ

ANALYSIS OF SOFTWARE DEVELOPMENT TOOLS

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Аннотация. В этой статье представлен всесторонний анализ инструментов разработки программного обеспечения, включая интегрированные среды разработки (IDE), системы контроля версий, системы отслеживания ошибок, инструменты тестирования и инструменты управления проектами. Мы оцениваем некоторые из наиболее популярных инструментов разработки программного обеспечения в каждой из этих категорий и обсуждаем их особенности, преимущества и недостатки. Цель этой статьи — предоставить разработчикам представление о различных инструментах разработки программного обеспечения и помочь им принимать обоснованные решения при