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SOME ASPECTS OF ROBOTIZATION OF THE ECONOMY AND CREATION OF A ROBOT MANAGER

Digital Kazakhstan programs are aimed at accelerating the pace of economic development of the Republic of Kazakhstan and improving the quality of life of the population through the use of digital technologies. The article is devoted to one of the most important areas of digitalization of the economy – the creation of robotic systems for managing the activities of firms, organizations and companies. Currently, robotics and robotic means are being introduced into various spheres of human activity and, in particular, in the economy. The most effective robotization can be used in control systems of manufacturing enterprises, firms, organizations through the use of robot-managers. The article describes the functions and tasks performed by robot managers that ensure the adaptation of firms to digital transformation, characterized by the use of broadband Internet, cloud services, RFID technologies, ERP systems, as well as the involvement of firms and companies in e-commerce. The structure and functional characteristics of robotic managers designed to control production processes are presented.The main structural elements included in the structure of robot managers are considered. The use of robot managers to manage the activities of firms and companies will help to improve the quality of management functions, improve management efficiency, which will lead to an increase in the return of investments, competitiveness and profitability of these enterprises. The robotization of our economy can become a locomotive for the overall economic growth of Kazakhstan in the near future.

Key words: economy, digitalization, management, digital technologies, robotic systems, robot managers.

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Экономикалық роботизация және робот-менеджерін құрудың кейбір аспектілері

Цифрлық Қазақстан бағдарламасы цифрлы технологияларды қолдану арқылы Қазақстан Республикасы экономикасының дамуын жеделдетуге және халықтың өмір сүру сапасын жақсартуға бағытталған. Мақала экономиканы цифрландырудың маңызды бағыттарының бірі – фирмалар, ұйымдар мен компаниялардың қызметін басқарудың роботтандырылған жүйелерін құруға арналған. Қазіргі уақытта робототехника мен робототехника адам қызметінің әр түрлі салаларына, атап айтқанда, экономикаға енгізілуде. Ең тиімді роботтандыруды робот-менеджерлерді қолдану арқылы өндірістік кәсіпорындардың, фирмалардың, ұйымдардың басқару жүйелерінде қолдануға болады. Мақалада фирмалардың цифрлық трансформацияға бейімделуін қамтамасыз ететін робот-менеджерлер орындайтын функциялары мен міндеттері сипатталады, кең жолақты интернетті, бұлтты қызметтерді, RFID технологияларын және ERP жүйелерін қолданумен, сондай-ақ фирмалар мен компанияларды электронды байланысқа қосумен сипатталады. Өндірістік процестерді басқаруға арналған робот-менеджерлерінің құрылымы мен функционалдық сипаттамалары келтірілген. Робот-менеджерлерді құрайтын негізгі құрылымдық элементтер қарастырылады. Фирмалар мен компаниялардың қызметін басқару үшін робот-менеджерлерді пайдалану менеджмент функциясының сапасын жақсартуға, басқарудың тиімділігін арттыруға көмектеседі, бұл инвестициялардың қайтарымдылығының, осы кәсіпорындардың бәсекеге қабілеттілігі мен рентабельділігінің артуына әкеледі. Біздің

экономикамызды роботтандыру жақын болашақта Қазақстанның жалпы экономикалық өсуінің локомотивіне айналуы мүмкін.

Түйін сөздер: экономика, цифрландыру, менеджмент, сандық технологиялар, роботтанды-рылған жүйелер, роботтандырылған менеджерлер.

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Некоторые аспекты роботизации экономики и создание робот-менеджера

Программа «Цифровой Казахстан» нацелена на ускорение темпов развития экономики Республики Казахстан и улучшение качества жизни населения за счет использования цифровых технологий. Статья посвящена одному из важнейших направлений цифровизации экономики – созданию роботизированных систем управления деятельностью фирм, организаций и компаний. В настоящее время робототехника и робототехнические средства внедряются в различные сферы человеческой деятельности и, в частности, в экономике. Наиболее эффективно роботизация может использоваться в системах управления производственными предприятиями, фирмами, организациями посредством применения роботов-менеджеров. В статье описаны функции и задачи, выполняемые роботами-менеджерами, которые обеспечивают адаптацию фирм к цифровой трансформации, характеризующейся использованием широкополосного Интернета, облачных сервисов, технологий RFID, ERP-систем, а также вовлечением фирм и компаний в электронную коммерция. Приводится структура и функциональные характеристики роботов-менеджеров, предназначенных для управления производственными процессами. Рассмотрены основные структурные элементы, входящие в состав роботов-менеджеров. Использование роботов-менеджеров для управления деятельностью фирм и компаний поможет улучшить качество управленческих функций, повысить эффективность управления, что приведет к увеличению возврата инвестиций, конкурентоспособности и прибыльности этих предприятий. Роботизация нашей экономики может стать локомотивом для общего экономического роста Казахстана в ближайшей перспективе.

Ключевые слова: экономика, цифровизация, менеджмент, цифровые технологии, робототехнические системы, роботы-менеджеры.

Introduction

By the Decree of the Government of the Republic of Kazakhstan dated 12th December 2017, the State Program "Digital Kazakhstan" was adopted. The goals of the Digital Kazakhstan program are to accelerate the development of the economy of the Republic of Kazakhstan and improve the quality of life of the population through the use of digital technologies in the medium term, as well as to create conditions for the transition of the economy of Kazakhstan to a fundamentally new development trajectory, ensuring the creation of the digital economy of the future in the long term. The country's economy is becoming more and more digitized. In 2018, the share of organizations using computers increased from 70.7% to 77.7%. Meanwhile, the share of organizations with Internet access increased from 67.7% in 2017 to 75.1% in 2018, and the share of organizations with Internet resources – from 21.7% to 22.3%.

Today, the digitalization of the economy in Kazakhstan is not an obstacle, but a real step to make a qualitative breakthrough in development, which will allow the republic to take a leading position in the world arena. This requires a set of measures and systematic work in the following main areas:

- "Digitalization of economic sectors";
- "Transition to a digital governance";
- "Implementation of the digital Silk Road";
- "Development of human capital";
- "Creation of an innovative ecosystem".

Digitalization can become the driver of the national economy and the generator of sustainable jobs. Digitalization will drive the development and adaptation of new technologies in the economy of Kazakhstan, which will launch a new wave of job creation. Already in 2019, in order to implement the state program "Digital Kazakhstan" saw the creation of 8 thousand jobs. One of the most important areas of digitalization of the economy – the creation of

robotic systems for managing the activities of firms, organizations and companies.

The object of the research is the models of activity in the sphere of business and social sphere caused by the emergence of new generation digital technologies and robotic means for management purposes.

Robotics is one of the core technologies of the 4th Industrial Revolution. It is an essential and integral automation element in most manufacturing industries (Cho and Kim, 2018: 45). These industries include the automotive industry and the growing semiconductor industry. In 2003-2010, the annual demand for industrial robots in manufacturing industries increased from 81,000 units to 121,000 units. At the same time, the world gradual documented growth rate was 6%. There was a robotics boom until 2015, with an annual growth rate of 16%. Modern robots are very capable in terms of reliability, accuracy, speed and power (Ishitani, 1989: 76). In the future, existing robots can be used without any improvements in their capabilities in the areas that require performing simple tasks and high processing speed, including tasks beyond human abilities, for example, hard work or high-precision work in dangerous environment

The increasing role of robots in the economy is called robonomics. Its spread can lead to a global redistribution of the labor market, the transfer of manufacturing enterprises to places of consumption, and the emergence of unconditional income. The emergence of robonomics will have a huge impact on the economic system. While most of the core principles will still apply, some will require a global transformation. In particular, scientists expect an increase in the level of production automation, which is a fundamental principle of robonomics.

Most of the products and services will be produced by robots and artificial intelligence. Human labor will be used mainly to oversee the process without personal involvement. Production facilities will move closer to consumers, which will allow creating products and services of very high quality, as well as optimizing logistics.

Most people will lose their jobs, but the number of knowledge-intensive professions to support robots and artificial intelligence will increase. This will lead to the fact that employment will no longer be the main source of income for people. National governments will provide citizens with a universal basic income. Pay will no longer be a competitive advantage, while knowledge and creativity will come to the fore in employment.

Literature Review

The development of the digital economy is one of the priority areas for many countries, including the economic leaders: USA, United Kingdom, Germany, Japan, etc. (Military Review, 2019). More than 15 countries of the world are currently implementing national digitalization programs. The leading countries in digitalizing their national economies are China, Singapore, New Zealand, South Korea and Denmark. China in its Internet Plus program is integrating digital industries with traditional ones. Canada is creating an ICT hub in Toronto. Singapore is forming a Smart Economy driven by ICT. South Korea in the Creative Economy program focuses on the development of human capital, entrepreneurship and the dissemination of ICT achievements, and Denmark focuses on the digitalization of the public sector (Abroskin, 2018: 62).

The country evaluates projects submitted for the competition and selects the winner based on the results of the pilot project competition. The conqueror, as a rule, does not receive direct government subsidies, but receives the opportunity to implement your project. The government provides support in the field of the regulatory framework, synchronization and cooperation with regional authorities, as well as the creation of incentives for "digitalized" industries. It is also possible to choose a consortium of conquerores, which allows to reduce the risks during implementation, at the same time, maintaining competition between 3-4 participants. Singapore is a good example of digitalization of the economy. In 2014, the government initiated the development of the Smart Nation program and called on business structures to cooperate to refine and implement it. Smart Nation is a government initiative to improve the quality of life by introducing digitalization into the everyday life of citizens. The state formed an initial request for solving a number of tasks, which were identified as paramount for launching major initiatives within the Smart Nation.

In South Korea, with the active position of the government, large companies are independently investing in breakthrough digital technologies. Thus, one of the largest telecom operators in the country SKT, has indicated its intention to invest more than 4 billion US dollars in artificial intelligence (AI) and Internet of Things technologies. The operator notes the need for partnerships in the development of new technologies, and plans to attract local startups to develop main solutions (https://creativeconomy.ru/lib/39963). Robots And Computers Could Take Half Our Jobs Within the Next 20 Years" "Robots

Could Put Humans Out of Work by 2045" "White House Predicts Robots May Take Over Many Jobs That Pay $20 Per Hour" "Robot Serves Up 360 Hamburgers Per Hour" "Why the Highest-Paid Doctors Are the Most Vulnerable to Automation", "Robot Receptionist in Tokyo Department Store" (Freeman, 2016: 65). These headlines have the flavor of yellow journalism. But they are based on the predictions of researchers across many disciplines and on technological advances developed by firms large and small. The "half our jobs" figure comes from Oxford social scientists. The "out of work by 2045" prediction comes from a prominent computer scientist. Reports of machines competing with humans in hamburger flipping, highly paid medical work, and administrative tasks are the tip of the iceberg: robots may substitute for humans in virtually every domain. If computers can beat humans in Jeopardy, chess, and Go, it should be no surprise that they will soon be able to do many of our jobs as well as we can. But whether robotization will be good or bad for society isn't a foregone conclusion – it will depend crucially on how public policy and private firms respond.

Candidate of Economic Sciences Koleseiik I.V. notes that the development of robotics is a priority direction of the country's industrialization, not only in the near term, but also in the future perspective. Robotics can become a locomotive of the economic growth of our republic, given that the most developed countries are setting up robotic enterprises (Kolesnik, 2019: 49). In the work of A.V. Paraskevov and A.V. Levchenko (Paraskevov, 2014: 31) it is noted that one of the directions of the state policy to stimulate robotics can be the development of a specialized innovative infrastructure that ensures the launch of dozens of new projects in the field of robotics. The greatest application of robotics in the Russian economy occurs in the automotive industry. The use of robots has increased in metal and equipment industries where welding, cutting and coating operations are widely used. In addition, there are broad prospects for using robots in the food industry, where lately large companies have seriously taken up the robotization of their enterprises.

Currently, the government of our republic pays close attention to the problems of digitalization and robotization. "Digitalization and robotization is not a fashion trend, but a key instrument for achieving national competitiveness. Today it is the same basic need as roads and electricity" said the President of Kazakhstan, Kasym-Jomart Tokayev, speaking with a message to the people of Kazakhstan (Tokayev, 2018). By 2025, the government faces the task of bringing the number of large and medium-sized manufacturing enterprises that have introduced digital technologies to 200. As a result, a transition from the current level of technological development to the level of so-called smart production, that is, full automation and robotization, should be ensured – Tokayev noted.

Methodology

The research method in this work is based on the analysis of the functional capabilities of robotic tools used for the management of economic systems, the description of modern innovative technologies implemented by robotic managers.

In recent years, another transformation wave of activity models in businesses and social spheres has been unfolding in our republic, caused by the emergence of new generation digital technologies, which, due to the scale and depth of influence, received the name "end-to-end" – artificial intelligence, robotics, Internet of Things, wireless technologies and a number of others. One of the promising areas of development of the digital economy today is robotization, namely the creation of robotic systems used in the management of economic systems – firms, enterprises, business structures (Baimukhamedov, 2020: 95).

Even half a century ago, the world famous philosopher and economist Itshak Adizes argued that the head of a large company is not able to single-handedly ensure the successful development of a company without the participation of a close-knit team of like-minded people (Adizes, 2013: 96). Nowadays, such a team can be represented by a robotic system – a robotic manager that helps a leader to make management decisions that ensure the successful development of a company or enterprise.

The creation of such robots is a promising direction in the implementation of the Digital Kazakhstan program, based on the use of methods and means of artificial intelligence, neural network technologies, and expert systems.

The introduction of software robot-managers will ensure the use of modern innovative technologies:

1. Big data – technologies for collecting, processing and storing structured and unstructured information arrays, characterized by a significant size and fast rate of changes (including in real time), which requires special tools and methods of working with them.

2. Artificial intelligence is a system of software and/or hardware, capable of perceiving information with a high degree of accuracy, learning and making

decisions based on the analysis of large volumes of data that imitate human behavior (Baimukhamedov, 2019: 123).

3. Distributed ledger technologies (blockchain) – algorithms and protocols for decentralized storage and processing transactions, structured as a sequence of related blocks without the possibility of their subsequent change (Blockchain (world market)).

4. New production technologies – technologies for digitalization of production processes, providing improvement in the efficiency of resource use, design and manufacture of individualized objects, the cost of which is comparable to the cost of mass-produced goods.

5. Additive technologies – technologies of layer-by-layer creation three-dimensional objects based on their digital models ("copies"), allowing the manufacture of products of complex geometric shapes and profiles.

6. Computer engineering – is a technology for digital modeling and design of objects and production processes.

7. Wireless technologies – data transfer via a standard interface without using a network connection. 5G is the fifth generation of wireless technologies, which is characterized by high bandwidth (at least 10 Gbps), network reliability, security, low latency of data transmission (no more than one millisecond), as a result of which it is possible to effectively use big data.

The increasing role of robots in the economy is called robonomics. Its spread can lead to a global redistribution of the labor market, the transfer of manufacturing enterprises to places of consumption, and the emergence of unconditional income. The emergence of robonomics will have a huge impact on the economic system. While most of the core principles will still apply, some will require a global transformation (Akatkin, 2019: 3).

In particular, scientists expect an increase in the level of production automation, which is a fundamental principle of robonomics. Most of the products and services will be produced by robots and artificial intelligence. Human labor will be used mainly to oversee the process without personal involvement. Production facilities will move closer to consumers, which will allow creating products and services of very high quality, as well as optimizing logistics.

Unfortunately, robotization in our republic is not used at full capacity. While this is happening at the level of individual local projects, while in the West, robotic systems are widely used in production. For example, the company Adidas has opened a factory in Bavaria, almost fully automatic, which can quite easily make any model of footwear in a matter of days. Currently, robotics and robotic means are being introduced into various spheres of human activity and, in particular, in the economy. What makes robotization profitable for business? The main thing is the incredibly high productivity and readiness of modern technologies for almost complete automation of many routine processes. Most effectively robotization can be used in control systems of manufacturing enterprises, firms, institutions through the use of robot-managers.

Results and Discussion

The creation and implementation of software robot-managers in the economy will make it possible to implement the following management functions:
- planning and forecasting the activities of the enterprise;
- accounting for human, material, technical, financial, natural and other resources;
- overview of the implementation of managerial decisions, of the technological processes, processes of sales and marketing of products, over the fulfillment of contractual and other obligations, etc.;
- analysis of the main indicators in the implementation of the production programs of the company, input and output information related to the activities of the company, the current and planned state of the company;
- coordination of the activities of structural divisions of a firm, enterprise, company;
- optimal regulation of the financial, industrial, foreign, legal and social insurance activities of the company.

Within the framework of digitalization, in a robotic system, the following groups of tasks can be distinguished, implemented in the control system:
- tasks of collecting data about the control object and digital control of the production process (execution time – seconds, fractions of a second);
- extreme control tasks associated with the calculation of the required parameters of the controlled process and the required values of the tuning regulator, with the logical tasks of starting and stopping the units, etc. (execution time – seconds, minutes);
- tasks of optimization and adaptive control of production processes (reaction time – a few seconds);
- information tasks for administrative management, dispatching and coordination tasks on the scale of the shop, enterprise, planning, forecasting tasks, etc. (response time – hours).

When creating robotic managers, methods and models of automated control, methods and means of artificial intelligence, methods of fuzzy logic and neural network technology, as well as methods and models for optimizing the management of production processes are used.

The advantages of robotic control in comparison with traditional control will significantly increase the efficiency of management of firms, manufacturing enterprises, improve the economic performance of their activities, and increase their competitiveness.

The software robot-manager structure includes the following main blocks (Figure 1):

- block for inputting incoming information from structural divisions of an enterprise, organization;

- an analytical block that provides static and dynamic analysis of data coming from the block that is inputting incoming information from the structural units of the enterprise, from sensor equipment, video cameras and other devices for collecting data on the activities of the enterprise;

- block for solving optimization management problems based on the application of optimal control theory, methods and models of artificial intelligence, fuzzy logic and neural networks;

- block for development of options for management decisions and selection of the optimal solution;

- information and reference block, which provides the head of an enterprise or organization with the necessary information about the state of production and economic activity, about the progress of the production program, about the progress of product sales, etc.
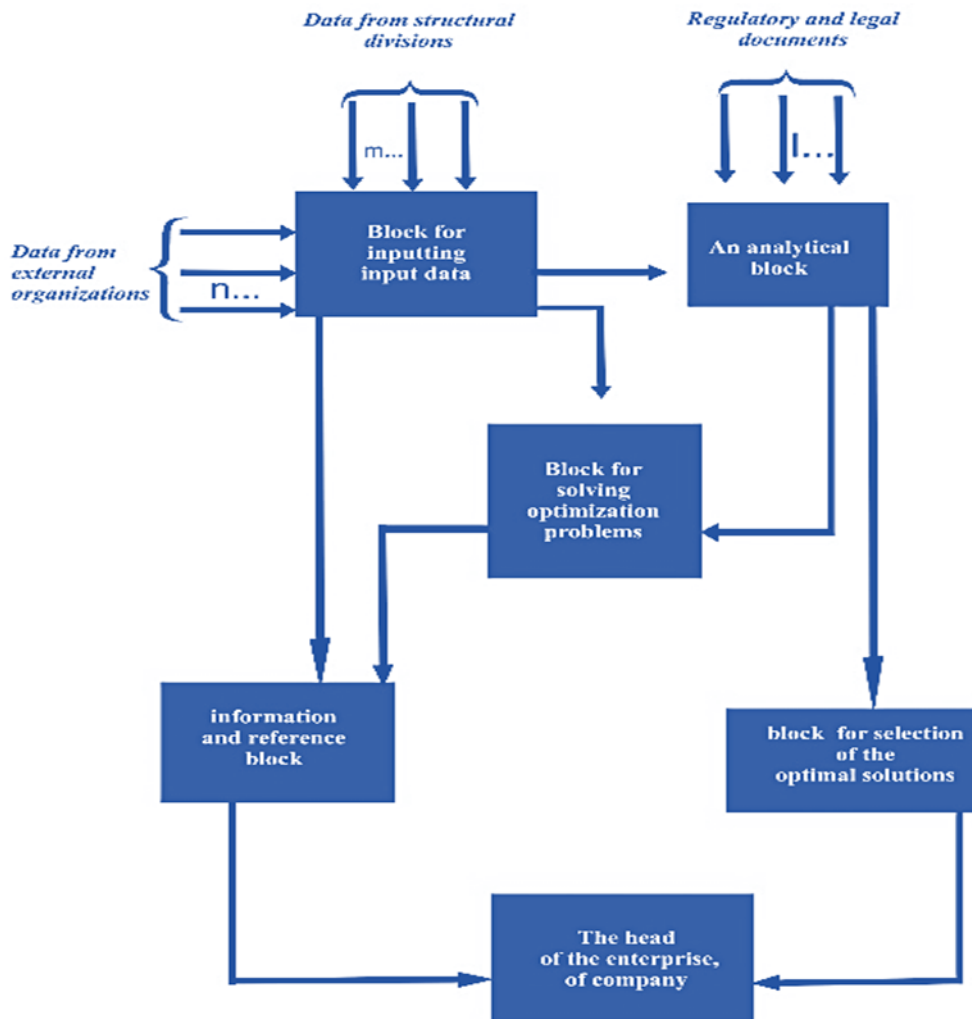

Figure 1 – Structure of the software robot-manager
Note – compiled by authors

The input block receives data that includes complete information about the production activities of all structural units of an enterprise or organization. This data is structured in a certain way, Submitted to the analytical block and information and reference block. The analytical block is provided with data that includes regulatory and legal materials, information about the state of the company's activities, the progress of sales of manufactured products, the fulfillment of contractual obligations, etc. Thein formation input block also receives data, including information about production relations with external organizations, international relations and cooperation, etc.

In the block of solving optimization problems based on the use of AI methods, neural networks, models and algorithms of optimal control, problems of optimal control of various production processes carried out by this enterprise will be solved. In the optimal solutions selection block, the optimal control solution is selected for a specific task, and the results obtained in this block are transmitted for use by the head of the company or company.

Conclusion

In conclusion, it should be noted that the software robot-managers used to manage firms, organizations and companies must ensure their adaptation to digital transformation, characterized by the use of broadband Internet, cloud services, RFID technologies, ERP systems, the inclusion of firms and companies in e-commerce, and also the optimal regulation of financial, industrial, foreign, legal and social insurance activities of the company. There are a lot of questionable arguments in the literature related to the current industrial transformation. Enthusiasts regard robotization as an advance that frees people from unsatisfactory work and poverty. The same phenomenon is viewed by skeptics as the ominous contributor to mass unemployment. They believe that the introduction of robotics is may lead to a greter divide between he haves and the have-nots. So far the actual and anticipated human, organizational and social impacts of robotization on the major industrial giants have been based mainly on the assumptions rather than empirical research (Hollon and Rogol, 1985: 78).

However, the use of software robot- managers in order to manage the activities of enterprises, firms and companies will help improve the quality of management functions, increase management efficiency, which will lead to an increase in the profitability, competitiveness and profitability of these enterprises. Robots are a key tool for increasing productivity and the living standard. Nowadays, robotics is the most widely implemented in the industry. There has been developed a wide range of robots, capable of more efficiently and consistently performing various operations previously done by humans (Fortunati, 2018: 2678). The development of technology expands the use of robotics in many other sectors, from agriculture to logistics and hotel business. Robots are becoming increasingly important for economic productivity and competitiveness. The level of robotics implementation is a crucial economic indicator, as it reflects the development and progress of the country. Many leading world economies have consolidated the provisions on the strategy of robotic innovation and the introduction of robots in their development strategies.

Expanding the range of robotic management functions will lead to a reduction in administrative and managerial personnel, an increase in productivity and an improvement in other economic indicators of the enterprise.

References

Cho J., Kim J. Identifying factors reinforcing robotization: interactive forces of employment, working hour and wage // Sustainability. – 2018. – vol. 10(2). – p. 490.

Ishitani H., Kaya Y. Robotization in Japanese manufacturing industries // Technological Forecasting and Social Change. – 1989. – vol. 35(2-3). – pp. 97-131.

Digitalization and robotization of industry: the threat of unemployment or the foundation of the economy of the future // Military Review. – 2019.

Abroskin A.S. International experience in measuring the digital economy // Bulletin of the University. – 2018. – №12. – pp. 59-66.

Аленина К.А., Грибанов Ю.И. Развитие механизма формирования компетентностного потенциала управления с использованием возможностей сетевизации и цифровизации социально-экономических систем // Креативная экономика. – 2019. – Том 13, Номер 3. https://creativeconomy.ru/lib/39963.

Freeman R.B. Who Owns the Robots Rules the World // Harward Magazine. – 2016.

Колесник И.В. Проблемы роботизации в современной экономике // Журнал «Инновации и инвестиции». – 2019. – №2. – С. 45-53.

Параскевов А.В., Левченко А.В. Современная робототехника в России: реалии и перспективы // Журнал Кубанского государственного аграрного университета. – 2014. – №5. – С. 28-34.

Послание главы государства Касым-Жомарта Токаева народу Казахстана https://www.akorda.kz/ru/addresses/addresses_of_president/poslanie-glavy-gosudarstva-kasym-zhomarta-tokaeva-narodu-kazahstana

Baimukhamedov M.F., Aitbenova A.A. Fundamentals of Robotics. – Kostanay: Master Reprint, 2020. – 189 p.

Adizes I. Managing change. – The Adizes Institute Publications, LLC "Western Agency", 2013. –286 p.

Baimukhamedov M.F. Artificial Intelligence: Fundamentals of Theory and Practice. – Kostanay: Master Reprint, 2019. – 278 p.

Blockchain (world market) // TAdviser: portal. – 2019

Akatkin Yu.M. Digital transformation of government: data centricity and model orientation // Information resources of Russia. – 2019. – No. 1. – pp. 2-7.

Hollon C.J., Rogol G.N. How robotization affects people // Business Horizons. – 1985. – vol. 28(3). – pp. 74-80.

Fortunati L. Robotization and the domestic sphere // New Media & Society. – 2018. – vol. 20(8). – pp. 2673-2690.

References

Abroskin A.S. (2018) International experience in measuring the digital economy. *Bulletin of the University*, vol. 12, pp. 59-66.

Adizes I. (2013) *Managing change*. The Adizes Institute Publications, LLC "Western Agency", 286 p.

Akatkin Yu.M. (2019) Digital transformation of government: data centricity and model orientation. *Information resources of Russia*, No. 1, pp. 2-7.

Alenina K.A., Gribanov Yu.I. (2019) Razvitiye mekhanizma formirovaniya kompetentnostnogo potentsiala upravleniya s ispol'zovaniyem vozmozhnostey setevizatsii i tsifrovizatsii sotsial'no-ekonomicheskikh sistem [Development of the mechanism for the formation of the competence potential of management using the possibilities of networkization and digitalization of socio-economic systems]. *Kreativnaya ekonomika*, vol. 13, No 3. https://creativeconomy.ru/lib/39963.

Baimukhamedov M.F. (2019) *Artificial Intelligence: Fundamentals of Theory and Practice*. Kostanay: Master Reprint, 278 p.

Baimukhamedov M.F., Aitbenova A.A. (2020) *Fundamentals of Robotics*. Kostanay: Master Reprint, 189 p.

Blockchain (world market) (2019) TAdviser: portal.

Cho J., Kim J. (2018) Identifying factors reinforcing robotization: interactive forces of employment, working hour and wage. *Sustainability*, vol. 10(2), p. 490.

Digitalization and robotization of industry: the threat of unemployment or the foundation of the economy of the future (2019) *Military Review*.

Fortunati L. (2018) Robotization and the domestic sphere. *New Media & Society*, vol. 20(8), pp. 2673-2690.

Freeman R.B. (2016) Who Owns the Robots Rules the World. *Harward Magazine*.

Hollon C.J., Rogol G.N. (1985) How robotization affects people. *Business Horizons*, vol. 28(3), pp. 74-80.

Ishitani H., Kaya Y. (1989) Robotization in Japanese manufacturing industries. *Technological Forecasting and Social Change*, vol. 35(2-3), pp. 97-131.

Kolesnik I.V. (2019) Problemy robotizacii v sovremennoj ekonomike [Problems of robotization in the modern economy]. *Zhurnal «Innovacii i investicii»*, №2, pp. 45-53.

Paraskevov A.V., Levchenko A.V. (2014) Sovremennaya robototekhnika v Rossii: realii i perspektivy [Modern robotics in Russia: realities and prospects]. *Zhurnal Kubanskogo gosudarstvennogo agrarnogo universiteta*, №5, pp. 28-34.

Poslanie glavy gosudarstva Kasym-Jomart Tokayeva narodu Kazahstana [Message from the head of state Kassym-Jomart Tokayev to the people of Kazakhstan]. https://www.akorda.kz/ru/addresses/addresses_of_president/poslanie-glavy-gosudarstva-kasym-zhomarta-tokaeva-narodu-kazahstana