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IMPLEMENTATION OF DIGITAL TECHNOLOGIES IN PERSONNEL MANAGEMENT SYSTEM OF ENTERPRISES OF ROCKET AND SPACE INDUSTRY

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ABSTRACT

The authors conducted a scientific study of the actual problem of assessing the economic efficiency of investment projects at high-tech industrial enterprises. In the process of organizational and economic analysis, the reconstruction of industrial enterprises of the aerospace complex and the most effective methods for justifying financial investments in the process of reproduction of all fixed assets were studied. A detailed justification has been carried out for the optimal choice of the most attractive investment projects for aviation and rocket and space enterprises, which are recommended to be included in the state investment program for the digitalization of the national economy. The author's classification of new criteria is proposed, depending on the numerous requests of all participants in investment construction in the process of reconstruction and technical re-equipment of industrial enterprises. The authors assign a special role to a detailed analysis of investment projects to reform advanced industrial enterprises that are actively introducing modern digital technologies in their work.

Keywords: Digital Economy, Digital Transformation, Enterprises Of Rocket And Space Industry, Human Resource Management.

1. INTRODUCTION

Digital economy is developing so rapidly that at the same time it is vigorously changing the accepted models of personnel management. It requires the management of companies to restructure all business processes in order to achieve the firm's competitiveness in the Russian and world markets. The intensive development of information and communication technologies actively affects all sectors of the economy and social activity, including manufacturing, healthcare, education, financial services, energy and transport. In the modern highly industrial society of the XXI century, a large-scale digital transformation of advanced enterprises is taking place under the influence of the advanced development of an integrated technological infrastructure and the active use of Big Data.

A wide range of digital services, products and systems are being deeply integrated into cyber-physical systems.

At the enterprises of rocket and space industry in Russia, "Industry 4.0" and "smart factory" as its

technological core are the drivers of digital development (Figure 1).

A new concept of large-scale social transformation, called "Society 5.0", first appeared in Japan in 2016. It is a "super-smart community" whose goal is global digitalization and digital transformation at all levels. The Japanese concept is a creative development of the well-known "Industry 4.0" program, which appeared in Germany as a kind of "smart business". This "project of the future" was defined by the German government as a part of the High-Tech Development Strategy to establish Germany as a world leader and supplier in the industry.

Internet of Things, artificial intelligence and analytics (Big Data) also play an important role in the development of the concept, but now we are talking not only about technologies in people's lives: concept describes problems that are relevant for others countries (population aging, natural disasters, environmental pollution, etc.).

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digital units and major global infrastructures have appeared.

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We consider how "digital transformation" differs from digitalization and how these concepts relate. Digitalization of business processes is the transition of companies to electronic platforms. Often, digitalization is equated with automation, which allows transferring part of the tasks from personnel to software solutions. However, automation is only the first stage of digitalization. Automation is the transfer of business processes to electronic systems for storing and exchanging data in its current form, as they work in a company. Digitalization is the next stage at which business processes are optimized with adaptation to the tools and technologies of digital economy. It is important to understand that as a result of digitalization, labor productivity increases, but the business model does not change (Figure 2).

The digitalization of production makes it possible to make all the processes of setting the strategic goals of the enterprise and assessing the quality of the main work relevant. The planned result of the digitalization of the organization is the accumulation of the necessary structured information, due to the automation of the main processes of activity. The next stage of business development after digitalization is its digital transformation, which provides for a fundamental change in the current business model and development strategy of the company.

Digital transformation is the process of changing existing business models with the help of new technologies. It goes beyond digitalization, creating new strategies to deliver even more value to customers and save the most valuable corporate resources: time and money. Businesses can leverage digital transformation to enter new markets, develop new products and attract new customers. It is the process of transitioning to digital business [1,2]. So, if digitalization means, first of all, a method of changing processes or objects to automated (digital) ones, then digital transformation is a process of reorganizing and adapting a business with a strategic aim to create an updated business model. This can be visualized as a change in the current form A to a new form B in the Figure 3.

Not all digital transformation processes are related to technology, many of them are cultural, changing the thinking of the team, goal setting and motivation. A large number of new professions and competencies have appeared in Roscosmos State Corporation, completely new project and unit management methodologies have been created, fully

The stage of digitalization at enterprises provides for the development of new modern technological processes. It ends at the final stage with the modernization of the entire production, after the introduction of innovations. A deeper meaning is in the new concept of "digital transformation of society". At this stage of the strategic development of the organization, a total coverage of virtually all areas of business is envisaged: production, technological. financial and economic. organizational and personnel. The large-scale modernization process involves the entire product line that the company produces, a variety of services and optimal management approaches. Along with the complex integration of innovative technologies, there is also a general change in the thinking of all personnel in the new conditions of the digital economy.

The goal of this transformation is to create updated, sustainable business model for the organization that can operate effectively and adapt to digital technology cycle. This process requires not only knowledge of technology, but also an understanding of the basic principles of building next-generation assets that can support and develop innovative business models [3,4].

The concept of "digital transformation" is the most complex term of all of them used in the digital economy. It is, literally, at the very top of the digital evolution of the development of society. For each individual company, digital transformation is presented in a different form. It is very difficult to give a single definition of digital transformation that can be applied to all participants. The authors emphasize that this is not only about the introduction of modern technologies into the business processes of a high-tech enterprise (installation of modern technological equipment or software), but about fundamentally new changes in the approach to enterprise management, its internal corporate culture and external relations. We believe that this guided process of organizational modernization is a strategic business adaptation to the new realities of the digital economy. As a result of digital transformation, the competitive stability of the entire enterprise, labor productivity and productivity of each employee increase. As additional options, we can point to increasing the level of customer satisfaction and strengthening the image and



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To assess the level of digitalization, experts used a scale of points from one to four. One point meant "HR on paper": in such companies, the processes are done manually. The maximum score was given to enterprises where modern tools are used to work with personnel: machine learning, predictive analytics, VR and AR for employee training. As it turned out, 55% of employees are forced to print and bring documents to HR department in person, 35% of companies operate without well-built processes and systems in HR analytics, and 60% of HR managers still use standard office applications for data analysis [5].

Compared to foreign companies, digitalization index of Russian companies is 1.84, and of foreign ones it is 2.08, which corresponds to the stage of fragmented automation. Only 9% of Russian companies meet the "mature automation" stage, 25% meet the "paper HR" stage. At the same time, in comparison with foreign companies, not a single Russian company matched the stage of "intelligent HR".

The study showed that the most advanced were companies with more than 10 000 people. These companies have the need and opportunities to implement digital HR transformation, while most small companies with up to 100 employees can do without HR and without automation at all.

In 2019 "Global Human Capital Trends" study was conducted by Deloitte, analysts cite the following data on HR digitalization in Russia:

- 73% of companies consider the trend for cloud solutions in HR as important one, 38% are already ready to work with them;
- 69% of Russian business representatives consider necessary to develop HR technologies;
- 50% of respondents are already actively using automation;
- 50% of respondents use manager and automation to search for candidates and process job applications;
- 46% of survey participants consider investments in the integration of HR technologies with cross-functional platforms as the highest priority for the company.

The previously proposed management mechanisms were organically adapted to the special specifics of the activities of enterprises

reputation of the company, which can be considered progressive and modern.

The main topic of the research is the use of digital technologies in the personnel management system at the enterprises of rocket and space industry. The relevance of the introduction of digital technologies in the management of high-tech organizations is increasing every year, with the constant growth of all technological progress. Electronic technologies are being actively introduced at the stage of design and production of modern aerospace equipment. To increase the competitive sustainability of the company, it is necessary to optimize all available resources and mainly human resources, because it is highly professional employees that are the main engine of progress. For the successful formation of a personnel management system, special technologies are being actively introduced at the enterprises of the State Corporation Roscosmos, designed to simplify the set of techniques and methods of influencing personnel in the process of hiring, using and developing in order to obtain the best economic results of labor activity.

The research task is to confirm the working hypothesis about the economic feasibility of introducing digital technologies into the personnel management system of the space industry enterprise. In the organizational and economic analysis, the results of previous studies were used, which show the clear benefits of introducing digital transformation elements into the enterprise management system.

According to the large-scale future of HR survey conducted by KPMG, more than 65% of respondents believe that HR functions have changed or are changing right now under the influence of digital transformation (2020). At the same time, 49% of HR leaders have invested in IT products for human capital management, and 32% in cloud solutions. In the next couple of years, respondents plan to increase investments in three areas of HR management development:

- 1. 60% to predictive analytics;
- 2. 53% in improved solutions from the field of process automation;
- 3. 47% in artificial intelligence.

A study on digitalization of HR in Russian business in 2019 was jointly conducted by Deloitte and SAP SE. Analysts surveyed more or less 500 people representing 434 companies in 14 industries.



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that produce unique space products that have no **3**. analogues in the world.

2. METHODOLOGY

The authors study and analyze the existing facts of using elements of digital economy in the personnel management of high-tech enterprises. The processes systematization of intensive development of information and communication technologies in modern organizations is carried out. To process the results, methods of the empirical level of comparison are used, when, based on the study of similarities and differences, a comparative analysis and comparison of various approaches to personnel management using elements of HR analytics is carried out.

A working hypothesis is considered that the basic technologies of digital economy are based on the global development of Internet and mobile communications. The results of the implementation of these processes in all economy sectors and social activity (including manufacturing, healthcare, education, financial services and transport), are being studied. The authors provide a theoretical proof of the position that the digital economy is a complex system of financial, economic, socio-social and cultural relations of the organization's personnel, based on the total use of modern digital information and communication technologies.

The development of the technological infrastructure of mechanical engineering enterprises, where the use of large databases has caused a largescale digital transformation of the entire society, is analyzed. The study predicts the intensive development of a new stage of digitalization of the economy, which is characterized by the global integration of the widest range of digital services, products and systems into the cyber-physical system.

The methods of analysis and synthesis are used to process large databases, the volumes of which will double every two years according to the forecast of Boston Consulting Group. Thanks to universal connectivity to the global network and the exchange of big data, there is an opportunity for more efficient use of resources, shared use of infrastructure and more complete capacity utilization. This "mutual aid economy" or "shared consumption economy" fundamentally changes the structure of the global economic system: possibilities of consumers, structure of industries and role of states.

3. RESULTS

The digital transformation of a high-tech enterprise is a large-scale transformation of all products and services, as well as the corporate culture of the organization, its development strategy, methods of working with personnel and clients and intra-organizational changes. We can imagine digital transformation as a revolutionary change in the entire organizational model of a company. People still stand at the center of a successful digital transformation strategy: there is no point in developing innovation for the sake of innovation. The term "digital transformation" is not entirely correct: it is people who transform organizations and drive business growth, and innovation gives them the opportunity to generate ideas, change the course of work and find new partners. An organization can adapt to its needs only those technologies that its employees understand, value and use, such a technological transformation that can unleash their human potential to the fullest. Modern technologies used at the enterprises of the State Space Corporation "Roscosmos" are only an important component of a diversified production and technical association. The main and defining part of the entire production system are, of course, the company's employees. For the core staff of an organization, digital transformation is a new way of looking at how employees work to effectively interact with their customers, actively using the use of modern information and computer technologies and big data analysis methods. This is a whole path to attract a set of opportunities and change a number of processes, functions, models and other things in order to strategically and prioritize all the changes and new opportunities of digital technologies taking place in the enterprise for their positive impact on a society as a whole.

In the very near future, the business will not really need large assets and labor reserves to support its life: on the contrary, the company of the future is mobile, rapidly growing and capable of quickly developing and launching products to the market with a flexible structure. It can be argued that HR structure of an enterprise plays one of the leading roles in digital transformation process, because knowing what resources are available to the business, where to get them and how to organize them for a specific task can become a key factor in competitiveness. The main task of HR in the process of business transformation is the creation of a new corporate culture and formation of new values, which are expressed in the competencies and

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personal qualities necessary for employees in the new business environment. To do this, HR leader must, first of all, transform himself, have a strategic vision, be an integrator of changes and find a way to help teams transform without losing the values and advantages of traditional business.

In the company's digital transformation are not new technologies, but new business models. The key to transformation is the emergence of new business models that reshape and create new digital markets and ecosystems. At the same time, specific leading companies are at the forefront of changes of this magnitude, introducing new technologies to achieve these goals. IT companies and start-ups are most actively implementing technologies in HR: they are generally open to new solutions, they understand the benefits they will receive, it is easier for them to start using technological products due to the peculiarities of the corporate culture. Through them, technologies become mainstream and introduce "deeper" in other areas.

We are talking not only about the widespread introduction of modern technologies into all business processes of high-tech enterprises (installation of modern equipment or software), but also about the most ambitious changes in management approaches to working with key personnel, as well as improving the internal corporate culture and strengthening the external relations of the organization. This is a strategic and controlled process of business adaptation in digital economy challenges, the resulting effect of which increases the productivity of each employee of Roscosmos State Corporation and the level of satisfaction of the customer representatives. At the same time, modern high-tech enterprises acquire the reputation of progressive and modern companies [6].

It can be considered that the digital transformation of an enterprise provides for the most profound transformation of all manufactured products and services, as well as improving the organizational structure, developing new development strategies, better customer service and a modern corporate culture. Digital transformation is a large-scale revolutionary change in the entire organizational model of an enterprise. Human resources are still at the center of a successful digital transformation strategy: there is no point in developing innovation for the sake of innovation. The term "digital transformation" is not entirely correct: it is people who transform organizations and drive business growth, and innovation gives them the opportunity to generate ideas, change the course of work and find new partners. An organization can adapt to its needs only those technologies that its employees understand, value and use, such a technological transformation that can unleash their human potential to the fullest. Electronic technology is only a part of a large mosaic, but its main connecting element is people. Digital transformation is a largescale rethinking of how employees work for their effective interaction with customers, through the use of modern technologies and big data analysis. This is a whole path towards attracting a set of opportunities and changing a number of processes, functions, models, etc., in order to use these changes and opportunities of digital technologies and their impact on society as a whole, in a strategic and priority way [7].

In the very near future, manufacturing enterprises will not really need large assets and big labor reserves to ensure their livelihoods. On the contrary, the modern enterprise of the future is mobile and fast-growing structure that can quickly develop and bring products to market, with a flexible management system. One of the leading roles in the process of digital transformation of an enterprise is played by the personnel management structure, because the knowledge of what resources are available to production, where to get them and how to organize for a specific task can become a key factor in competitiveness. The main task of HR services in the process of business transformation is the creation of a new corporate culture and formation of new values, which are expressed in the competencies and personal qualities necessary for employees in the new business environment. To do this, HR leader must, first of all, transform himself, have a strategic vision, be an integrator of changes and find a way to help teams transform without losing the values and advantages of traditional business [8].

Timely implementation of digital transformations in rocket and space industry is a strategic imperative for many developed countries, including Russia. Currently, there are no unambiguous leaders in the implementation of Industry 4.0 technologies, and the "pioneers" of the implementation of these technologies have the opportunity to gain an advantage over competitors due to the early start effect and even set standards for new generation industry solutions on a global scale. The aerospace industry is most adapted to the new digital phase of development, thanks to gradual structural transformations in the industry and in related areas.

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In Roskosmos State Corporations and Rostec, smart systems appear, concept of virtual design bureaus is used, when engineers from several design bureaus and production sites work on designing a model of an aircraft in a single digital environment. In the most technologically advanced branches of mechanical engineering, additive technologies are also successfully used, composite materials (ceramic and polymer) are produced, robots perform laser welding and perforation and apply thermal barrier coatings [9].

Digital economy is such a complex environment that will take many years to form and will require the involvement of the competencies of a huge number of highly professional specialists. Human resource management today is not just about moderating a secondary supporting business process. A deeply secondary approach to HR is leading to HR services becoming "kingdoms within a kingdom". This isolation creates conditions when HR service can stop prioritizing the interests of the business as a whole, living its own self-sufficient life. For example, a situation is widespread when HR specialists, limiting their area of responsibility by the speed and number of vacancies, force recruitment without worrying too much about the quality of their own work. As a result, not the best candidates are hired, but more or less suitable according to formal criteria. The question is the following: how useful is it for the business in general? The answer is obvious. To avoid this state of affairs, HR director must not only lead the division, but be a full-fledged business partner actively involved in the life of the business. Only a real interest in the success of the company will allow HR service to prioritize the interests and objectives of the business [10].

The results of this study showed that the issue of automating HR function, including the use of cloud solutions, is among the top 5 priorities for Russian companies.

Another study was conducted in the summer of 2019 by the international recruiting company Hays "IT technologies in the field of HR", in which more than 500 medium and large Russian and foreign companies took part. Its results are as follows: 78% of them have automated personnel records and administration, 41% have automated personnel recruitment and 20% are planning automation at the present time.

4. DISCUSSION

In the field of human resource management, a new trend is emerging associated with the emergence of HR analytics. Leading companies in aviation and space industry are actively transforming their strategic programs, quickly changing the main focus manufactured products from to modern technologies. In new conditions of digitalization of the economy, there is an urgent need to develop an organization's digital strategy, which provides for the dominance of the company's IT assets used in the overall portfolio of orders. A modern HR specialist in a digital organization must:

- constantly monitor the productivity of each employee of the enterprise;
- introduce advanced motivation mechanisms to increase income per employee;
- actively introduce innovative processes into practice, considering that innovations increase added value by more than 5 times compared to the growth of labor productivity [11].

In the world market, the speed of decision-making and the implementation of changes becomes the competitive advantage. The main best competitiveness will be for the enterprise that most quickly manages to catch the main trends in changing consumer preferences. In order for an organization to remain among the leaders, its leaders must actively engage in continuous training of their employees in new skills. The strongest positions in the modern world will be held by those companies that are constantly adapting to the actively changing conditions of the outside world, through the use of information and computer technologies. The main technological trends in the field of HR at the present time can be distinguished:

- 1. Digitalization of recruiting;
- 2. Automation of HR processes;
- 3. Analytics and Big Data as the basis of new HR management;
- 4. HR marketing;
- 5. Smart recruiting.

The rocket and space industry is the most modern, but rather conservative branch of engineering. The heads of all enterprises that are part of State Space Corporation "Roscosmos" are well aware that digital transformation opens up a lot of new opportunities and prospects, but they try to introduce such changes gradually and very carefully, because the responsibility and the cost of a mistake are too great.

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The technical solutions used in the latest aircraft, rockets and satellites always balance at the junction of a bold flight of creative engineering, the latest achievements of science, technology and unique experience. The reckless introduction of all new, untested methods and approaches into rocket science is categorically unacceptable, therefore State Space Corporation "Roscosmos" pays considerable attention to the consistent and comprehensive study of new technological approaches, the practice of their application in other industries where side effects of technology are possible not so critical when testing them in pilot tasks [10]. Only after full confidence in the effectiveness and safety of the applied new technology, it is brought to full-scale industrial implementation. The most promising digitalization technologies for leading enterprises in the rocket and space industry are currently:

- artificial intelligence technologies;
- analytics based on Big Data;
- semantic search with the meaning of large amounts of information;
- tasks of design, optimization, fabrication of structures using modern additive technologies and composite materials;
- creation of digital twins of aircraft for various purposes to solve the tasks;
- use of augmented and virtual reality in the design, production and maintenance of aviation and rocket and space technology;
- industrial Internet of Things;
- technologies of predictive analytics of failure states.

The main difference of the presented research work is the fact that earlier such studies have not been carried out due to the uniquely specific field of activity of the space industry enterprise. from previously published ones. A clear advantage is the very possibility of studying the control systems of an advanced enterprise that produces not massproduced products, but the most complex spacecraft, presented in a single form all over the world. Actually, analogues of such a sphere of production activity can be found in only a few countries of the world. As a disadvantage, in comparison with the known results, we can recognize the initial period of digital transformation, which requires further study and development.

5. CONCLUSIONS

Of course, digitalization of enterprises in rocket and space industry is a guarantee of their competitiveness and high efficiency, allowing them to expand sales markets, offer the market absolute know-how through technical innovations, save time and costs and focus on maintaining the highest quality standards. Active use of artificial intelligence in enterprises significantly helps in collecting, accumulating, analyzing and transmitting data in a unified format. The use of 3D programs makes it possible to halve the cycle of development work from design to launch into production, "paperless" drawings are quickly adapted and transferred to modern five-axis machines. Previously, these drawings had to be physically delivered hundreds or thousands of kilometers away, multiplied, and only then, based on them, the production technology for each of the thousands of parts and assemblies had to be adjusted. In addition, digital technologies give a significant effect at the stage of flight tests, replacing full-scale tests with digital modeling, including supercomputer using technology. Digital technologies at the enterprises of State Space Corporation "Roscosmos" make it possible to create state-of-the-art aircrafts, in which all the best achievements in science and technology are applied. It is important to note that the current level of technology development in the aviation and rocket and space industries does not allow for creating competitive products without large-scale design and production cooperation with active use of integrated IT systems [12].

In the personnel management system of a hightech enterprise based on digitalization, the following tasks can be solved:

- reduction of losses of working time of employees and increasing labor productivity;
- increasing the attractiveness of the employer;
- decreasing in staff turnover;
- reduction of administrative and management costs and optimization of the personnel structure.

The personnel department of the enterprise should face the following long-term tasks:

- improving the quality of HR services;
- reallocation of the time of HR specialists from routine operations to tasks that are more important for the development of the enterprise (talent management, development of the employer's brand, analytics, etc.);
- increasing the involvement and satisfaction of personnel;

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- reduction of personnel costs due to better quality expertise;
- optimization of the number of personnel services.

Currently, the digital economy has been named one of the priority areas of the "Strategy for the Scientific and Technological Development of the Russian Federation", approved by the Decree of the President of Russia. Full-scale digitalization of the entire Russian economy should become a powerful basis for quantitative and qualitative changes in its structure in the long-term period of development. The new era of modern digital technologies should change the consciousness of all employees of the organization. The digital transformation of competitive enterprises requires the search for new models of organization management, and the adaptation of existing management methods to new modern phenomena. The active introduction of robotics in enterprises leads to the fact that some human functions can now be most effectively performed by machines. However, no matter what priorities in approaches and technologies are used, the high human potential of the company is very important: it is the employees who are able to generate new knowledge and manage it. A significant increase in the role of intellectual capital is seriously changing the work of the company's management and HR departments: from functional managers to strategic business partners and customers [13].

The study showed the need for the introduction of modern digital technologies in the main processes of personnel management of enterprises in the aviation and rocket and space industries. Thanks to digital transformation, the management of the high-tech enterprise of the State Corporation Roscosmos has received the following competitive advantages:

- 1. Automating the search for candidates using artificial intelligence has reduced the burden on HR management.
- 2. New digital tools for conducting interviews with candidates have appeared, significantly speeding up the workflow.
- 3. Reduced by 18% the complexity of the recruiting function.
- 4. There was an acceleration in the adoption of managerial and personnel decisions.
- 5. The quality of analytical data sent to the management of the enterprise has improved.
- 6. Elements of strategic forecasting have appeared in the work of HR departments.

- 7. New technological solutions were formed.
- 8. Based on the results of HR-analytics, the optimization of the number of employees of the enterprise was carried out, which does not reduce the main production potential.
- 9. Personnel management system was organically integrated into the overall management system of the enterprise.
- 10. Automation of the adaptation system led to a decrease in staff turnover by 1.6%.
- 11. A new HR trend has been developed: personnel diversity.

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Converting Information becomes available in digital format

Figure 2: Features of "Digital transformation" concept

transformation New business applications are being created that integrate all

digitized data and applications



Figure 3: Business Reorganization Process For Digital Transformation