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ANALYSIS OF TECHNOLOGICAL INNOVATIONS IN THE INDUSTRY BASED ON INFORMATION TECHNOLOGIES

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In this article we analyze modern ICT technologies that are "breakthrough" for traditional industries in the issue of productivity and enterprise management.

The industry of information and communication technologies (ICT), or information technology (IT), is one of the fastest growing industry in the world economy. It is not the only instrument that actively promotes the economy to a higher level, but it is also a sector that has significantly changed the economic processes in large basic industries. This sphere continues to influence the formation of information of a new type based on the use of information and products of intellectual labour rights.

The achieved level of development of information technologies in the scientific and technical spheres can be assessed by comparing the position of Belarus with the indicators of other countries in the ICT Development Index (IDI), Table 1 [International Telecommunications Union, Measuring the Information Society Report 2015]. This index is used to track the development of local ICT structures in comparison with other countries, the performance of developed and developing countries in this area and to assess the potential of IT development [6].

Table 1 – ICT Development Index, 2015 (rank change from IDI 2010)

Economy	IDI		ICT Access		ICT Use		ICT Skills	
	Rank	Index	Rank	Index	Rank	Index	Rank	Index
Korea (Rep.)	1	8.93	9	9.00	4	8.42	2	9.82
Denmark	2	8.88	13	8.72	1	8.83	12	9.29
Iceland	3	8.86	2	9.37	8	8.11	10	9.35
United Kingdom	4	8.75	4	9.24	3	8.42	44	8.42
Sweden	5	8.67	10	8.90	6	8.32	24	8.91
United States	15	8.19	31	7.82	11	7.86	5	9.57
Estonia	20	8.05	28	7.86	14	7.66	15	9.22
Israel	35	7.19	25	7.98	42	5.57	26	8.86
Belarus	36	7.18	38	7.68	47	5.40	4	9.75
Latvia	37	7.16	49	7.23	32	6.29	30	8.76
Lithuania	40	7.08	54	7.04	34	6.10	17	9.13
Poland	44	6.91	51	7.15	41	5.62	20	9.02
Russian Federation	45	6.91	48	7.24	44	5.52	19	9.04
Ukraine	79	5.23	72	6.27	109	2.17	14	9.25

All this testifies to the relevance of the tasks of expanded reproduction of the scientific and technical potential and the optimization of the personnel structure based on the inflow of young specialists and scientists. It is important to ensure further activities in the "breakthrough" areas and to increase the influence of the scientific components in economic growth in the long term.

The development IT computing technic and digital telecommunications has a great impact on other areas of human activity. The basis for the practical application of new digital technologies are traditional industries and activities. The key importance in the integration of the digital environment has priorities of a "breakthrough" character, which form a new quality of the industrial basis of production processes. Such are the technologies of digital production, connecting information flows into a single system for its production, processing, storage and use.

The application of digital production is directed at obtaining complex solutions for the development of "smart production" and at the integration of information and communication technologies for infrastructure management.

The main world technological trends in the digital industry are [1]:

1) the introduction of smart sensors in equipment and production lines (industrial Internet based on the Internet of things);

2) mass introduction of robotic technologies;
3) information storage and computing on servers (cloud technologies);
4) integration of production and management processes into a single information system;
5) big data technology;
6) additive technologies, 3D-printing;
7) automation of services for the order and direct supply of stock (materials, components) to manufactories and finished products – to consumers;
8) application of unmanned technologies;
9) application of mobile technologies for control and management of production processes.

A brief description of these areas allows us to consider the prospects for introducing technological transformations into the national industry.

The Internet of things is networks array, consisting of objects that can cooperate with each other without human intervention, through an IP connection. The feature of the system lies in the stand-alone devices and their ability to transmit data independently. The use of industrial Internet implies the use of the Internet of things in a single industry to create an integrated solution that combines information processes with production [4].

Technologically, the industrial Internet of things includes the following components: devices and sensors that can record events, collect, analyze data and transmit them over the network; a network structure that combines different communication channels; platforms from IT providers, designed to manage devices and communications, applications and analytics; applications and analytical software, responsible for processing data, creating demonstration models and smart device management; storage systems and servers, capable of storing and processing large volumes of various types of information; IT services for creating solutions in the field of industrial Internet, requiring knowledge of the industry and specific business; security solutions that meet not only the information security of all components of the solution, but also the security of the operational process (Fig. 1).

With the development of the industrial Internet of things, it will be possible to increase labour productivity and optimize business processes by integrating IT systems and production systems, reliable data entry and the creation of end-to-end processes for collecting and analyzing information at all stages. The transition to the Internet of things can significantly affect the performance indicator by automating routine processes and reducing the impact of the human factor. The ability to get data from devices in real time allows you to control the execution of business processes and change them depending on the situation without the direct participation of a person.

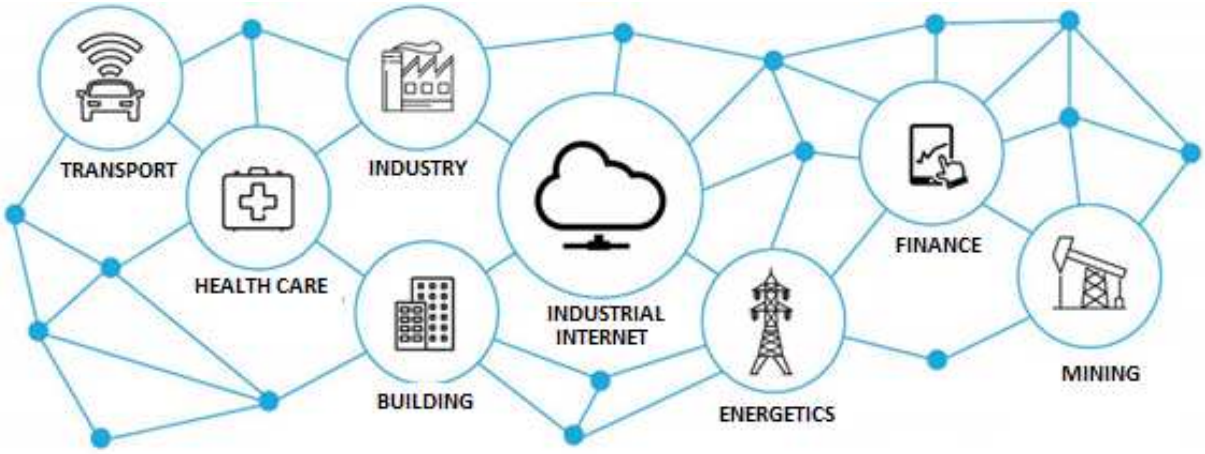

Fig. 1. Several basic options for implementing the Internet of things in the field of activity

Industrial robotization process helps to reduce the influence of the human factor and achieve the best quality and quantity of products due to the accuracy of work and resistance to external factors. Industrial robots are a very flexible tool that allows you to solve many complex and routine tasks such as sorting, packaging, welding, cutting, painting and other processes that require large labour and time costs.

A new trend in the introduction of robots into production are collaborative robots (cobots). Such robots are designed for use not in special fenced areas, as in the case of industrial robots, but in close cooperation with people.

Small advantages of industrial robotization:

1) Reduction of the number of working personnel.
2) Total growth in production and finished products.
3) There is no need to train the working personnel.
4) Utilization of industrial robots in harmful areas of production.
5) Reduction of materials due to high precision of industrial robots.
6) Maintaining of production areas.
7) High technological flexibility of production.
8) Improving the overall quality of products.

The disadvantages of this process can be a large cost of purchase and serving of this equipment and a drastic reduction in workplaces at production site.

The main economic factor that depends on the introduction of robots into production is the reduction of working personnel and the need for highly skilled personnel who would be engaged in the diagnostics, control and service of automated devices. This is a minus in the immediate implementation process, but it has a positive potential to increase highly educated personnel in the future [8].

Cloud technologies is the information technology of distributed data processing in which computer resources and capacities are provided to the user as an Internet service (servers, storage systems, applications).

One of the most common applications of clouds for industrial automation is the deployment of a SCADA system in the cloud. One of the following methods can be used:

1) SCADA-system works in a company and sends information to the cloud, where this information is stored and from where it is provided to all who need it and who are allowed;

2) SCADA-system itself operates in the cloud and remotely controls devices [2].

The main advantages and disadvantages of cloud systems are presented in Table 2.

Table 2 – Advantages and disadvantages of cloud technologies

Advantages	Disadvantages
- Access to personal information from any computer connected to the Internet; - You can work with information from different devices (PCs, tablets, phones, etc.); - One and tinier information can be viewed and edited simultaneously by multiple users from different devices; - Quick access to updated information; - Reduction or even absence of capital expenditures for IT; they are replaced by operating costs; - Flexible payment system for services - as needed; - Transfer or sharing of responsibility with the provider; - Easy to use mobile devices	- High prices of building your own cloud; - The loss of control over IT assets; - The complexity of the integration of services, especially provided by different providers; - No legal basis if there is a need for a well-regulated relationship; - The need for regular audits; - High requirements for IT literacy of users. Dependence on the quality of communication and the availability of the Internet; - Decrease of security layer

The need for competent and relevant business information based on the current state of things in production is reflected in the reduction of both time and financial costs. Therefore, innovative approaches to *the integration of production and management information systems* (IS) in the company are important in the development of advanced IT services.

Integration of information systems is a complex technological process directed at reducing transaction costs, namely the costs of collecting information, increasing the speed of access to it and speeding up its processing, as well as improving the quality of accounting and management in the company. The combination of complex automated systems entails reconfiguring the work of all units, whether they are integrated directly or in one way or another depend on the integrated systems, changing a significant part of the organization's functioning processes and, in some cases, radically changing employee relationships.

Enterprise Resource Planning (ERP) systems allow you to organize a total account of events, providing automatic monitoring of the current status of all processes, equipment and resources throughout the technological and related processes (Fig. 2).

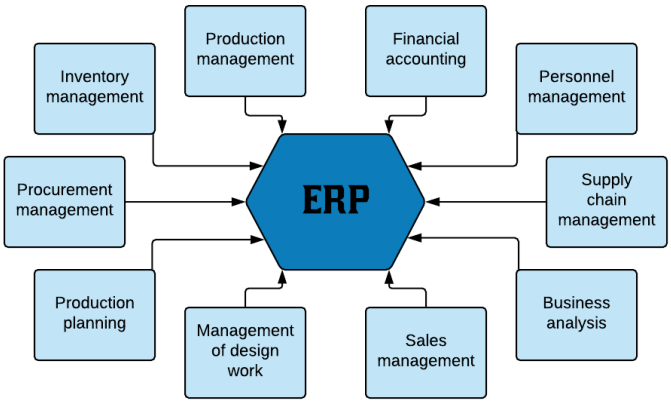

Fig. 2. A variety of tasks that serve information systems

Technically, *the analysis of "Big Data"* is the direction of ICT development, which includes storage technologies and calculations, as well as services such as: combining, organizing, managing and analyzing large amounts of data.

The software provides processing of databases, where these data can be created and updated, perform computational operations and manage received arrays. Among the advanced software that companies use for Big Data Analysis technology, we can distinguish the following: SQL, NoSQL, MapReduce, Hadoop, SAP HANA.

The field of use of Big Data technologies is very extensive. With their help, you can learn about customer preferences, the effectiveness of marketing campaigns or conduct a risk analysis. Most companies use the Big Data in the customer service area, the second most popular direction is operational efficiency [3].

Additive production has long since passed from the category of "emerging technology" into a leading innovation. Additive production is the process of manufacturing a part or an object based on the original digital 3D model by depositing material layer by layer. All stages of the project realization from the idea to the finished product output are in a single technological chain and executed in the digital CAD \ CAM \ CAE system, bypassing the stage of drawing a two-dimensional drawing, a 3D model is immediately constructed and sent to the press.

With the help of additive technologies, it is possible to solve a wide range of production tasks: acceleration of work on the development of experimental design; performance of work on the development of models; rapid prototyping of complex products; small-scale production; functional modeling; rapid production of individual parts; reduction in the cost of design work.

A 3D printer can replace a more expensive CNC machine, and, unlike the latter, will allow the creation of products with an arbitrary internal structure. 3D printing already penetrates most of the key industrial segments, both for creating the tooling and for the production of the final product.

Companies that manage assets located in large areas have long faced the challenges of mobility and high-quality information that can be solved with the help of *unmanned device technologies*. Integration of such devices into the daily operational process will help to create great advantages in the implementation of large-scale capital construction projects, in infrastructure management and in agriculture. And the transport industry will be able to completely change its concept of product delivery [7].

Unmanned aerial vehicles not only can do dangerous works, but also facilitate access to different sets of data for companies, providing high accuracy and low cost of information. Among such industries are the following: energy, road industry, railways.

In the field of Internet trade, when choosing a courier service, the delivery time is paramount. Unmanned devices provide delivery of goods in a short time to a specific, pre-determined location, not requiring a large number of actions from people. Similar concepts are already being actively developed in large companies, such as Amazon and Google, which are currently testing such solutions. In the sphere of delivery of goods, one more trend is gaining popularity: the delivery of spare parts.

Mobile technologies are introduced into industrial complexes, because they can provide full and quick access to important information and applications that ensure the stable operation of the company. Monitoring and management using mobile technologies closely overlap with the industrial Internet of things and cloud technologies.

Technologies of production management and technological processes widely use personal computers that act as a web server. Embedded Web servers can be easily configured as hosts with the Human-Machine

Interface (HMI), which will store production statistics or maintenance information. The managing web server allows the personnel who work with large production lines to change the parameters of the equipment operation using a tablet PC, regardless of the distance from the central control computer. Analytical data obtained from the cloud or directly from the application, allows to increase the functionality of mobile devices and avoid delays in obtaining information that arise when it is necessary to go or call the control centre for this. The control system generates tables adapted for mobile devices screens with data about the operation of the equipment for any given time interval [5].

Such direct communication with a control system using mobile or wearable devices as a human-machine interface gives an unprecedented level of flexibility, providing critical information to all involved personnel, regardless of its location. In addition, using a control system connected to the Internet, users can use their personal and already familiar devices, which reduces the time it takes to train staff to work with new control systems.

Conclusion. The integrated application of innovative IT in industrial organization contributes to the integrated development of key parameters aimed at optimizing production and management processes, improving the quality and speed of production of products and services, and quickly and flexibly obtaining up-to-date information. When implementing each individual technological approach or equipment, it is necessary to take into account various features of the location, structure or organization of the enterprise.

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