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PRIORITIES FOR THE APPLICATION OF HIGH TECHNOLOGIES IN THE INDUSTRY

Abstract. The purpose of the research is to reveal the main scientific approaches to understanding the essence of high-tech industries, to determine the targets and principles of the introduction of high technologies in industrial enterprises.

Methodology – the study was conducted using statistical and comparative analysis methods. The sources of the research are theoretical and analytical articles, works of Kazakh and foreign authors, which consider scientific approaches to understanding the essence of high-tech industries.

Originality/value – the author studied modern types of high technologies focused on the development of industry and formed: priorities for the use of high technologies; the principles of the introduction of high technologies in industrial enterprises.

Conclusions – In the Republic of Kazakhstan there are enough resources to build modern production on the principles of high technology. The study

of modern approaches to understanding the essence of high technologies shows that the construction and application of the latter in industry and other sectors of the economy should take into account the trends associated with the transition to a knowledge-based economy. In our opinion, it is possible to characterize certain types of high technologies, which in theory and practice are widely used in industries, including to the greatest extent in the manufacturing industry.

At the present stage of industry development, one of the leading areas of high technology is electronics.

On the basis of the studied material, we have formed priorities for the use of high technologies in the industry on the principles of greening the industry, developed targets and principles for the introduction of high technologies in industrial enterprises.

Key words: innovative development, high technology, sustainable development, greening, high-tech production.

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ӨНЕРКӘСІПТЕ ЖОҒАРЫ ТЕХНОЛОГИЯЛАРДЫ ҚОЛДАНУДЫҢ БАСЫМДЫҚТАРЫ

Аннотация. Бұл мақалада өнеркәсіпті дамытуға бағытталған жоғары технологиялардың қазіргі түрлері зерттелді. Келтірілген материалдар негізінде индустрияны экологияландыру қағидаларында өнеркәсіптерде жоғары технологияларды пайдалану артықшылықтары қалыптастырылды, өнеркәсіптік кәсіпорындарда жоғары технологияларды енгізудің мақсаттық бағыттары мен қағидалары жасалды. Жоғары технологияларды және оларға тиісті техниканы пайдалануға өту ғылыми-техникалық революция (ҒТР) және қазіргі кезеңдегі ғылыми-техникалық ілгерілеудің (ҒТІ) маңызды буыны болып табылады.

Жоғары технологиялардың мәнін түсінудің заманауи тәсілдерін

зерттеу өнеркәсіпте және экономиканың басқа салаларында құру және қолдану кезінде білімге негізделген экономикаға көшумен байланысты тенденцияларды ескеру қажет екенін көрсетеді. Біздің ойымызша, теориялық және практикалық тұрғыдан өнеркәсіп салаларында, оның ішінде ең көп дәрежеде өңдеуші өнеркәсіпте кеңінен қолданылатын жоғары технологиялардың жекелеген түрлерін сипаттауға болады. Өнеркәсіп дамуының қазіргі кезеңінде жоғары технологияның жетекші бағыттарының бірі электроника болып табылады. Қазақстан Республикасында жоғары технологияларды пайдалану қағидаларында заманауи өндірістерді құру үшін ресурстар жеткілікті.

Түйін сөздер: инновациялық даму, жоғары технологиялар, тұрақты даму, жасылдандыру, жоғары технологиялық өндіріс.

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ПРИОРИТЕТЫ ПРИМЕНЕНИЯ ВЫСОКИХ ТЕХНОЛОГИЙ В ПРОМЫШЛЕННОСТИ

Аннотация. Автором изучены современные виды высоких технологий, ориентированных на развитие промышленности. На основе изученного материала нами сформированы приоритеты применения высоких технологий в промышленности на принципах экологизации индустрии, выработаны целевые ориентиры и принципы внедрения высоких технологий на промышленных предприятиях. Переход к использованию высоких технологий и соответствующей им техники является важнейшим звеном научно-технической революции (НТР) и научно-технического прогресса (НТП) на современном этапе.

Изучение современных подходов к пониманию сущности высоких технологий показывает, что при построении и применении последних в

промышленности и других отраслях экономики необходимо учитывать тенденции, связанные с переходом к наукоемкой экономике.

На наш взгляд, можно охарактеризовать отдельные виды высоких технологий, которые в теории и на практике широко используются в отраслях, в том числе в наибольшей степени в обрабатывающей промышленности.

На современном этапе развития промышленности одним из ведущих направлений высоких технологий является электроника.

В Республике Казахстан имеется достаточно ресурсов для построения современных производств на принципах применения высоких технологий.

Ключевые слова: инновационное развитие, высокие технологии, устойчивое развитие, озеленение, высокотехнологичное производство.

Introduction. High technologies are very complex technologies used in production and other processes. High technologies are fundamentally different from «low technologies» – simple technologies used for centuries and associated with the production of basic necessities (Arslanova K.G. 2020: 222).

The transition to the use of high technologies and related technology is the most important link of the scientific and technological revolution (STD) and scientific and technological progress (STP) at the present stage. High technologies usually include the most knowledge-intensive industries. As a result, high-tech production is the industrial enterprises using in system of production and economic activity high technologies, achievements of NTR and NTP (Arslanova K.G. 2020: 368).

It is also possible to classify technologies as «high» depending on the measure of non-participation of a person – the less participation of a person in the technological process, the higher the technology. High technologies include not only industrial technologies, but also social technologies, such as news distribution systems, teamwork and learning technologies. In this regard, we can talk about high social technologies.

Under the knowledge-intensive sectors of the economy are understood to be a group of enterprises producing homogeneous products of General purpose, within the formation of production costs of which, investment costs, there is a high proportion of costs, investment in R & D.

Materials and methods. The main part of the study. High technologies at the present stage of development of scientific and technological progress, can be classified in the following areas: social technologies (news distribution systems, teamwork technologies, learning technologies); electronics; software

(artificial intelligence); wireless technologies; robotics; nanotechnology; environmentally friendly technologies, energy saving and alternative energy (waste processing, nuclear energy, solar energy, hydrogen energy); security systems(biometrics, sensors, detectors, electronic analyzers, covert surveillance systems); navigation technologies; defense technologies and dual-use technologies (aircraft construction, rocket construction, spacecraft development); biotechnologies (genetic engineering, igenotherapy, microbiological industry);organic chemistry; pharmacology.

Historically, most types of high technologies are attributed exclusively and only to the field of technology and industry, which is why other types of areas and sectors of the economy remain out of consideration. The above criteria of classification to high technologies – new, progressive, science-intensive – are not invariant signs of "height" of technology (Elektronnyiy resurs 2020 -132).

In our opinion, it is possible to characterize certain types of high technologies, which in theory and practice are widely used in industries, including to the greatest extent in the manufacturing industry.

At the present stage of industry development, one of the leading areas of high technology is electronics.

Electronics is a branch of science and technology engaged in the study of the physical foundations of the functioning, research, development and application of devices, the work of which is based on the flow of electric current in a solid, vacuum and gas. Such devices are semiconductor (flow of current in a solid body), electronic (flow of current in a vacuum) and ionic (flow of current in a gas) devices. The main place among them is currently occupied by semiconductor devices. The common property of all these devices is that they are essentially nonlinear elements, the nonlinearity of their current-voltage characteristics, as a rule, is a sign that determines their most important properties.

Industrial electronics is a part of electronics that deals with the use of semiconductor, electronic and ion devices in the industry. Despite the difference in applications and the variety of modes of operation of industrial electronic devices, they are based on General principles and consist of a limited number of functional units. General principles of construction of these functional units-electronic circuits – and considers industrial electronics.

Industrial electronics is divided into two broad areas:

(a) information electronics, dealing with devices for transmitting, processing and displaying information. Signal amplifiers, voltage generators of various shapes, logic circuits, counters, display devices and displays of computers – all devices of information electronics. The characteristic features

of modern information electronics are the complexity and variety of tasks, high speed and reliability. Information electronics at the present time is inseparably connected with the use of integrated circuits, the development and improvement of which in the main determines the level of development of the industry of electronic equipment.

b) energy electronics (converting equipment), engaged in the conversion of one type of electrical energy into another. Almost half of the electricity produced in all countries of the world is consumed in the form of direct current or non-standard frequency current. Most of the conversion of electrical energy is currently performed by semiconductor converters. The main types of converters are rectifiers (AC to DC conversion), inverters (DC to AC conversion), frequency converters, adjustable DC and AC voltage converters.

The development of electricity and electrical engineering is closely linked to electronics. The complexity of the processes in power systems, high rate of their occurrence has demanded widespread introduction for the calculation of the regimes and management processes of electronic computing machines (computers) connected with a system of sophisticated electronic devices and is equipped with the developed device to display information. The main production processes are automated on the basis of modern information electronics devices, in which integrated circuits and microprocessors have been widely used in recent years. Semiconductor converters of electric energy are one of the main load elements of networks, their work largely determines the operating modes of networks. Valve converters are used for power supply of electric drives and electro-technological installations, for excitation of synchronous electric machines and in schemes of frequency start of hydro generators. On the basis of semiconductor valve converters, DC power lines of high power and DC inserts are created.

Thus, electronic devices are important and highly complex components of power and Electromechanical installations and systems, and for their creation it is necessary to involve specialists in the field of industrial electronics, automation and computer technology. However, engineers specializing in the field of electricity and electrical engineering, cannot be removed from the solution of issues related to electronics. First, they should be able to clearly articulate the task for the electronic circuit designer and present the difficulties that the developer may face. Not fully specified requirements can lead to the creation of an inoperable device, and unjustified overstatement of requirements – to increase the cost and reduce the reliability of electronic equipment. In order to speak with the developer of electronic equipment in one language, it is necessary to clearly imagine what electronics can do and at what cost and in what ways it is achieved. The latter is also necessary for the

qualified selection of equipment manufactured by the industry (Gorbachev G.N. et al 2018:239).

Secondly, there is a need for proper operation of electronic devices. Third, electrical engineers are actively involved in the installation and adjustment of equipment, including electronics. Fourth, the design of a number of power plants, including DC transmission lines, requires the joint work of specialists in energy and Converter technology.

All this requires a lot of knowledge in the field of industrial electronics. The basis of such knowledge lays a separate scientific direction - "Industrial electronics". It explores the modern scheme of information and energy electronics. Many of the most important problems of science and technology arise at the junctures of science. Electronics, electrical engineering and power engineering now touch very closely, require joint work of scientists and engineers, great knowledge in related fields. For many engineers, our course will be only the first step in the problem of electronics.

Electronic technology is constantly evolving, each problem can be solved on the basis of different circuit options: you can build a circuit on discrete components, you can perform it on integrated circuits, use a microprocessor kit, to process information in digital or analog form.

In the end, everything is decided by economic analysis, and making the wrong decision (say, the refusal to use chips) may not interfere with the solution of local technical problems, but in the end it will be unprofitable for the national economy: the cost of equipment will increase, or the cost of its operation will increase, or the service life will decrease. Almost every engineer in his place affects the PA technical policy in his field and in the development and defense of technical solutions should act not only as a specialist, but also as a citizen.

Another type of high technology, directly focused on the development of industry is robotics.

Robotics in industry – is a set of industrial robots designed to perform motor and control functions in the production process, manipulation robot. It is used to move objects of production and perform various technological operations.

In the scientific sense, there are other definitions. Industrial robot – an automatic machine, stationary or mobile, consisting of an Executive device in the form of a manipulator having several degrees of mobility, and reprogrammable software control device to perform motor and control functions in the production process.

In the industry, along with the manipulation robots that have received

the greatest distribution, mobile (locomotive), information, information management, complex and other types of industrial robots are also used.

Industrial robots are usually one of the components of automated production systems used in flexible automated production, which at the same level of quality can increase productivity as a whole (Martyinenko A. V. 2016:64-67)

It is economically advantageous to use industrial robots together with other means of production automation (automatic lines, sections and complexes).

Robotics in industry in modern science is classified into two areas:

- by type of control;
- by function and scope.

(a) By type of management:

- controlled robots, demanding that their every movement was controlled by the operator. Due to the narrowness of applications are few. And not quite robots;

- automatic and semi-Autonomous robots: operate strictly according to the specified program, often do not have sensors and are not able to adjust their actions, can not do without the participation of the worker;

- Autonomous: can perform a programmed cycle of actions without human intervention, according to the specified algorithms and adjusting their actions as necessary. Such robots are able to completely block the field of activity on its section of the conveyor, without the involvement of live manpower.

b) Functions and scope of application:

- by appointment and executable functions (universal, welding, machine-building, cutting, completing, Assembly, packing, warehouse, painting).

In parallel with robotics, an innovative high – tech direction-nanotechnology-is being formed in the industry.

Nanotechnology is a new area of science and technology that has been actively developing in recent decades. Nanotechnology includes the creation and use of materials, devices, and technical systems whose functioning is determined by nanostructures, that is, its ordered fragments ranging in size from 1 to 100 nanometers.

The term «nanotechnology» (nanotechnology) was introduced in 1974 by Professor of materials science from the University of Tokyo Noriotaniguchi (NorioTaniguchi), who defined it as "a production technology that allows to achieve ultra-high accuracy and ultra-small dimensions of the order of 1 nm.

In the world literature clearly distinguish nanoscience (nanoscience) from nanotechnology (nanotechnology). The term «nanoscalescience» (nanoscale science) is also used for nanoscience (Elektronnyiy resurs 2017:23).

In modern industry, in practice, the term «nanotechnology» combines

"nanoscience", "nanotechnology", and sometimes even «nanoindustry» (areas of business and production where nanotechnology is used).

Fully or partially created on the basis of nanomaterials and nanotechnology functionally complete systems and devices, the characteristics of which are radically different from the performance of systems and devices of similar purpose, created by traditional technologies.

It is almost impossible to list all the areas in which nanotechnology can significantly affect technological progress. You can name only some of them:

- elements of nanoelectronics and nanophotonics (semiconductor transistors and lasers;
- photodetectors; solar cells; various sensors;
- ultra-dense information recording devices;

telecommunication, information and computing technologies;

- supercomputers;
- video equipment - flat screens, monitors, video projectors;
- molecular electronic devices, including switches and electronic circuits at the molecular level;
- nanolithography and nanoimprinting;
- fuel cells and energy storage devices;
- micro and nanomechanics devices, including molecular motors and nanomotors, nanorobots;
- nanochemistry and catalysis, including combustion control, coating, electrochemistry and pharmaceuticals;
- aviation, space and defense applications;
- the device control status of the environment;
- targeted delivery of drugs and proteins, biopolymers and healing of biological tissues, clinical and medical diagnostics, creation of artificial muscles, bones, implantation of living organs;
- biomechanics; genomics; bioinformatics; bioinstrumente;
- registration and identification of carcinogenic tissues, pathogens and biologically harmful agents;
- safety in agriculture and food production.

The strategic reference point for the use of high technologies in industry is environmentally friendly technologies.

Environmentally friendly technologies are a segment of the market of technologies, methods of production and services that contribute to the efficient use of available resources, as well as the protection and conservation of natural resources (Elektronnyiy resurs 2021 -223).

The real direction of solving environmental problems is the implementation of scientific and technological progress, providing for changes in the technical

and technological basis of production through the transition to low-waste, resource and energy-saving technologies. Practically, this means a change of course aimed at the elimination of the adverse effects caused by change in the quality of the natural environment, the course of the control of pollution and prevention of consequences. This approach in the considered situation is not only the most logical, but also the most cost-effective solution, because the cost of eliminating environmental consequences is often much higher than preventive measures.

Results and discussion. Resource-saving technology in this case is understood as a technological process that involves minimizing the use of natural resources and minimal disruption of natural (natural) conditions, i.e. differs from traditional technologies by significantly lower specific consumption of raw materials and energy. For low-waste (non-waste) technologies, the main thing is the transition to closed technological cycles, to some extent reproducing natural ones, which allows to obtain a minimum of solid, liquid, gaseous and thermal waste and emissions. The Declaration on low-waste and non-waste technologies and waste management, adopted at the pan-European meeting of the economic Commission for Europe on cooperation in the field of environmental protection, defines: «low-waste and non-waste production refers to a method of production (process, enterprise, territorial production complex), about which all raw materials and energy are used most efficiently and comprehensively in the cycle of raw materials – production – consumption – secondary raw materials and any impact on the environment do not violate its normal functioning». According to the definition, there are two aspects of closed production: in the case of an individual production process (within a single enterprise) and in the case of a group of enterprises, where different technologies are combined into sequential and parallel chains in order to make better use of raw materials and reduce waste.

The technological principles of the organization of environmentally friendly technologies depend on the nature of production processes, on groups of industries. For the mining industry, which is characterized by large volumes of movement of rocks, such technologies are associated with the transition to fundamentally new technologies of mining, for example, it can be underground leaching, electrolysis, gasification and hydro-shock production (coal), the introduction of which usually requires a very high start-up capital investments. For the manufacturing industry (in particular metallurgy), transitions to deeper processing of raw materials and the maximum use of generated waste may be promising. Sometimes a situation is created when it is more effective to reduce the degree of extraction of the main component

in order to ensure a gain in General on the complex processing of raw materials and the production of by-products. Such situations are difficult to imagine without going beyond the individual enterprise. It is more likely such developments in the presence of large investments in the framework of the holding company or other industrial enterprises. For industries with discontinuous production processes based mainly on mechanical processing of raw materials (mechanical engineering, woodworking, light industry), the organization of environmentally friendly technologies is usually associated with a significant reduction in the total amount of waste based on changes in the means of influence on the subject of labor.

Options for changing the technical and technological basis of production:

- improvement of existing machinery and production technology in order to transform existing production from discrete to continuous closed production, intensive in its basis. This way assumes "step-by-step" greening of production: improvement of the existing production – introduction of low-waste resource and energy-saving technologies; waste disposal, creation of a system of integrated waste-free production with the addition of its specialized plants for the processing of all industrial and domestic waste into materials suitable for assimilation by nature or economic use;

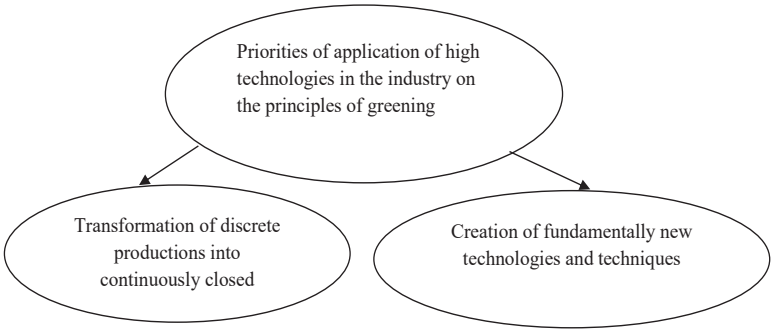
- «Biologization» of production – connection of biological processes to the existing production (according to the type of natural cycle of substances).

- the creation of fundamentally new technologies and techniques, the use of which in the process of work will qualitatively change the nature of environmental management in General.

The first two directions are not fully effective, because they suggest the evolutionary progress of means of influence on nature (technology) with unchanged or slightly modified principles, methods and methods (technology) of this impact.

The real direction of achieving the desired result (intensification of production and preservation of the environment) is the creation of environmentally friendly technologies and techniques, which are understood as such samples of technological processes, technical means and units, which in the course of their operation will exclude the costs of public labor for the elimination, compensation or prevention of damage caused to society as a result of the unproductive use of natural resources and environmental pollution (konferentsiya 2020 -233).

Conclusion. Priorities of application of high technologies in the industry on the principles of industry greening are presented in figure 1.



Note: compiled by the author

Figure 1 – Priorities of application of high technologies in industry on the principles of industry greening

The transition of industries, including manufacturing, to high technology may involve several scenarios:

- transition of the industry to high technologies on the principles of technology transfer;
- transition of the industry to high technologies on the principles of activation and intensification of R & d.

The main target aspects of high technology can be both the production process and other economic subsystems of the enterprise.

The study of modern approaches to understanding the essence of high technologies shows that the construction and application of the latter in industry and other sectors of the economy should take into account the trends associated with the transition to a knowledge-based economy. In this aspect, it should be noted that the country has sufficient resources to build modern production on the principles of high technology: measures to stop the outflow of capital, including a temporary ban on investment abroad (primarily for exporters of raw materials); the establishment of mandatory deductions from the revenue from 1 ton of the exported raw materials to strengthen scientific-technical potential of the country; introduction of the rent on natural resources; the use of levers of indirect regulation, including the investment credit.

It should also be noted that the design and application in the practice of industrial enterprises of high technology should always be accompanied by the formation of appropriate innovation processes, directly and indirectly contributing to the transition of the industry to a new, higher level of development.

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