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MATHEMATICAL MODELING OF THE METEOROLOGICAL FACTORS IMPACT ASSESSMENT ON RELAY SCATTERING OF ELECTROMAGNETIC WAVES IN THE ATMOSPHERE

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ABSTRACT

In the article, the problem relevance of solving many methodological issues by means of mathematical modeling is due to the fact that the technological possibilities of controlling remote sensing signals with the necessary accuracy are limited, and considering that the main type of scattering of electromagnetic waves during remote sensing with the help of artificial Earth satellites is Relay scattering and the issue of mathematical modeling of the evaluation of the impact of meteorological factors on this process of electromagnetic waves in the atmosphere was solved. For this purpose, the structure of the mathematical model was selected and its adequacy was checked and For a more detailed investigation of the capabilities of the mathematical model, computational experiments were conducted. In order to verify the adequacy of the mathematical model of the assessment of the influence of meteorological factors on the Rayleigh (molecular) scattering of electromagnetic waves in the atmosphere, the values of the molecular scattering coefficient calculated using the appropriate formula and were reconciled with the data provided in the relevant literature sources. The obtained results show the adequacy of the model. For a more detailed study of the capabilities of the mathematical model, computational experiments were conducted. The obtained results showed that the proposed mathematical model can be successfully used in solving a number of practical problems.
Keywords: Remote sensing, electromagnetic waves, Relay scattering, mathematical modeling, meteorological parameters.

Introduction

It is known that the presence of the atmosphere between the observed object and the optical-electronic systems in remote sensing is the cause of the main distortions. The energy of the rays from the object weakens when passing through the atmosphere, and the spectral composition of the rays undergoes transformation. In addition, the temperature gradient in the atmosphere causes turbulence, which in its turn affects the parameters of the measuring device and deteriorates the image signals quality [4. 10]. To eliminate the atmospheric effects, it is necessary to know the atmospheric model, aerosol model (type and concentration), optical thickness of the atmosphere, surface reflection coefficient, and a number of other parameters for gaseous components. Since it is very difficult to measure such characteristics of the atmosphere directly, methods are being developed to obtain them from the spectral values of sounding data. As a result, the received data is used to develop high-precision models of atmospheric correction.

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For example, in solving the issues of remote sensing of the earth's surface, data from the EOS MODIS (Earth Observing System, MODerate Resolution Imaging Spectroradiometer) and NOAA POES (National Oceanic and Atmospheric Administration, Polar Operational Environmental Satellite) satellites of the global earth surface monitoring system are used. However, this data processing is efficient for "standard atmosphere" or weakly cloudy atmospheric conditions, and large distortions are allowed in other cases. One of the main reasons for this is that the optical-meteorological conditions of the atmosphere are not taken into account during satellite observations. However, relevant studies have been started to overcome such difficulties. One of them was the solution of the issues of restoring the temperature field of the surface coating based on the physical models of the transport of heat radiation. To this and, the distorting effect of the atmosphere on the results of surface temperature monitoring was directly taken into account by using a priori optical-meteorological information (satellite observation data, prognostic data, radiozonde data, AERONET network data). Later, according to the data of EOS MODIS and NOAA POES systems, based on the RTM-method (Radiative Transfer Model), researches were conducted on the development of algorithms and software tools for operational atmospheric correction of satellite infrared measurements of the earth's surface temperature [8], some results of the various algorithms development for performing atmospheric correction [11, 14, 15] are given in the article.

A brief analysis of the characteristics of the influence of the atmosphere on electromagnetic signals in the real conditions of aerospace observations shows that for the atmospheric correction of remote sensing data, the issues of mathematical modeling of the main characteristics of the Earth's atmosphere must be solved and their adequacy must be checked in different time intervals for specific areas [9].

Mathematical modeling

It is known that depending on the ratio of the sizes of the particles in the atmosphere and the wavelength of the incoming rays three types of scattering are distinguished in the atmosphere: Relay scattering or molecular scattering (while the sizes of the atmospheric particles are smaller than the wavelength); - Mi scattering or aerosol scattering (the sizes of particles in the atmosphere are comparable to the wavelengths of the visible, near-infrared and thermal infrared regions; - non-selective scattering (independent of wavelength, scattering occurs by particles with a radius of more than 10 μm) A review of studies on the determination of Relay dispersion [10] shows that there are certain difficulties in the of Rayleigh dispersion value calculating.

The basis of the mathematical model for influence evaluating of meteorological factors on Relay scattering evaluatin -;of electromagnetic waves in the atmosphere is the following expression [10]:

$$\alpha_m = \frac{3}{8 \cdot \pi} \cdot \beta_m , \qquad (1)$$

β_m is determined by the Relay formula [2, 7, 13]:

$$\beta_m = \frac{8}{3} \pi^3 \frac{\left(n^2 - 1\right)^2}{N \cdot \lambda^4} \cdot \frac{6 + 3\delta}{6 - 7\delta}. \qquad (2)$$

The calculated concentration of molecules in the air can be determined as follows [7]:

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$$N = \frac{P}{k \cdot T}, \qquad (3)$$

It can be noted that in standard atmospheric conditions (T=273.1K, P=1013.25 hPa=101325 Pa) the value of $N=2.686763 \cdot 10^{25}$ m^{-3} is called Loschmidt constant. The change of the calculated concentration of air molecules depending on the height above the earth's surface (H, km, up to 50 km) can be calculated by the following formula obtained by us using literature data [5]:

$$N = -5 \cdot 10^{-5} \cdot H^3 + 0.006 \cdot H^2 - 0.2143 \cdot H + 2.4883, \qquad r = 1.00. \qquad (4)$$

The degree of depolarization (δ, dimensionless quantity) of the main atmospheric gases and mixtures is as follows [3, 13]: - air – 0.035; H_2O – 0.020; N_2 – 0.036; O_2 – 0.065; CO_2 – 0.097; SO_2 – 0.031; H_2S – 0.003; CH_4 – 0.000; Cl_2 – 0.041; HCl_2 – 0.007; CO – 0.013.

$$n = 1 + 10^{-6}\left(b(\lambda)\frac{P\left(1+10^{-6}P(1.049-0.0157T)\right)}{720.833 \cdot (1+0.003661T)} - P_w \frac{0.0624-0.00068\lambda^{-2}}{1+0.003661T}\right), \qquad (5)$$

$$b(\lambda) = 64.328 + \frac{29498.1}{146-\lambda^{-2}} + \frac{255.4}{41-\lambda^{-2}}, \qquad (6)$$

where β_m is molecular scattering coefficient; N – the calculated concentration of molecules in the air; δ – degree of depolarization of scattered radiation; P–atmospheric pressure, Pa; T–air temperature, K; $\kappa = 1.380658 \cdot 10^{-23}\ \frac{Coul}{K}$–Bolsman's constant; P_w – partial pressure of water vapor, hPa; λ-length of the wave, μm.

In order to verify the adequacy of the mathematical model of the assessment of the influence of meteorological factors on the Relay scattering of electromagnetic waves in the atmosphere, the values of the molecular scattering coefficient calculated using the formula (1) with the data for the range of 0.2-0.4 μm given in the relevant literature sources (for standard conditions in the near-earth layer of the atmosphere) [1, 6] is reconciled. The obtained results show the adequacy of the model (Figure 1) and it can be successfully used to solve relevant problems.

As can be seen from Figure 1, the values of the Rayleigh scattering coefficient calculated by the model and the values given in the literature sources are very close to each other, and this is confirmed by the very high correlation coefficient between them (r=0.9999). These data show the adequacy of the model and it can be successfully used to solve relevant problems.

Then, computational experiments were conducted for a more detailed investigation of the model capabilities. Meanwhile, different values of air temperature were used, the calculation was made for two options. In these options, P=101325 Pa was taken, and the air temperature was changed from 0^0C to 45^0C every 5^0C. Air and carbon dioxide environments are considered as atmospheric environments. The degree of depolarization (δ) for air is 0.035 and for carbon dioxide is 0.097

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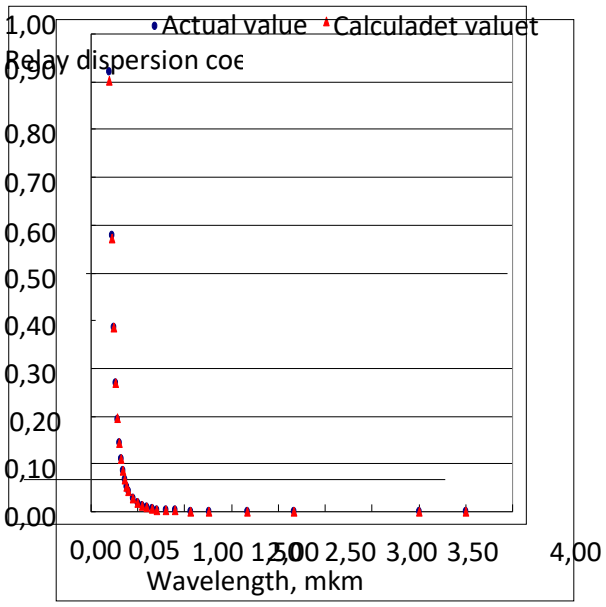

Figure 1. The value comparing results of the values of the molecular scattering coefficient in theory and the values calculated by the formula (1).

In the 1st option, λ=0.20 μm was adopted. The results of calculations are given in figure 2. It can be seen from here that the effect of air temperature on the relay coefficient is linear and as the temperature increases, the coefficient also increases. These changes range from 1.00 1/km (0^0C) to 1.60 1/km (45^0C) for air, and 0.90 1/km (0^0C) to 1.40 1/km (45^0C) for carbon dioxide. is in the interval. The relay dispersion coefficient increases by ≈0.05 1/km for every 5^0C increase in temperature for both environments.

In the 2-nd option, λ=0.55 μm was adopted. The calculation results are shown in figure 3.

It can be seen from Figure 3 that the effect of air temperature on the relay coefficient is linear and as the temperature increases, the coefficient also increases. These changes are in the range of 0.013 1/km (0^0C) – 0.090 1/km (45^0C) for the air environment, and 0.0115 1/km (0^0C) – 0.0185 1/km (45^0C) for the carbon dioxide environment. For both environments, the relay dispersion coefficient increases by ≈0.00062 1/km for every 5^0C increase in temperature.

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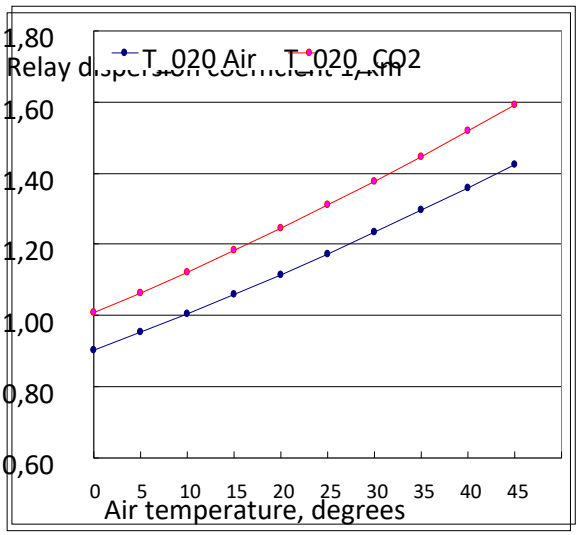

Figure 2. Variation of Relay scattering coefficients in air (T_020_air) and carbon dioxide (T_020_CO2) environments as an air temperature change function.

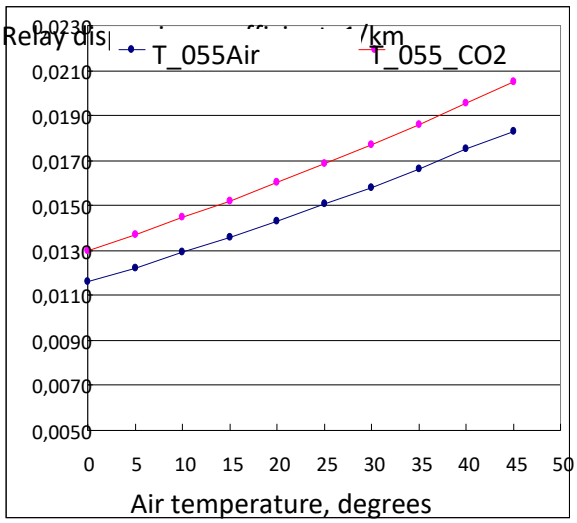

Figure 3. Variation of Relay scattering coefficients in air (T_020_air) and carbon dioxide (T_020_CO2) environments as a function of air temperature change.

At the next stage, the air temperature is T=00C; p=760 mm Hg, and the values of partial pressure of water vapor (Pw) were assumed to vary from 0 to 27 hPa every 3 hPa. Again, the environment of air and carbon dioxide was considered. Calculations were made for λ=0.20 and 0.55 mkm. The results of the calculations for the option λ=0.20 mkm are given in figure 2.7.

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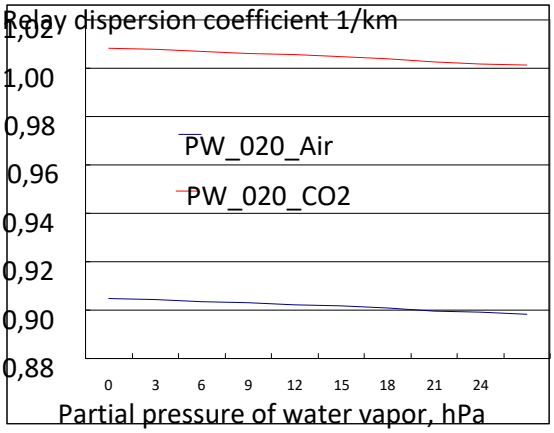

Figure 4. λ=0.20 mkm, depending on the change in the partial pressure of water vapor, the change in values of the relay scattering coefficient in air and carbon dioxide.

Conclusions

The article analyzes the effects of electromagnetic signals of the atmosphere in real conditions of aerospace observations, considers the problems of mathematical modeling of the main characteristics of the Earth's atmosphere for Atmospheric correction of remote sensing data and their adequacy in different time intervals on Con-Cretaceous areas.

In order to verify the adequacy of the mathematical model for assessing the influence of meteorological factors on the relay scattering of electromagnetic waves in the atmosphere, the calculated values of the molecular scattering coefficient were compared with the data for the 0.2-0.4 mm range given in the relevant literature sources, and the adequacy of the model was confirmed based on

In order to study the detailed model possibilities, two variants of computational experiments were carried out, graphs of dependence of relay scattering coefficients on changes in air temperature were established using different values of the air temperature. The graphs show that the influence of air temperature on the relay coefficient is linear, and as the temperature increases, the coefficient increases.

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IMPROVEMENT OF INTELLIGENT INTERNAL COMBUSTION ENGINES

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ABSTRACT

Research investigations of the solutions of internal combustion engine control problems based on artificial intelligence systems are quite relevant. The power of ship devices and mechanisms is increasing, the requirements for accuracy, reliability, speed and other indicators of the quality of control processes are increasing, increased operational requirements related to economy and efficiency of ship systems and equipment.

Currently, there are a lot of studies which are successfully performed to create the installations with a higher degree of automation – adaptive (intelligent) internal combustion engines, including a class of marine diesel installations. This term means the Engine controlled by adaptive automatic control systems with elements of artificial intelligence that can apprehend and analyses quite complicated and changeable ambient and take a decision. However, the problematic issues of adapting a piston engine in operating conditions are still under study and theoretical conceptualization.

In this article, a study of the scientific and technical problem of improving the operational qualities of intelligent marine diesel installations is carried out. The problem has a great technical importance and requires scientific substantiation of the directions of both improving the operational qualities and reliability of existing models, and identifying ways to modernize existing structures of marine diesel installations.

Keywords: internal combustion engines, marine diesel, intelligent engine, adaptive systems, adaptive motors, microprocessor controls, controlling algorithm, neural networks.

Introduction

At the end of the XX century, the world marine diesel industry, following the automobile industry, started attempts to create adaptive marine diesel installations. Marine engines are a special class of power plants that differ from industrial analogues, they have different operating modes and loading cycles, as well as increased requirements for reliability, durability, and safety. All this determines the design and automation features of the ship's power plant.

The appearance of microprocessors in 1972 led to a qualitative change in the element base of shipboard automated control systems of the shipboard power plants. The first implemented microprocessor-based automatic control system of a ship's power plant (SPP) performed the following functions: control of the parameters of the technological processes of SPP, warning and emergency alarms; the automatic control of the ship's power plant; the automatic control of the start-ups and operation of the main engines and other auxiliary mechanisms of SPP. The system was divided into several subsystems, for each microprocessor was provided. All microprocessors were integrated into a common network.

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The modern electronic control system, in addition to monitoring the parameters of the main engine systems, includes a microprocessor with software that solves a wide range of engine management tasks.

The purpose of microprocessor control of internal combustion engines is to improve their ecological and economic characteristics due to a high level of individual optimization of the workflow in each cycle of each cylinder. It is achieved by automatically selection and setting a set of values of the working process parameters in the engine cylinders and by controlling algorithms that are optimal in terms of fuel consumption and the quality of transients, while fulfilling environmental and technical parameters restrictions.

It should be noted that since the development of engine control systems, the computers controlling the engines have been improved. So, the first computers equipped with Caterpillar engines had an 8-bit processor, then a 16-bit processor. Currently, ECM ADEM-III (Advanced Diesel Engine Management) has a 32-bit processor. At the same time, the number of inputs/outputs also changed due to the need to increase the number of sensors and controlled quantities to take into account a large list of operating parameters and external conditions. The newest ECM ADEM-IV has 170 inputs and communication lines with the engine [1].

In addition to the main tasks for controlling the workflow of a diesel engine, ECM provides solutions to a number of other tasks, including:

- monitoring of sensor readings with a control of their serviceability;
- self-diagnosis of the electronic control system with the output of active codes-notifications of malfunctions of their components (modules);
- storing fault notification codes in memory;
- storing in memory of the operating parameters that have occurred beyond the set limits (overheating, exceeding the set speed limits, low oil pressure, etc.);
- performing tests and calibrations of some elements by commands of a special program.

The achievements listed above, applied in electronic engine control systems, allow us to draw conclusions about the absence of constraining factors for the integration of the internal combustion engine into a single target control system of marine power plant, which allows to implement control scenarios depending on the external operating conditions of the vessel.

One of the most important ways to develop modern internal combustion engines and units based on them is to equip them with intelligent systems that perform the functions of automated or automatic control, regulation, control, maintenance and protection, automatic diagnostics, adaptation of the engine to changing operating conditions. The adaptive motors, which have a large number of controllable parameters and allow adjustment to each operating options, arecalled intelligent motors. These engines are controlled by adaptive automatic control systems with elements of artificial intelligence in the form of the ability to perceive and analyze a rather complex and changing external environment and make appropriate decisions.

An important factor determining the quality of microprocessor engine control is the controlling algorithm. The use of "intelligent" control algorithms allows you to achieve the maximum possible best indicators of the workflow’s quality. This applies, first of all, to the accuracy of maintaining the engine crankshaft speed when operating in steady-state loading modes, limiting the maximum deviation of parameters and duration of transient start-ups, acceleration, loading and tracking loading changes.

The complex of control algorithms generally includes algorithms for adaptive control of fuel supply advance, pressure, the number of injection stages, the form of fuel injection characteristics,

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fuel supply restriction, exclusion of fuel supply under conditions that do not ensure its ignition and
effective combustion, gas distribution phases, boost pressure, etc. It is important that for the implementation of control algorithms, information received from sensors of regulated parameters is collected and processed, which also allows the implementation of algorithms for automatic technical diagnostics.
Taking into account the tightening of environmental standards, the problems of saving fuel and energy resources, as well as transport safety problems related to the fault tolerance of marine internal combustion engines and especially their control systems, it is obvious that the task of intelligent control of this object is relevant.

Development of intelligent engines.
An American company Caterpillar was the first who mastered the industrial production of electronically controlled diesels. Most of the engines of this company are now produced with electronic control. The microprocessor installed on the engine performs the following functions:

- an electronic speed controller that supports a given speed and a loading mode;
- fuel supply control according to the set mode;
- recording and monitoring of the main parameters of the engine and its maintenance systems;
- the implementation of an emergency warning alarm when the parameters go beyond the setpoint and the engine resets or stops when the setpoint is significantly exceeded;
- the implementation of an emergency warning alarm when the parameters go beyond the setpoint and the engine resets or stops when the setpoint is significantly exceeded;
- fixing in the processor memory of all violations in the operation of the engine and regardless of the term of limitations of their issuance on the screen of the computer connected to the microprocessor.
- the implementation of these functions significantly increases the level of control and technical operation, prolongs the life of the engine.

In the field of marine engine building, the first steps were taken by "MAN &BW", "Wartsila" and "Sulzer".
The use of technical solutions with electronic control by MAN-B&W corporation was introduced in 2001 in the engines of the ME series [2]. The company has developed and laid the foundation of the electronic system software. In recent years, this company has achieved a very high degree of reliability of electronic control circuits and they have replaced mechanical devices in many installations that perform the functions of supplying fuel into diesel cylinders.
In the fuel injection control scheme developed by MAN (Fig.1), several sections of a high-pressure fuel pump (HPFP) are used to pump fuel from a fuel tank (FT) into a special battery tank (BT). The pressure in the accumulator tank is regulated by acting on the fuel injection pump spool, as well as using a high-speed discharge valve (V), which, if the pressure increases excessively, discharges part of the fuel back into the tank (FT). Diesel injectors (I) are equipped with a special hydro- locking system where the pumps (P) maintain a constant oil pressure of 20 MPa.

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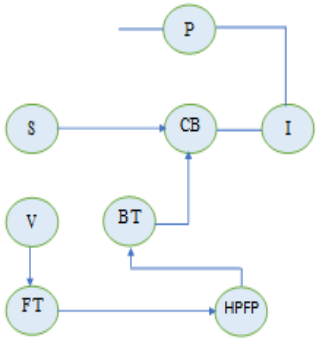

Figure 1. Electronic fuel injection system diagram.

Fuel is supplied to the nozzle sprayers by commands generated by the control unit (control unit), the input of which receives signals from sensors (S) injection pressure, gas pressure in the cylinder, charge air pressure, shaft speed and other measuring devices. The control unit compares these signals with the preset ones, and, in case of their inequality, changes the fuel supply and charge air pressure accordingly. Commands are given at certain positions of the crankshaft. The timing of the command signals determines both the moment of the start of injection, as well as its duration and the amount of fuel supplied. Electromagnetic high-speed valves are installed on the pipeline connecting the battery tank with the injectors, when triggered, the fuel supply to the injectors stops and at the same time the cavity of the injectors in front of the sprayers communicates with the drain line.

The control unit of the system is made with a wide use of digital integrated microchips. The basis of the control unit is a microprocessor, whose programs are implemented into permanent storage devices to which are connected: sensors (E) of injection pressure, gas pressure in cylinders, air pressure, shaft speed sensor. The microprocessor evaluates all incoming signals; performs appropriate calculations according to the specified programs; generates the necessary commands that control fuel injection, the processes of start-ups, reversing the diesel engine, as well as the operation of various information display devices.

To achieve high quality engine management, it is necessary to provide flexibility in the management of the fuel supply and exhaust valve. Ensuring the flexibility of engine control with the fuel pump and exhaust valve driven from the camshaft will require the creation of a complex mechanical complex, which will greatly affect the reliability of the engine.

All this led to the creation by MAN corporation of an intelligent engine with a new type of drive for high-pressure fuel pumps and exhaust valves, which would be controlled by electronic controls under the control of an engine condition monitoring system.

The block diagram of the intelligent motor control is shown in Fig. 2. The engine operation programs can be set from the control panel or by the intelligent engine's own control system.

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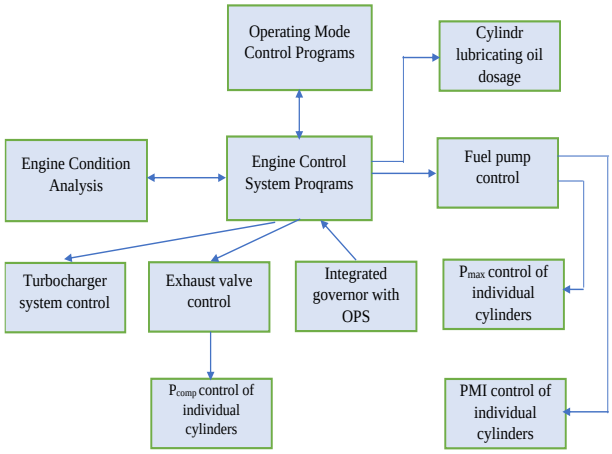

Figure 2. Block diagram of intelligent motor control

The control system contains data for optimal control in these programs, which consist of separate modes corresponding, for example, to different engine loads or limits on emissions into the atmosphere.

The fuel economy and atmospheric emission limits options are set from the engine control panel, and the reverse and emergency stop mode is selected by the control system when the maneuvering system requests the execution of the appropriate command.

The engine damage warning mode is set exclusively by the engine condition analysis system, regardless of the current operating mode.

The electronic control system analyzes the condition of the engine and controls the operation of the following systems: fuel injection, exhaust valves, cylinder lubrication and turbocharging.

The main advantages of the "intelligent engine" are: reduction of fuel consumption; reliability and flexibility of management; flexibility in managing exhaust gas emissions.

In the Wartsila-Sulzer RT-flex/X engine, all functions in the system are operated and controlled through the WECS-9520 engine management system [3]. It is a modular electronic system with separate microprocessor control units for each cylinder and common control and supervision by duplicated microprocessor control units. They provide interconnection with an electronic controller, a remote automatic control system and an alarm system. Microprocessor control units, or electronic control units, are installed directly on the engine, either on the front of the battery pack, or next to it.

- One of the most important changes in the engine was the introduction of a battery fuel supply system consisting of a fuel injection pump that creates a pressure of 1000 bar, a fuel accumulator and electronically controlled valves that distribute fuel through the injectors (Fig. 3) [3].
- From the battery, fuel is supplied to standard injectors, the opening and closing of their needles occurs in the usual way under the pressure of fuel entering each of them from the control valve. The latter sets the moment of needle opening - the advance angle, the amount of fuel injected and the shape of the fuel supply curve (Fig. 4) [4].

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- The three nozzles in each cylinder are controlled independently of each other - programmed to work individually or as needed in unison.

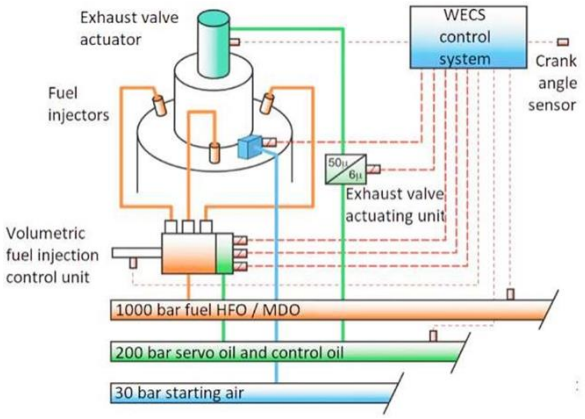

Figure 3. Battery fuel supply control system.

The valve is controlled by a microprocessor-based electronic control system WECS 9500, which has a modular design with a separate microprocessor for each cylinder. The same system is responsible for monitoring the entire engine.

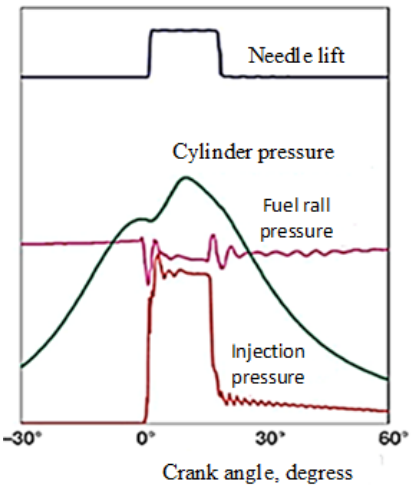

Figure 4. RT-flex/X engine injection scheme

RT-flex/X engines have standardized interfaces (DENIS) for remote control and safety systems. Remote control and safety systems are supplied to the vessel by various approved manufacturers, and DENIS determines the interaction between the equipment installed on the engine and remote automatic control systems, emergency warning alarm and security system.
The main advantages of RT-flex/X engines with their electronically controlled systems are:
- Reduced specific fuel consumption in partial modes.
- Smokeless operation at all speed modes.

- Very low, stable rotation speed at a value of about 10% of the nominal.
- Easy engine setup for less maintenance.

Increased time between major repairs, primarily due to a better load balance between the cylinders and cleaner combustion at all loads.

From the above mentioned it follows that on all engines with electronic control systems, a significant reduction in operational fuel consumption has been achieved, starting and braking characteristics have been improved, and the reliability of engine components and parts has been increased. Microprocessor systems are increasingly being used for information processing and decision-making in the automation of SEU. One of the problems of using diagnostic systems in the process of adaptive management is the large amount of information processed, which is not always possible to perform in real time.

Currently, fuzzy neural networks (FNS) are used for more accurate, perfect control and monitoring with internal combustion engines [5]. The most important advantage of the FNS is the ability to build a single network to calculate multiple output values from multiple inputs. Hardware implementations of the FNS are ideal for solving identification and control tasks, as they provide, thanks to the parallel structure, extremely high speed of operations.

With the advent of new technologies in the marine industry, management systems are being improved every year. With the support of the European Commission, the "Auto-ship" project has been developed, which includes the construction and operation of unmanned and autonomous vessels. The era of marine robotics has begun.

Conclusion.

The safety of navigation is the most important requirement for the exploitation of the vessel. Ensuring the safety of navigation is more related to the reliability of working with internal combustion engines, which in turn depends on their technical condition. Modern automated control system by ship technological processes is implemented in the form of a three-level system. The first levels sensors and measuring transducers for collecting information, acting technologies for controlling the working parts of control objects. The second level is programmable microcontrollers. The third level consists of hubs, multiplexers, switches, and "intelligent" microcontrollers that ensure the execution of the control algorithm.

The use of artificial intelligence elements allows you to automatically configure a computer program to solve a specific task. The operator's participation is reduced only to the formation of a database of source data and the choice of the purpose of finding a solution.

The largest manufacturer of marine diesel engines MAN B&W is developing a package of computer diagnostics CCS EDS (Computer Controlled Surveillance Engine Diagnostic). The software package allows you to integrate it with the system of centralized control and monitoring of the main diesel engine through a standard interface. Thus, the system acquires data on the operation of the diesel engine, analyzes them and gives an assessment of the technical condition. The system can store data of normal operation mode of the diesel engine and a database of expert data, allowing you to give a conclusion about the deviation from normal operation and recommendations for the operation of the diesel engine.

Experts predict that the development of artificial intelligence will occur exponentially, which will allow computers to be used to analyze the future course and maneuvers of the vessel, increasing situational awareness of the crew and reducing accidents.

The development of piston engine building has entered a new phase – the creation, production and operation of super-intelligent engines of new generations. On this path, we are waiting for impressive scientific and technical ideas that will extend the life cycle of modern internal combustion engines for the foreseeable future, increase their importance in the global energy sector.

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THE ROLE OF METROLOGICAL SUPPORT IN INNOVATIVE ACTIVITIES

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ABSTRACT

The transition to new technologies sets a number of new specific tasks determined by the parameters and structure of innovative products to science and technology. Both the technological process of creating innovative products and the measurement of parameters, processing of measurement information, and ensuring the credibility and metrological reliability of measurements need metrological support. The functioning of modern measuring instruments is connected not only with the possibility of a purposeful choice of a rational measurement algorithm in a fixed situation but also with the procedure for making decisions about the nature of further actions. Therefore, fundamental research concerning the design of intelligent measuring instruments is currently being actively conducted in mathematical metrology.
The development of an electronic information and analytical system for measuring equipment will ensure the installation of the optimal range of quantitative target indicators and the formation of metrological measures of priority programs and projects.
The article considers the possibilities of successfully solving the problems of metrological support for the implementation of innovative technologies. The solution of such problems depends on the completeness, validity, and feasibility of metrological measures.
The expediency and necessity of the formation and implementation of metrological measures of innovative technologies are shown.
Keywords: Metrology, metrological support, quality, innovative activity, infrastructure, metrological measures, measuring indicators.

Introduction

Currently, in the Republic of Azerbaijan, the processes of modernization and the formation of an innovative economy are highlighted, they are implemented through a set of legislative and organizational measures, including the formation and development of an innovative infrastructure. A number of state programs and normative-legal documents contain provisions related to innovations. First of all, the Law of the Republic of Azerbaijan "On Science" (14.06.2016) [1] defines the main principles of the state policy in the field of organization, management and development of scientific activity in Azerbaijan, the goals of science and scientific-innovation activities, the mechanisms of financing science, and the stimulation of scientific achievements. The role of metrology, standardization and conformity assessment as a quality infrastructure is emphasized in Decrees, Orders of the President on innovation activities in the Republic. In recent years, special attention has been paid to considering organizations and institutions as part of the innovation infrastructure that provide services and perform work in the field of metrology,

standardization and certification, which contributes to the development of the metrological infrastructure.

A Memorandum of Understanding on cooperation was signed between the Institute of Standardization and Certification at the State Committee for Standardization, Metrology and Patent and the "Innovations Center" of the State Agency for Service to Citizens and Social Innovations under the President of Azerbaijan. The Institute of Metrology was transferred to the State Service of Antimonopoly and Consumer Market Control under the Ministry of Economy.

The effectiveness and efficiency of priority programs and projects is determined by a set of economic-static, technical, metrological and other indicators, the requirements for which are established by regulatory legal acts and technical documents acting in Azerbaijan Republic. One of the conditions for the effectiveness and efficiency of priority programs and projects involving the development of innovative technologies is their metrological security. Insufficient metrological security is the reason for the duplication of previously completed developments or the adoption of unreasonable decisions on the development of non-promising measuring technologies, the technical level of which does not meet the requirements of international and national standards. The use of modern national standards and measuring instruments contributes to better competitiveness of domestic products and the promotion of innovative products and technologies to the world markets.

Metrological services play an important role in ensuring the priority directions of the development of science, technology and engineering, one of the main mechanisms of the state innovation policy. The analysis of the data base of state standards showed that the standards satisfy the needs of the economy in the measurement capabilities of all priority directions of the development of science, technology and technique, as well as in the metrological provision of new technologies corresponding to these directions. Taking into account the importance of these technologies and the priority directions of the development of science, technology and technology for the implementation of the scientific and technical policy of the state and the formation of an innovative economy, all types of subjects of innovative infrastructure, which are necessary for any country, including such a subject as metrology, should receive timely support and development. That is why mandatory official registration is required as part of the innovation infrastructure of organizations and institutions providing services and performing work in the field of standardization, metrology and conformity assessment, i.e. quality infrastructure. This will contribute, in accordance with the requirements of the innovative economy, to the development of metrological infrastructure and increase the innovative activity of the domestic industry.

Metrological support – endurance of innovative processes

The measurement aspect of the theory of innovation lies in the need to develop and implement procedures for extracting and managing measurement information at various stages of the life cycle of innovation processes. Measurement information about the complex dynamic systems of modern industries is equally important for improving the management of technical systems and socio-economic ones. Technological innovation management is associated with the management of measuring information of various enterprise resources in the context of a process controlling model. A modern digital enterprise, as a complex dynamic system, operates with measuring information that is characteristic of both technical systems and socio-economic ones (measuring information about the business processes of an enterprise). Measuring information about business process indicators serves as the initial information for the formation of a business decision.

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Directed adjustment of the measurement results will allow to manage the key performance indicators of the enterprise.

The main trends in the construction of metrological measures and the evaluation of quantitative indicators and indicators of innovative programs are shown in Fig. 1 [2]:

Scientific and technical innovations cause the need to develop new types and units of measurements, which stimulates the development of fundamental and applied metrology, and this, in turn, allows the introduction of new instruments and devices for any field of technology. In other words, metrology supports research and development and other innovative processes in enterprises and organizations that lead to innovation.

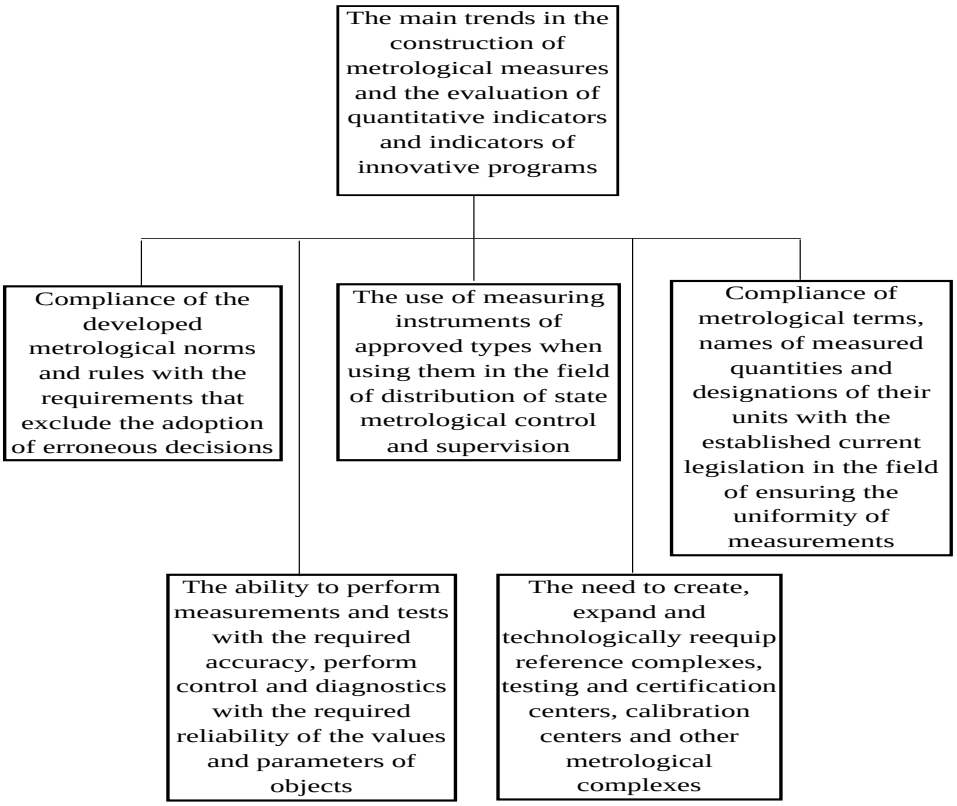

Figure 1. The main trends in the construction of metrological events.

metrology supports research and development and other innovative processes in enterprises and organizations that lead to innovation. Thus, we can talk about a kind of "self-reinforcing mechanism" that links metrology, operational measurements, research and development and innovation (Fig. 2).

Numerous studies confirm the positive impact of metrology not only on the economy, but also on the activities of people and society as a whole. The most significant areas can be identified.

1. Metrology improves the quality of production processes, labor productivity.

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2. Measurements contribute to the development of an innovative culture of society, its readiness for new quality, since they provide objective evidence that an innovative product is actually the best.
3. Improvement of metrological support contributes to the improvement of the quality of commodity-money relations in a market economy due to the reduction of transaction costs between suppliers and consumers.
4. The development of metrology has a multiplicative effect, as it contributes to improving the quality of not only industrial goods, but also services (for example, the development of the educational sphere is also associated with the ability to assess the quality of student training, the work of educational institutions).

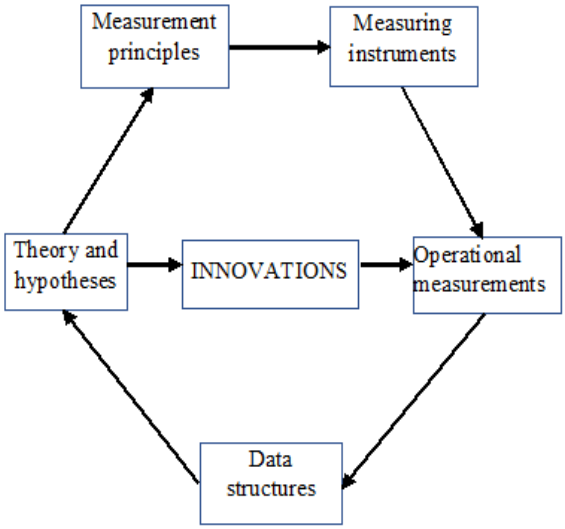

Figure 2. Self-reinforcing mechanism [3].

The functioning of modern measuring instruments is connected not only with the possibility of a purposeful choice of a rational measurement algorithm in a fixed situation, but also with the procedure for making decisions about the nature of further actions, therefore, fundamental research in mathematical metrology is currently being actively conducted, concerning the design of intelligent measuring instruments.
The introduction of the concept of virtual measuring circuits as an innovation in assessing the reliability of metrological analysis makes it possible to implement the analysis and synthesis of measuring circuits in the presence of the necessary composition of a priori knowledge about the measurement procedure.
Measurements of tactical and strategic levels of management are determined to a greater extent by economic measurements, which are the values of business process indicators. Economic measurements are represented by a set of values of business process indicators. For each indicator of the business process, its own series of sample data is accumulated. However, such an indicator as the economic situation must be assessed using a set of indicators - a set of sample data series.

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For the analysis of sample data, methods of statistical analysis, fuzzy logic, neural networks, expert assessment methods.

The system of metrological support of programs, innovative projects development and modernization of the economy [2], consisting of scientific-educational, informative- analytical and regulatory-technical modules, which all together allow you to create a mechanism that let us solve the following tasks:

- monitoring, analysis and selection of measuring technologies developed or used in innovative programs and projects, assessment the level of their metrological support;
- training and advanced training in the field of metrological and regulatory support of programs for employees involved in the development, examination and implementation of innovative programs and projects, in order to acquire the necessary and sufficient level of qualification to perform work on the formation, examination and implementation of metrological measures;
- development of standard- regulatory and standard -technical documents that establish and ensure the procedure for the formation, examination and implementation of metrological measures of innovative programs and projects, the complexity, completeness and sufficiency of metrological indicators, as well as the reliability of metrological indicators.

The main goal of the integrated metrological support system is to increase the targeted effectiveness and economic efficiency of innovative programs and large high-tech projects implemented within their framework. This goal is achieved through the development and use of competitive and perspective measurement technologies, confirmation of compliance with mandatory metrological requirements and the implementation of planned metrological measures, obtaining reliable and comparable measurement results, monitoring and diagnostics and, accordingly, excluding the adoption of unreasonable decisions and erroneous actions based on unreliable measurement information.

One of the main tasks to be solved in the implementation of the informative-management system of metrological support of innovative technologies is to make a rational decision on the development of a new measuring technology or the use of already used measuring technologies. The complexity of solving this problem lies on the fact that it is quite difficult to choose the most effective solution, since a huge fleet of measuring instruments and at the same time the lack of reliable and up-to-date information about specific samples of measuring equipment makes it much more difficult to choose the optimal solution. Innovative products require special approaches to determining their characteristics, since they may have unique values. Precision techniques and measuring instruments should be used to determine these values.

Metrological activities are formed taking into account the system of quantitative indicators that provide the ability to verify and confirm the achievement of the intended goals and solve problems implemented by innovative technologies. The values of most indicators have metrological roots and their evaluation is associated with the measurement of physical quantities with established accuracy and reliability. In this case, only the use of an innovative system for metrological support of innovative technologies becomes an effective tool that allows developing and implementing the intended goals and solving the tasks set.

An approximate list of measures for the metrological and regulatory support of innovative programs and their metrological and regulatory expertise is determined by the State Programs. The need for a mandatory examination of the requirements for measurements, standard samples and measuring instruments contained in the draft regulatory legal acts of the Republic is

determined in the Law of the Republic of Azerbaijan "On ensuring the uniformity of measurements" [4]. But despite the significance of the steps taken, the task of creating a unified integrated system of metrological support for state technological, product and environmental programs for innovative development of the economy has become more relevant in the implementation of innovative programs. The programs lack indicators of adequacy, accuracy, reliability, reproducibility of the planned indicators, which is a consequence of the lack of unified legal and intersectoral scientific and methodological mechanisms that determine the procedure for the development and examination of metrological measures and quantitative indicators, as well as an insufficiently high level of competence of the management implementing and guiding practice in this area.

The effectiveness of the developed innovative technologies can be assessed by the level and completeness of metrological support, including metrological indicators and measures that must meet the mandatory metrological requirements and characteristics of measurements, measurement standards, standard samples, measuring instruments and the conditions under which these characteristics must be provided.

The fulfillment of these requirements encounters significant difficulties due to the huge amount of data on the developed, operated and supplied measuring instruments, information-measuring systems and test equipment. Therefore, there is a need to search for a qualitatively new approach to solving the metrological support of innovative technologies. Providing developers and performers with operational information about competitive tools for metrological support of innovative technologies will allow to make the optimal choice of quantitative values of indicators and form the metrological measures necessary to achieve them. The development of an electronic information and analytical system for measuring equipment will ensure the installation of the optimal range of quantitative target indicators and the formation of metrological measures of priority programs and projects.

Conclusion

Today, in the context of the globalization of the world economic and socio-cultural space, the solution of quality issues is becoming the most important component of the success of socio-economic development. And since mankind is unlikely to turn off the path of globalization, the solution of quality issues in all its diversity of manifestations is becoming more and more relevant.

As it is known, quality is achieved through innovation. However, in order to consolidate an innovation, it is necessary to learn how to measure its parameters and characteristics. This is the main task of metrology. Therefore, today, when knowledge in any field is rapidly updated, refined, new data and facts appear that require evaluation and scientific understanding, metrology is becoming an increasingly popular science. Correct and accurate measurements create a solid foundation for making effective management decisions, reduce the risk of error, and therefore improve quality. Metrology, standardization and certification are types of quality control, now they belong to the quite common category - "quality infrastructure" [5].

Beginning of the 21st century coincided with the formation of the sixth technological order as a set of technologies characteristic of a new level of production development and capable of giving mankind an increase in labor productivity and an improvement in the quality of life. These are bio- and nanotechnologies, means of production with artificial intelligence, new medicine, “smart” energy supply networks, including alternative ones, etc. At the same time, the state

scientific and technical policy is practically implemented through the growth of innovative activity.

Scientific and technical innovations cause the need to develop new types and units of measurement, which stimulates the development of fundamental and applied metrology, and this, in turn, allows the introduction of new instruments and devices for any field of technology. In other words, metrology supports research and development and other innovative processes in enterprises and organizations that lead to innovation.

Creation of a unified integrated system of metrological support for state technological, product and environmental programs for innovative development of the economy

Providing developers and performers with operational information about competitive tools for metrological support of innovative technologies will allow to make the optimal choice of quantitative values of indicators and form the metrological measures necessary to achieve them.

The development of an electronic information and analytical system for measuring equipment will ensure the installation of the optimal range of quantitative target indicators and the formation of metrological measures of priority programs and projects.

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INTELLIGENT CONTROL SYSTEMS IN OIL REFINING PROCESS

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ABSTRACT

The oil refining industry is an industry with high requirements for process control. Nowadays, an important problem is the creation of the concept of control systems for oil companies and enterprises. Oil is one of the Earth's most important resources. Its extraction and processing have become relevant for mankind. However, in the modern environment, the tasks of extracting oil with the latest equipment, as well as the use of cleaning and processing with minimal losses, have become important. This paper discusses intelligent control systems and their use in the oil refining industry. The purpose of the abstract is to create a structure that will be useful in the respective enterprises. But in order to achieve the goal of the work, it will be necessary to take into account such common problems as the instability of demand; restrictions imposed by the state and many others. That is why the features of each enterprise, which may bring various risks in the future, are considered at the design stage. Also, (it is necessary to indicate that,) the implementation of intelligent control systems in various industries is a time-consuming process. In these situations, the heads of enterprises need to take into account the human factor and help their employees adapt to new systems in every possible way. Among these methods, there are incentives with awards, the introduction of a team to train how to work with intelligent systems, and others. To delve into this topic, it is initially necessary to consider intelligent control systems separately from the oil refining industry.
Keywords: automated control systems, deposits, oil refineries, quality of intelligent systems.

Introduction

Accurate reporting on the production resources of many sectors of the national economy (energy, water supply, gas supply, heat supply, supply of petroleum products and many other sectors) always leads to an intersectoral problem consisting in the uneven differences between the results of measuring resource producers and the results of multiple measurements in the distribution of these resources to consumers. An accurate report is based on the results of measurements of various physical quantities carried out by modern automated information-measuring control systems (IMCS). Currently, due to the rapid development of digital computing technology, there are practically unlimited opportunities to create modern automated IMCS of various classes. Minimization of measurement errors in the construction of automated IMCS, delivery of oil products to numerous consumers is an interdisciplinary problem.

Intelligent control systems (ICS) are the ultimate in complexity class of automated control systems (ACS), focused on the acquisition, processing and use of some additional information, understood as "knowledge". These systems are made to work with uncertain information about the various qualities of objects and their functioning. If the level of data inaccuracy is very high, then

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it is necessary to apply new information technologies, that is, to develop new principles for building intelligent control [5].

Intelligent control occurs where information is considered to be a collection of data and relationships between them in the current interpretation. For meaningful management, you need a database if the context and relationships of the data are constant. If the essence of the information is quite complex, and the purpose of the work and the context are adjusted over time, then the database needs to restructure internal relationships. A distinctive feature of intelligent management is just these requirements for restructuring, which allows you to actively interact with information. Intelligence characterizes how the system relates to the outside world. Intelligence helps to form an image that affects the reaction to external stimuli. It is used during interaction with other complex systems and reorganization of internal communications. The main factor in the operation of intelligent systems is related to knowledge. Classical control does not require such a configuration, since it cannot be broken down into these structures. Management through the “image” needs to take into account the specifically accumulated knowledge and more critically reacts to changes in information in the process of work. The intellectual properties of the "object - control" system have a discrete manifestation [7].

Given the database definitions of intelligence, a system can only have these properties at certain times. To be more precise, intellectual characteristics appear at the moments of modification of the knowledge base, which essentially gives a new context. With a stable structure, these properties are not necessary on a permanent basis [2].

The apparatus for restructuring knowledge bases is based on mechanisms similar to the "arrangement function". For the legitimate use of a finite automaton (computer) as part of an intelligent system, the theory should consider the possibility of constructing abstract structures that implement objects that are not computable in the usual sense. The oil refining industry is a branch of heavy industry covering the refining of oil and the production of petroleum products [4].

An increased interest in oil deposits and its distillation in order to obtain more valuable products began in the first half of the 19th century. In pre-revolutionary Russia, oil refining was carried out according to primitive technology; kerosene was the main processed product that was marketed. Oil refineries were concentrated mainly in the Caucasus (in Baku and Grozny). The share of foreign capital accounted for 56% of all capital investments in the oil industry (1917) [1].

Now the main direction of development of oil refining is the modernization and reconstruction of existing oil refineries with the advanced construction of capacities to deepen oil refining, improve the quality of petroleum products and produce catalysts. Such results can be achieved precisely through the use of intelligent control systems in production processes [3].

The creation of intelligent systems is a very complex process, which includes such items as inspection of production facilities, development of an automation concept, design of control systems, technical support, consulting and many others. The concepts should contain the structure of the entire intelligent control system, all kinds of applications and suppliers of software and hardware systems. Also, there should be decisions on building a network structure, a schedule for the implementation of work and their stages. Development and coordination of design solutions take place at the stage of technical design. This approach allows you to create intelligent control systems with minimal resources. To implement this idea, it is necessary to solve the following set of tasks in laboratory business processes: reducing the time of analysis using equipment, standardizing and systematizing information, ensuring confidentiality, reducing labor costs for

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document management, maximizing throughput, monitoring the adequacy of instruments, reducing the input of errors, etc.
Laboratory information management systems should cover all enterprise structures and provide for comprehensive automation of quality management [9].

Disadvantages of Existing Automation Techniques.
The unstable economic situation, the lack of stable development in the field of oil refining and other problems create obstacles for the growth of this industry and the introduction of information technologies into it. The main external disadvantage is fluctuations in demand, which affect the use of production capacities. Also harmful is the instability of supply, which depends on price, quality, availability and profitability. In addition, government regulations also impose restrictions on the supply of products.
Awareness of all these facts leads oil refineries to the use of hardware and software systems to support management decisions. They apply to information process modeling technologies, design tools, simulation optimization methods, performance monitoring, energy management, and more [8].
Another major disadvantage of automation concerns the recycling of production waste. In the oil industry, they are called oil sludge. These products are very dangerous for people and the environment. The composition of oil sludge may vary depending on the production. However, these wastes are often stored in the same way - in worn-out and overcrowded storage facilities, which may be located near water bodies. The lack of desire to allocate the necessary funds for recycling leads to the fact that in this area it becomes practically unmanageable and cannot be automated. This can be solved by including in the technological series of management and the creation of reports on this activity in the information branch. The ideal model of an intelligent control system, of course, implies ideal situations in production processes. However, the desire for this contributes to any changes for the better [12].
The need to create an intelligent development management system hydrocarbon deposit was determined considering the following circumstances: [3].

1. Increasing uncertainties and associated risks of natural (for example, during the development of deep deposits of hydrocarbon deposits raw materials or with hard-to-recover oil reserves) and market (change demand/supply and various price fluctuations for hydrocarbon resources) nature and risks caused by the human factor.
2. The emergence of new, innovative technologies and equipment for mining hydrocarbon raw materials, as well as systems for providing comprehensive monitoring development of oil and gas fields.
3. A significant increase in the volume of geological and field information and application different types of software and hardware systems for its collection, transmission, processing, analysis and storage.

With the help of a digital (virtual) permanent geological and technological oil field model it is possible to provide an effective solution to the following tasks: [10].

a. clarification of the geological structure of deposits (deposits) in the process drilling new wells;
b. calculation of various development technology options: determining the nature and the degree of development of explored reserves (when analyzing the distribution fields saturation of various fluids and specific residual reserves hydrocarbons), as well as

identifying the features and conditions for promoting process waters injected into the reservoir;

c. forecast of optimal rates of fluid (oil, gas and water) withdrawal in production wells;
d. improving the efficiency of operating modes of production wells;
e. planning of various geological and technical measures (GTM) and calculation economic efficiency of their implementation;
f. forecast of the state of development of a hydrocarbon deposit (in the course of purposeful change in the conditions for the development of productive formations in within the planned GTM).

The essence of the concept of "smart" oil fields is to ensure transparency and instant availability of any required production parameters and performance indicators of an oil production enterprise: technological, technical, geological, ecological and economic. This availability of constantly growing production data (and necessarily in real time) allows you not to simple to organize remote control of oil production facilities, but also significantly improve their existing energy efficiency, as well as ensure significant growth almost all performance indicators of equipment operation, and besides this - optimize staff performance. The core of an intelligent oil and gas development management system deposits of hydrocarbon raw materials is a software and hardware complex, capable of providing a real-time analysis of a rather voluminous fishery information, and as a result of which the prompt identification of any deviations from the design (set) parameters, the formation of effective options control actions and the development for them of optimal technical, technological and logistics solutions, and in some cases the independent implementation of these solutions (still with permission from the operator).

In accordance with this approach, the "smart" oil field is a system for operational management of oil production processes, which includes a set of specific business processes aimed at optimizing production and reduce financial costs through the timely identification of emerging problems and quickly making optimal decisions, based on the received real-time production data [11].

Development of an ideal model of an intelligent system.

Over the past decades, there has been a great leap in the development of information technology. Legacy oil refining systems face many challenges. Old technologies reduce productivity and slow down reorganization. For this reason, modern enterprises compete in the use of the latest scientific achievements, which increases competitiveness and positively affects production. Each enterprise has its own individual situation, which makes the development of any ideal model abstract without taking into account the particular. However, this quotient must be calculated at the design stage. In production, there should be a desire to maximize the use of analytical data in order to minimize all risks. In this way, problems can be avoided in technological, economic, and other terms. In some situations, a phased introduction of reconstruction is possible. Failure to take these measures will result in greater losses due to maintenance costs and lower revenues. The main thing is to reflect the real amount of work for such an update. The final choice of software and technical means of automation systems, control and security systems is always with the consumer, considering the following requirements: reliability, guarantee of technical support, full integration of technical solutions. At the same time, the software, which is one of the most important elements of the automated management and control system, must be original and approved by the relevant government agencies to protect against malfunctions, various types of freezes and unauthorized access. Currently, in practice, the volume-mass dynamics method and direct mass

flow measurement systems are widely used. Measuring devices for liquid volume consumption are divided into two types: absolute compaction (volume) meters and indirect measuring meters. Volumetric meters measure flow directly by dividing the flow into specific volume fractions and calculating these fractions. In indirect meters (primarily turbine meters), the flow rate is determined based on the measurement of some dynamic characteristics of the fluid flow [6].

As a rule, the value measured by the meter is converted into electrical impulses that are proportional to the volume of fluid passing through the meter. The most important characteristics of the meter for practical application are as follows: [12].

a. Coefficient k is the number of pulses that occur when a volume of liquid passes through the meter;
b. the characteristic of the meter is the dependence of the coefficient K on the flow rate;
c. linear-maximum sharpness in the range of processing consumption between the actual value of the coefficient K and the accepted fixed value;
d. dynamic range is the interaction of the maximum possible and minimum costs for certain characteristics.
e. reproduction (reproduction) – the ability of the measured system to reproduce the output signal during a series of calibration tests under stable operating conditions.

Turbine flowmeters. It is achieved at the expense of high accuracy and repetition of the statements of the calculators:

- optimal constructive solutions;
- high class of processing and manufacturing accuracy of details;
- properly selected high-quality materials;
- high balancing level of rotor;
- the use of filters that eliminate large solid particles in the liquid;
- application of plates in front of the turbine flowmeter, which level the surface of the flow rate;
- application of modern electronics and microprocessors as secondary equipment;
- testing of each meter at the factory-manufacturer;
- high accuracy of Assembly;
- regular individual calibration of flow meters under operating conditions over the entire flow range using high-precision calibration tools (fuses).

Volume counters. Volumetric meters have been used for decades, have significant dimensions and are more expensive than turbine meters of the same consumption, have a more complex interior design, more moving parts. The advantages of these meters should include:

- can be installed close to other fixtures and fittings without dividing directly into sections and without flow aligners;
- lower pressure loss on the meter itself and reduced overall losses due to lack of flow rectifiers;
- high release viscosity unlike turbine meters;
- a wider permissible range for measuring viscosity without taking into account the K-factor of the meter.

Mass flowmeter. Recently, vibration Coriolis flowmeter devices have been used to calculate mass flow, this flowmeter provides direct measurement of mass flow. In these flowmeters, the Coriolis effect is applied, the Coriolis effect consists in the fact that a body moving at a certain linear speed in a rotating coordinate system is affected by the force of inertia (Coriolis), which is in the

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ratio of speed and mass. Mass flowmeters are produced by most traditional flowmeters manufacturers. The advantages of mass flowmeters are as follows:

- direct measure of mass;
- large dynamic range;
- non-dependence of flowmeter properties on liquid properties (density, viscosity, presence of gas);
- there is no need for direct sections before and after flowmeters;
- lack of moving parts;
- the ability to measure density.

There are following parameters of intelligent systems.

Table 1. Parameters of intelligent systems.

Internal	External
structual	load
functional	environment parameters
x_i	particular performance indicators
a_i	weight indicator coefficient of x_i

In general terms, the system design problem is formulated in the following way. The purpose of the intelligent system is set, determined by: [11]

- a list of functions assigned to the system;
- a list and values of load parameters that describe;
- the interaction of the system with the external environment and the need for resources;
- systems for the implementation of specified functions;
- requirements for the characteristics of the system - power, temporary, reliable, economic, limiting admissible values of characteristics.

It is required to determine:

- structural organization of the system, i.e. nomenclature and composition elements, as well as the configuration of links between them;
- functional organization of the system, i.e. mode system functioning, satisfying the given requirements and maximizing (minimizing) direct (inverse) efficiency criterion.

Requirements for the quality of the functioning of the intellectual systems in the form of restrictions on characteristics and efficiency criteria are formulated on the basis of the analysis of the results of model experiments. [9]

The formation of an efficiency criterion involves the construction a generalized performance indicator based on a set of private indicators based on one of the following approaches:

- construction of a composite efficiency criterion in the form of an additive F1 or multiplicative F2 functional;

$$F_1 = \sum_{i=1}^{k} a_i x_i;$$

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$$F_2 = \frac{\prod_{i=1}^{k} x_i}{\prod_{i=k+1}^{k} x_i}.$$

choice as an efficiency criterion F of one quotient indicator with restrictions imposed on other indicators efficiency:

$F = x_j$ under restrictions $x_i < x_j$ or $x_i > x_j$

for all $x_i \neq x_j$.

Solution of the problem of design (synthesis) of a new or modernization existing intelligent system with specified properties is to determine the parameters of the structure and functioning systems that provide specified restrictions on characteristics systems. [1]

The ideal model should combine a complex of rapid response to non-standard situations and an adapted base for the coordinated action of all services. The main difference between an abstract system and a traditional one is a significant increase in productivity while reducing costs. New intelligent technologies help to increase the efficiency of the work of console operators, control engineers and maintenance specialists.

Conclusions

This article shows the impact of intelligent systems in the modernization of management in the oil refining industry. The possibilities and features of the production of petroleum products are disclosed. The industry has been looked at from different angles, which helped to make an assumption about which direction it is worth going in order to succeed. The main conclusion is that technology and scientific progress are only aids to production. However, in the implementation process, you need to take into account all the risks and deal with possible problems so that the enterprise reveals its full potential.

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THE USE OF "SOFT COMPUTING" FOR THE DIFFERENTIAL DIAGNOSIS OF THE FUNCTIONAL STATE OF THE CARDIOVASCULAR SYSTEM

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ABSTRACT

The application of soft computing technology for diagnosing the functional state of the cardiovascular system is considered. Soft computing technology uses fuzzy sets, fuzzy logic, fuzzy neural networks, genetic algorithms and evolutionary modeling as tools. Various methods of soft computing technology in solving various problems often complement each other when used in various combinations. This technology is focused on solving control problems with semi-structured control objects. The main informative indicators (indicator variables) characterizing the functional state of the cardiovascular system and obtained on the basis of statistical information are identified. These informative indicators include the tension index, the vegetative rhythm index, the indicator of the adequacy of regulatory processes, the tension index of regulatory systems, and also special indicators that are derivatives of classical statistical indicators: respiratory modulation index, functional arrhythmia index, cardiorespiratory synchrony index, parasympathetic control destabilization index. The quality of the classification of possible diseases is determined by indicators such as sensitivity, specificity, predictive value and diagnostic efficiency.
Keywords: Neural networks, fuzzy inferences, diagnostic conclusion, confidence coefficient.

Introduction

Cardiovascular diseases of various etiologies are one of the key problems of modern medicine. Despite significant advances in the diagnosis and treatment of cardiovascular diseases in recent decades, the number of patients with this type of pathology continues to increase. Due to the fact that the effectiveness of the treatment of cardiovascular diseases largely depends on the accuracy of prognosis, diagnosis of stages and their severity, one of the main directions in choosing a rational strategy for managing patients with this pathology is to improve classification methods, including predicting the onset of diseases, prenosological and differential diagnostics. Known methods of examining patients with cardiovascular pathology, as a rule, provide their accurate nosological interpretation. However, in a number of cardiovascular diseases, known approaches require significant costs, sometimes using very painful invasive procedures. In this regard, the task of finding methods that facilitate and accelerate the procedures for predicting and diagnosing various types of cardiovascular pathologies becomes relevant. It is possible to improve the quality of solving the studied class of problems using the methods of fuzzy set theory in combination with exploratory analysis, and reflexology with the addition of modern information technologies. Existing methods and tools for diagnosing cardiovascular concerns do not provide the required quality of classification under the given restrictions on decision-making time and technical and economic costs, and a high percentage of these diseases require solving the problems of improving the quality of diagnosis and treatment, the problem of increasing the efficiency of

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decision support systems that allow to study various manifestations of cardiovascular disease is very relevant. An analysis of the literature data and our own research led to the conclusion that the tasks of predicting and diagnosing an early stage of cardiovascular diseases in conditions of a shortage of expensive non-invasive equipment are characterized by the fact that the signs used (data from a survey, examination, instrumental and laboratory studies) are heterogeneous. and often fuzzy and incomplete, and the distinguished classes have a complex, intersecting structure. Under these conditions, it is most expedient to use the theory of fuzzy decision-making logic based on exploratory analysis data. The tasks of diagnosing and predicting cardiovascular pathology, as well as other tasks of medical forecasting, can be considered as determining the answers to one of the following questions: a) to determine with what confidence, in the presence of certain risk factors, the subject can develop the selected cardiovascular pathology within a fixed time interval? b) determine after what time and with what certainty the subject may develop a particular cardiovascular disease, taking into account possible concomitant diseases with certain sets of risk factors with a given time limit?

A natural limitation on the tasks of medical forecasting in the conditions of observation of a large contingent of subjects are temporal and technical and economic constraints. These limitations, as well as the real state of affairs with monitoring the health status of the population of the regions, lead to the fact that the informative signs used for forecasting, and in particular risk factors, are most often collected in insufficient volume (incompleteness of the characteristic description). Used signs are measured in various quantitative and qualitative scales (heterogeneity of the structure of signs). Often, experts find it difficult, and sometimes they cannot express in clear terms what the expected prognosis for a particular class of diseases is for the selected, given and (or) obtained by available methods values of informative features [1, 11].

When solving classification problems in the case of fuzzy logical inference, it is proposed to use a medical application based on the use of confidence coefficients in the used giontheses. The possibility of using artificial neural networks for the analysis of electric cars is shown. diographysical signals, where the measured and calculated informative features were used as input parameters.

The decision recommendation system in this study aims to determine the amount of building materials that must be available to meet the construction needs of a residential project. Calculating the right amount of building materials is very important for the project as it determines the amount of budget the construction company has to allocate. This decision uses a Tsukamoto fuzzy inference system to help determine the quantity of building materials needed based on inventory data and number of requests. Decision making in this study was modeled with three variables. Each variable consists of her 3 fuzzy sets. Inventory levels in this system are determined by the concentrated average de-fuzzification method. The proposed method can accurately predict the amount of building materials. The test data accuracy is displayed based on the MSE obtained from the prediction results. From the error calculation, we can conclude that the actual orders placed with the company had an error of 0.11505 compared to the Tsukamoto FIS calculation. From this we can conclude that the method works well in this system and has a high level of accuracy.

Diagnostic conclusions are routine in clinical practice, have great implications for patients, and determine subsequent treatment. However, many patients rarely understand the complexities of this process and are often misunderstood by their physicians.

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The confidence factor is the percentage of samples of a given size expected to contain the true mean. This means that given 95% confidence intervals, if many samples are collected and confidence intervals are calculated, about 95% of those intervals will contain the true mean over time. increase.

Soft computing technology is focused on solving control problems with semi-structured control objects. This technology uses fuzzy sets, fuzzy logic, fuzzy neural networks, genetic algorithms and evolutionary modeling as tools. Various methods of soft computing technology in solving various problems often complement each other when used in various combinations.

A characteristic feature of the functioning of complex objects (including living organisms) is that the information available for measurement is incomplete and fuzzy, and the classes of their states are not amenable to a strict analytical description and are evaluated by a set of fuzzy judgments. Inference mechanisms are based on fuzzy decision logic [1].

Statement of the problem

Consider the application of soft computing technology for diagnosing the functional state of the cardiovascular system. To do this, first of all, we select informative indicators (indicator variables) that characterize the functional state of the cardiovascular system and are derivatives of classical statistical indicators [2]:

- stress index

$$SI = \frac{AM_0}{2XM_0}, \quad (1)$$

where M0 is the mode determined by the number of the most frequently occurring RR intervals; AM0 is the mode amplitude, defined as the proportion of RR intervals corresponding to the mode value; X is the variation range, calculated as the difference between the duration of the largest and smallest RR intervals.

- index of vegetative balance

$$IVB = \frac{AM_0}{X}; \quad (2)$$

- vegetative rhythm indicator

$$VRI = \frac{1}{M_0}X; \quad (3)$$

- indicator of the adequacy of regulation processes

$$IARP = \frac{AM_0}{M_0}; \quad (4)$$

- index of tension of regulatory systems

$$ITRS = \frac{AM_0}{2 \cdot X \cdot M_0}. \quad (5)$$

Special indicators:

- respiratory modulation index

$$RM = \sqrt{\Sigma\left(\frac{R_{i+1}-R_i}{2}\right) \cdot \frac{2}{N_1}} \cdot 100\%, \quad (6)$$

where N1 is the number of half differences of RR intervals (-25÷+25 ms);

- functional arrhythmia index

$$FA = (1 - DM/RR_{variation}) \cdot 100\% - 30 \quad (7)$$

- average SI interval;

-index of cardiorespiratory synchrony

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$$CS = SI/RR_{average.}; \quad (8)$$

- destabilization index of parasympathetic control.

The spectral relative index is the most informative

$$SI = \frac{LF}{HF}, \quad (9)$$

where LF is the low-frequency component of the heart rhythm, the main spectral power of which falls on the frequency range 0.04÷0.15Hz; HF is the high-frequency component of the heart rhythm, the spectral power of which lies in the range of 0.15÷0.4Hz. The SI index characterizes the balance of influence on the work of the heart of parasympathetic and sympatheticpatic departments.

International Indices:

- standard deviation - SDANN;
- root-mean-square deviation of differences between adjacent cardiointervals - RMSSD;
- percentage of adjacent cardiointervals that differ from each other by more than 50ms - pNNSO.

Solution of the problem

The level of functioning of the cardiovascular system is the most important indicator that reflects the level of harmonious interaction between a person and the environment and the adaptive capabilities of the body. To assess the functioning of the cardiovascular system and assess its adaptive potential, the index of functional changes (health index) is also determined according to the formula

$$IFI = 0{,}011 \cdot css + 0{,}014 \cdot SBP + 0{,}008 \cdot DBP + 0{,}014V + 0{,}009m - 0{,}009R - 0{,}27,$$

where IFI is the index of functional changes, HR is heart rate, SBP is systolic blood pressure, DBP is diastolic blood pressure, P-growth; m is body weight, B is age, 0.027 is an independent coefficient.

Depending on the value of the IFI according to table 1 find the appropriate level of functioning of the cardiovascular system (CVS).

Table 1. Depending on the value of the FFI - the corresponding level of functioning of the CCC.

Group	Performance level (adaptive potential)	FFI values (points)
one	Satisfactory	less than 2.60
2	Tension mechanisms of adaptation	2.60-3.09
3	Unsatisfactory adaptation	3.10-3.49
four	Disruption of adaptation	3.5 and above

Pre-hospital screening based on the coefficient of health is based on the position of the state of the circulatory system as an indicator of the whole organism. The range of changes in the other indicated indicators in normal and pathological conditions is given in [3]. To objectify the results obtained, statistical tests of fuzzy decision rules are carried out on representative control samples.

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The sample size is determined in accordance with the recommendations [4] and is selected in such a way that the number of not sick and sick patients remains constant and amounts to 100 people for each class. This made it possible at each stage of the research not to violate the estimate of the probability of correct classification chosen as the standard at the level of 0.95.
The quality of classification is determined by such indicators as sensitivity, specificity, predictive value and diagnostic efficiency [5]. The distribution of observational results is shown in Table 2.

Table 2. Distribution of observation results.

Subjects	Research results		Total
	positive	negatve	
Number of surveyed classes$\omega_\ell - n_{\omega_\ell}$	True (IP)	False (LO)	IP+LO
Number of surveyed classes$\omega_0 - n_{\omega_0}$	False (LP)	True (IR)	LP+IO
Total	IP+LP	LO+IO	IP+LO+LP+IO
*- classes for comparison change depending on the pair being checked.			

LP is a false positive result, numerically equal to the number of healthy people classified by the decision rule as patients with a predictable (diagnosable) disease.
LO - false negative result, numerically equal to the number of people in the classω_ℓ, classified by the decision rule as healthy people.
IP is a true positive result, numerically equal to the quality of people of the class, correctly classified by the decision rule.ω_ℓ
AI is a true negative result, numerically equal to the number of sick people classified by the decision rule as healthy people.ω_ℓ
The diagnostic sensitivity (DS) of the decision rule in relation to the class is determined by the ratio of the frequency of true positive results to the number of patients, i.e.

$$DS = \frac{IP}{n_{\omega_\ell}}. \qquad (10)$$

Diagnostic specificity (DS) of the decision rule in relation to the class$\omega_0$represents the ratio of true negative results to the number of healthy people, i.e.

$$DS = \frac{IO}{n_{\omega_0}}. \qquad (11)$$

The predictive value of positive results of PZ+ is determined by the expression

$$PZ^+ = \frac{IP}{IP+LP}. \qquad (12)$$

The prognostic significance of negative results PZ- is determined by the expression

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$$PZ^{-} = \frac{IO}{IO+LO}. \qquad (13)$$

Diagnostic efficiency (DE) is determined from the expression.

$$DE = \frac{IP+IO}{IP+LP+LO+IO}. \qquad (14)$$

When solving classification problems using the theory of fuzzy logic, it is necessary to calculate the membership functions, which is determined in relation to the elements (points) of the sets. However, when solving the classification problem to process each individual point, as it is implemented in set theory, the general properties that form the basis of classification are easily lost. This may lead to incorrect results.

Another approach to fuzzy inference is proposed specifically for medical applications and is based on the use of confidence coefficients in the hypotheses usedω_ℓ[6]. This approach is based on the assumption that two mutually reinforcing evidence (signs, indicators) should increase confidence in the conclusion (prognosis, diagnosis), possibly giving a higher degree of truth than the average or even the maximum. On the other hand, a few pieces of evidence pointing in one direction cannot be fully offset by evidence pointing in the opposite direction. This logic of reasoning is implemented by the formula for calculating the confidence in the decision being made, which is determined through the corresponding coefficient of confidence CG$\omega_\ell\omega_\ell$:

$$KU_{\omega_\ell} = MD_{\omega_\ell} - MND_{\omega_\ell}. \qquad (15)$$

where$МД_{\omega_\ell}$- measure of confidence in the decision (to the classification)ω_ℓ,$МНД_{\omega_\ell}$- an appropriate measure of distrust.

In turn, each of the components is determined by iterative expressions of the form:

$$MD_{\omega_\ell}(j+1) = MD_{\omega_\ell}(j) + MD(Y_i)\cdot\left[1 - MD_{\omega_\ell}(j)\right];$$
$$MND_{\omega_\ell}(j+1) = MND_{\omega_\ell}(j) + MND^{*}_{\omega_\ell}(Y_q)\cdot\left[1 - MND_{\omega_\ell}(j)\right] \qquad (16)$$

where j is the iteration number, often coinciding with the numbers of features and (or) frequency (intermediate) confidence factors; - measure of confidence k from the newly received evidence (feature, combined indicator, etc.) to the moment when it has already been determined for all previous evidence; - a measure of distrust to from the newly received evidence.

$$MD^{*}_{\omega_\ell}(U_i)\omega_\ell Y_i MD_{\omega_\ell}(j) MND^{*}_{\omega_\ell}(U_q)\omega_\ell U_q. \qquad (17)$$

As the results of using fuzzy decision-making logic have shown, in medical practice, experts often use only those signs and (or) combined indicators as signs and (or) combined indicators, the analysis of which testifies in favor of the class . For example, a blood pressure scale can be used to indicate the degree of hypertension or hypotension.ω_ℓ

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Then, if there are no informative features that disprove the version , then , and the CG formula is modified to the expression:$\omega_\ell \mathrm{MD}_{\omega_\ell} = 0\omega_\ell$

$$\mathrm{KU}_{\omega_\ell}(j+1) = \mathrm{KU}_{\omega_\ell}(j) + \mathrm{KU}^*_{\omega_\ell}(U_i) \cdot \left[1 - \mathrm{KU}_{\omega_\ell}(j)\right];$$

where is the coefficient of confidence in from one evidence (factor) .$\mathrm{KU}^*_{\omega_\ell}(U_i)\omega_\ell U_i$

The meaning of the last formula is that the effect of new evidence in favor of the hypothesis with already known evidence affects the shift of CG towards complete certainty by a distance depending on the new evidence. Important properties of the above formula is its symmetry in the sense that the order of succession does not matter, and the movement towards the certainty of CG (MD or MND) is carried out as supporting evidence is accumulated.$(Y_i)\omega_\ell\omega_\ell Y_i\omega_\ell$.

Conclusions

The increase in the measure of confidence in the combined accounting of evidence, compared with the confidence in each of them taken separately, is consistent with the intuitive notion that several evidence pointing in the same direction should reinforce each other. There is no theoretical justification for these rules. MD and MSD are not probabilistic measures, although they obey some axioms of probability theory. They are not samples from any population and therefore cannot be given a statistical interpretation. However, they allow you to order hypotheses according to the measure of validity that they have.

One of the ways to increase the efficiency of diagnostic conclusions and classification of diseases is the addition of a decision support system to the software of computerized medical devices. The use of artificial neural networks is associated with pattern recognition, optimization, and data analysis [7]. Neural networks are widely used in medical diagnostics and treatment prognosis. Neural networks can also be successfully used to analyze electrocardiographic signals. Of the structures of neural networks under consideration, the three-layer perceptron can be considered the most acceptable, in which the measured and calculated above informative features (indicators) were used as input parameters of the initial data. At the output of the neural network, a diagnostic conclusion is formed.

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CRYSTAL STRUCTURE AND SURFACE MORPHOLOGY OF CD1-XFEXS SOLID SOLUTION-BASED THIN FILMS

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ABSTRACT

$Cd_{1-x}Fe_xS$ (x = 0.03) solid solutions were synthesized and thin films were obtained on their base by molecular beam condensation method. It was studied the effect of γ- irradiation on surface morphology, growth properties and crystal structure of obtained thin films. The characteristics of $Cd_{1-x}Fe_xS$ (x = 0.03) solid solutions exposed to γ-rays at doses of 50, 100 and 150 kGy from ^{60}Co source were characterized by XRD, SEM, EDX methods. XRD analysis showed that the orientation of crystal planes changes after γ-exposure. It was determined that the peak intensity of the (101) plane of $Cd_{1-x}Fe_xS$ solid solutions increased with the radiation dose. Sizes of crystallites increased after γ-irradiation. Thus it is possible to manage some crystal properties with γ-irradiation. XRD investigations demonstrates, that thin films grown on glass substrates at substrate temperature T_{sub}=470 K were polycrystalline structure and thin films grown at substrate temperature T_{sub} =670K were monocrystalline structure.
Keywords: Solid Solution, Semimagnetic Semiconductor, SEM, XRD, EDX, γ-radiation

Introduction

Cadmium sulfide (CdS) with a bandgap of 2.44 eV is considered to be one of the semiconductor compounds of II-VI group, and useful in solar cell devices, thin film transistors, optoelectronic devices, etc. making interesting material for application purposes. Thin films of CdS are more focused in the production of electronic devices, photovoltaic cells and optical detectors. In recent years, some research in the field of magnetic materials has been directed to obtain semiconductors with ferromagnetic properties at room temperature. Semiconductor compounds II-VI group containing Mn, Fe, and Co ions have been extensively studied for their properties as dilute magnetic semiconductors or semimagnetic semiconductors.

New class materials in which semiconductors are doped with magnetic impurities are II-VI semiconductors. Semimagnetic semiconductors (SMSC) is critical to the future of electronic science because it combines elements of semiconductors (charge) and magnetism (spin) into a single material known as spintronics [1, 2].

Nowadays, it is impossible to imagine modern electronics without thin films. Since devices are created on the surface of crystals, including all structural changes reflected in the parameters of devices, it is necessary to obtain thin films with perfect crystal structure and clean smooth surface. Meanwhile, one of the urgent problems of modern physics is to obtain radiation-resistant and radiation-sensitive materials with stable physical properties. It should be noted that due to the formation of radiation defects, changes in the physical properties of materials that are most strongly affected by ionizing radiation under certain conditions are observed. For this reason, it is

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important to study the effect of ionizing radiation on the physical properties of semiconductor materials. These materials have many promising applications in solar cells, optoelectronics, light amplifiers, light-emitting diodes, laser diodes, photoelectrochemical cells, nanosensing, and biomedical imaging [3-8].

$Cd_{1-x}Fe_xS$ thin films are of particular significance in actual application and basic research. Some works have been dedicated to the problem of physical properties of $Cd_{1-x}Fe_xS$ (x = 0.03) thin films. The current paper is about the investigation of the effect of γ-irradiation on the crystal structure and surface morphology of $Cd_{1-x}Fe_xS$ (x = 0.03) thin films.

Material and method

$Cd_{1-x}Fe_xS$ (x = 0.03) SMSC thin films of 1.5 μm thickness were deposited on cleaned glass substrates at the rate of υ=18-20 Å/s by molecular beam condensation technique in a vacuum of $(1\div2)10^{-4}$ Pa. All technical details and preparation methodology are reflected in our previous works [9,10].

Synthesis of $Cd_{1-x}Fe_xS$ solid solutions was obtained, therefore treatment of primary components: cadmium, sulfur, iron. In order to clean electrolytic iron covered with an oxide layer, we etch it in a solution of distilled water and nitric acid (HNO_3) taken in a ratio of 1:1, and then wash it in distilled water. We accurately weigh the primary components on the VLA-200 analytical scale. The following formula is used to calculate the amount of substances:

$$P_{Cd} = P \cdot A_{Cd} \cdot x / (A_{Cd} \cdot x + A_{Fe} \cdot y + A_S \cdot z); \quad (1)$$

$$P_{Fe} = P \cdot A_{Fe} \cdot y / (A_{Cd} \cdot x + A_{Fe} \cdot y + A_S \cdot z); \quad (2)$$

$$P_S = P \cdot A_S \cdot z / (A_{Cd} \cdot x + A_{Fe} \cdot y + A_S \cdot z), \quad (3)$$

where, P – total weight of charging, P_{Cd} – cadmium weight, P_{Fe} – Fe weight, P_S – sulfur weight, A – atomic weight of element, x,y,z – atomic share of Cd, Fe, S respectively [11].

It is noteworthy, which filling of drawn components into recycled and thermally treated ampoules is carried out in the same order. After creating a vacuum of $1 \cdot 10^{-4}$ Pa in the ampoules, its mouth is separated from the absorption system by melting and soldering, and then the process of synthesis of the materials to be processed is carried out. The ampoule set down in the horizontal furnace is heated to the melting temperature of the solid solution at 100 degrees/hour, and the temperature increases by 50 degrees after keeping for 3 hours. When the required temperature is obtained, the mixing mechanism is periodically changed for 2 hours. Then the temperature is reduced to T_{fus}. The bulb is kept at this temperature for 24 hours and the entire system is rotated periodically to mix the alloy well. After the synthesized samples undergo a homogeneous thermal treatment at a temperature of 873÷973 K for a week, the substance quantity of 10 g of $Cd_{1-x}Fe_xS$ (x =0.03) solid solutions is calculated using the above formula.

The rate of condensation is controlled by the temperature of the primary source. We can note that additional S source evaporation was used in order to obtain perfect film surface morphology without using any samples. It can be seen from the XRD studies that $Cd_{1-x}Fe_xS$ thin films develop in glass substrates at T=470 K have a polycrystalline structure, and at the substrate temperature T=670 K they have a monocrystalline structure.

$Cd_{1-x}Fe_xS$ (x = 0.03) solid solutions were irradiated with γ- rays obtained from ^{60}Co source of E=1.17 MeV, E=1.33 MeV energies.

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The structure and phase purity of the γ-irradiated these films were examined by *X*-ray diffraction (XRD) at room temperature using a BRUKER XRD D8 ADVANCE. The studies of surface morphology of $Cd_{1-x}Fe_xS$ (x = 0.03) solid solutions were carried out the scan electron microscope (SEM) JEOL/ JSM-6610. According to the Energy Dispersive *X*-Ray Analysis (EDX) technique, the chemical structure of these films was analyzed using standard energy dispersive analysis.

Experimental

On the characteristics of electronic devices are relatively related to the surface morphology of crystals, the study of external effects (temperature, pressure, lighting, radiation, etc.) occupies the significant place in diagnosing their surface. It is clear that radiation technology is more dominant favorable methods for the modification of semiconductor materials. Thus, by irradiating the material, it is possible to control the physical feature of these materials, as well as to predict the properties of devices based on them. In this regard, it is of great interest to study the changes in the surface of the $Cd_{1-x}Fe_xS$ (x = 0.03) solid solutions, therefore the effects of γ-irradiation. The results of SEM and XRD studies of $Cd_{1-x}Fe_xS$ (x = 0.03) solid solutions exposed to γ-irradiation (D_γ=10÷100 kGy) are presented in this study.

X-ray diffraction pattern of as-prepared $Cd_{1-x}Fe_xS$ (x = 0.03) solid solutions appears in figure 1. High intensity peaks of sample is given using Debye Scherrer equation. According to the table 1, the XRD measurement reveals that all the sharp diffraction peaks (100), (002), (101), (102), (110), (103), (200), (112), (201) and (202) confirmed face centered cubic structure of $Cd_{1-x}Fe_xS$ with crystal lattice parameter of $a = b$=4.1002 Å, c=6.6568 Å, $\gamma=120^0$. The crystallite size (figure 1) of $Cd_{1-x}Fe_xS$ (x = 0.03) solid solutions may be estimated from the width of the XRD peak using Debye–Scherrer's formula [12] given by

$$D = (0.9\,\lambda)/(\beta \cos\theta), \qquad (4)$$

where, D - is crystallite size, β - is full width at half maxima (FWHM) of the peak intensity, θ - is diffraction angle in degrees and λ - is the wavelength of *X*-ray used (table 1).

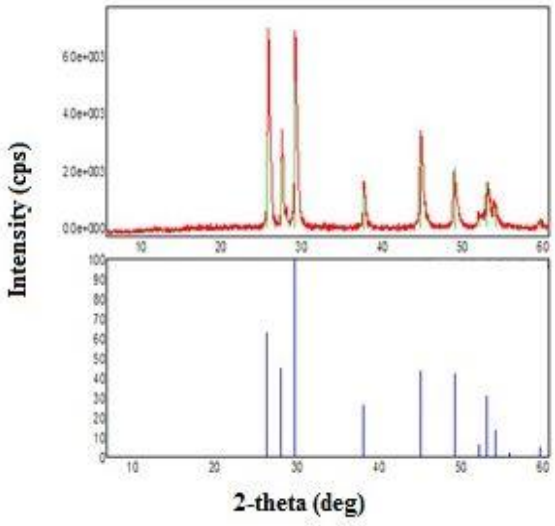

Figure 1. X-ray diffraction patterns of $Cd_{1-x}Fe_xS$ (x=0.03) thin films.

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Table 1. The XRD measurements.

№	2θ (deg)	Crystal system (hkl)	FWHM, β (deg)
1	27	100	0.15
2	28.2	002	0.15
3	30	101	0.15
4	38.4	102	0.1
5	45	110	0.25
6	50	103	0.25
7	52.7	200	0.2

It was studied effect of γ-irradiation on crystal structure of $Cd_{1-x}Fe_xS$ (x = 0.03) thin films. XRD patterns of $Cd_{1-x}Fe_xS$ (x = 0.03) solid solutions on glass substrate and irradiated by γ- quanta (E=1.17MeV, E=1.33MeV) with different doses (D_γ=10÷100 kGy) are shown in fig1. The diffraction pattern of γ -irradiated thin films with different doses 10, 50 and 100 kGy revealed that the peak intensity of (101) plane of $Cd_{1-x}Fe_xS$ increased with dose.

It can be seen that the number of planes aligned along the (101) direction increased with γ-irradiation. The reason for this is that ^{60}Co γ-rays are high-energy electromagnetic waves. When the radiation dose D_γ = 50 kGy ÷ 100 kGy, the surface energy becomes important in the process of crystal growth. During the process, atoms are easily attracted by the high surface energy (101) crystal face and condense there, which can lead to the predominance of the (101) plane [13,14]. XRD analysis confirmed the change in orientation of the planes after γ-irradiation exposure.

The SEM method was used to study the effect of γ-irradiation on the surface morphology of $Cd_{1-x}Fe_xS$ (x = 0.03) thin films. The morphology of the $Cd_{1-x}Fe_xS$ thin films before and after γ-irradiation was analyzed by SEM method. $Cd_{1-x}Fe_xS$ (x = 0.03) solid solutions were irradiated with γ-quanta at a dose of D_γ=100 kGy, which is caused by the interaction of γ-quanta with atoms in their paths during irradiation. It was reveiled, that after γ- irradiation, the $Cd_{1-x}Fe_xS$ crystallite size increased, which is in profitable consent with the XRD results. The compositional analysis of the pure $Cd_{1-x}Fe_xS$ solid solution was carried out using EDX shown in table 2.

Table 2. EDX analysis of pristine $Cd_{1-x}Fe_xS$ (x = 0.03) solid solutions.

Element	Weight %	Atom%
Cd L	79.38	52.71
S L	19.91	46.34
Total	100.00	100.00

Elemental chemical composition was investigated by means of EDX analysis. The results did not deviate much from the structure of starting precursor alloys (figure 2).

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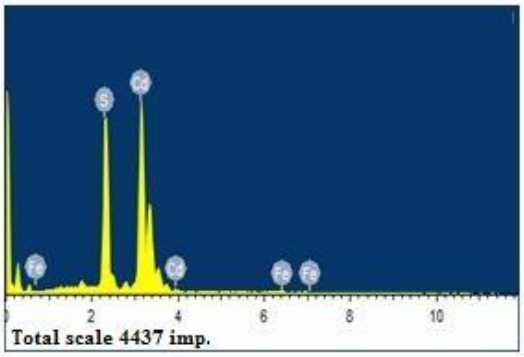

Figure 2. Energy-dispersive X-ray spectrum of $Cd_{1-x}Fe_xS$ (x = 0.03) solid solutions

Results

In the current research, $Cd_{1-x}Fe_xS$ (x = 0.03) solid solutions were synthesized and thin films were obtained on their basis by molecular beam condensation method. We studied the effect of γ-irradiation on growth properties of obtained thin films. Properties of $Cd_{1-x}Fe_xS$ (x = 0.03) solid solutions exposed to 50, 100 and 150 kGy doses of γ-rays from ^{60}Co source were characterized by XRD, SEM, EDX methods.

XRD analysis revealed that the peak intensity of the (101) plane of $Cd_{1-x}Fe_xS$ increased with dose. Crystallite size increased after γ-irradiation. Finally, it was realized, which is possible to control some crystal properties with γ-irradiation. The results obtained from XRD investigation demonstrates, that thin films with polycrystalline structure grow on glass substrates at substrate temperature T_{sub} = 470 K, and monocrystalline structure grow at substrate temperature T_{sub} = 670K.

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ОСОБЕННОСТИ ВЛИЯНИЯ СОПУТСТВУЮЩЕГО САХАРНОГО ДИАБЕТА НА КАЧЕСТВО ЖИЗНИ БОЛЬНЫХ ШИЗОФРЕНИЕЙ

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ABSTRACT

In this article, the features of the quality of life (QL) of patients with schizophrenia with concomitant diabetes mellitus were studied. Conducting this study on the assessment of the quality of life of patients in the compared groups, we came to the conclusion that concomitant diabetes mellitus significantly reduces the quality of life of patients with schizophrenia. The revealed stronger relationship between the subjective assessment of one's QL and the severity of positive and negative psychopathological symptoms in patients with concomitant somatic pathology suggests that the use of questionnaires to assess the quality of life in this category of patients for the development of individual rehabilitation programs is highly informative.
Keywords: quality of life, patients with schizophrenia, concomitant diabetes, positive and negative psychopathological symptoms.

Актуальность исследования

В последние годы во многих исследованиях, наряду с «объективными» количественными и качественными характеристиками социального функционирования больных, все большее значение придаётся субъективным переживаниям ими своего жизненного благополучия, получившего определение «качество жизни» [4, 8, 11, 12]. Привлечение данного понятия является отражением принципа партнёрства, предполагающего учет мнения и суждения больного о своём самочувствии, качестве получаемой помощи и жизни в целом, а также отражает стремление современной медицины обеспечить достойную жизнь пациента [3, 5, 18, 19]. Будучи сложным понятием, качество жизни включает в себя субъективные и объективные показатели определенных параметров оценки, отражающие различные стороны социального, физического и психического функционирования [1, 15, 16, 17].

Показателям качества жизни отводится ведущая роль в понимании множества феноменов, связанных с расстройствами шизофренического спектра: диссоциации между клиническими предпосылками к адаптации и реальным уровнем адаптации, процессов стигматизации и комплайентности. Исследование показателей качества жизни позволяет глубже понять внутренний мир пациента, его реакцию на лечение и становится дополнительным критерием при выборе тактики психофармако- и психосо-циотерапевтических мероприятий [4, 9]. В настоящее время большинство исследователей считают, что плодотворное понимание качества жизни возможно только на пути синтеза объективной и субъективной его сторон [14, 15, 16].

Цель исследования

Изучение основных показателей качества жизни больных шизофренией с сопутствующим сахарным диабетом.

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Материал и методы исследования

Объектом исследования стали 111 пациента, проходившие стационарное лечение в отделениях Республиканской психиатрической больницы МЗ АР и психосоматическом отделении КПБ №3 г. Баку. В соответствии с критериями отбора в основную группу исследования вошли 72 больных шизофренией и расстройствами шизофренического спектра с сопутствующим сахарным диабетом. Группу сравнения составили 39 пациентов с аналогичными психиатрическими диагнозами без сопутству-ющего сахарного диабета. Качество жизни (КЖ) пациентов основной группы оценивалось дважды - при купировании психотической симптоматики и перед выпиской, путём самостоятельного заполнения пациентами опросника «SF-36 Health Status Survey». Опросник для оценки социального функционирования и качества жизни психически больных представляет собой структурированное интервью и включает 36 пунктов, сгруппированные в восемь шкал: физическое функционирование, ролевая деятельность, телесная боль, общее здоровье, жизнеспособность, социальное функционирование, эмоциональное состояние и психическое здоровье. Помимо объективного критерия, каждый раздел имеет и субъективную оценку, т.е. отражает удовлетворенность больного соответствующей сферой жизни. Каждая сфера КЖ оценивалась в баллах, что позволяет выявлять наиболее проблемные аспекты жизненного благополучия у каждого пациента, оценивать динамику состояния и эффективность лечения, а также сравнивать показатели КЖ у разных групп пациентов. Опросник заполнялся респондентами самостоятельно и являлся субъективной мерой оценки благополучия и удовлетворенности условиями своей жизни.

Полученные результаты и их обсуждение

Проведенный нами сравнительный анализ двух групп больных шизофренией показал более низкий уровень качества жизни по всем сферам в группе пациентов с сопутствующим сахарным диабетом. Результаты представлены в таблице 1.

Таблица 1. Сравнение показателей качества жизни больных шизофренией в зависимости от наличия сопутствующей соматической патологии.

Сферы качества жизни	Me_1, осн. гр., баллы	Me_2, гр. сравн., баллы	P
Общее качество жизни и состояние здоровья	13	15	0,001
1. Физическая сфера	13,3	16	0,000
2. Психическая сфера	13,5	14,4	0,006
3. Уровень независимости	13,6	16,6	0,000
4. Социальные отношения	12,7	15,2	0,001
5. Окружающая среда	13,4	15,2	0,000
6. Духовная сфера	15,5	16	0,081
Суммарное значение	82,1	92,7	0,000

Me_1 - значение медианы в основной группе

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Me_2 - значение медианы в группе сравнения
p - вероятность ошибки

Большинство пациентов основной группы (с сочетанным сахарным диабетом) оценили своё качество жизни по разным сферам как среднее (11-13 баллов) и хорошее (14-17 баллов). Средние показатели были даны общему качеству жизни и состоянию здоровья, физической сфере, социальным отношениям и окружающей среде. Больные шизофренией из группы сравнения (без сопутствующей соматической патологии) оценили своё качество жизни преимущественно как хорошее по всем сферам.
Статистически значимые различия значений КЖ ($p<0,005$) наблюдались по всем сферам, кроме духовной. «Общее качество жизни и состояние здоровья»: значение медианы в основной группе (Me1) 13 баллов, в группе сравнения (Me_2) - 15 баллов ($p<0,001$), «Физическая сфера»: Me1=13,3 балла, Me_2=16 баллов ($p<0,001$), «Психическая сфера»: Me_1=13,5 балла, Me_2=14,4 балла ($p<0,006$), «Уровень независимости»: Me_1=13,6 балла, Me_2=16,6 баллов ($p<0,000$), «Социальные отношения»: Me1=12,7 балла, Me_2=16,2 балла ($p<0,001$), «Окружающая среда»: Me1=13,4 балла, Me_2=15,2 балла ($p<0,001$), «Суммарное значение»: Me1=82,1 балл, Me_2=92,7 баллов ($p<0,001$). По духовной сфере КЖ значения медиан было также выше в группе сравнения, но различия не достигли уровня статистической значимости ($p<0,08$).
Физическая сфера качества жизни состоит из трёх субсфер: физическая боль и дискомфорт; жизненная активность, энергия и усталость; сон и отдых. Результаты сравнения показателей качества жизни больных шизофренией по субсферам физической сферы в зависимости от наличия сопутствующей соматической патологии представлены в таблице 2.

Таблица 2. Сравнение показателей качества жизни больных шизофренией по субсферам физической сферы КЖ.

Субсферы физической сферы качества жизни	Me_1, осн. гр., баллы	Me_2, гр. сравн., баллы	P
1. Физическая боль и дискомфорт	14	15	0,009
2. Жизненная активность, энергия, усталость	11	15	0,050
3. Сон и отдых	15	17	0,004

Как видно из таблицы, наименьшие показатели КЖ в основной группе наблюдались по субсфере «Жизненная активность, энергия, усталость» (Me1=11). Наиболее высокие баллы были получены в группе сравнения по субсфере «Сон и отдых» (Me_2=17). По всем трём субсферам КЖ были выявлены статистически значимые различия между двумя группами пациентов.
Психологическая сфера КЖ состоит из 5-ти субсфер: положительные эмоции; мышление, обучаемость, память и концентрация (познавательные функции); самооценка; образ тела и внешность; отрицательные эмоции. Результаты сравнения показателей качества жизни больных шизофренией по субсферам психологической сферы в зависимости от наличия сопутствующей соматической патологии представлены в таблице 3.

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Таблица 3. Сравнение показателей качества жизни больных шизофренией по субсферам психологической сферы КЖ.

Субсферы психологической сферы качества жизни	Me1, осн. гр., баллы	Me_2, гр. сравн., баллы	P
1. Положительные эмоции	13	14	0,114
2. Познавательные функции	14	15	0,053
3. Самооценка	14	14,5	0,181
4. Образ тела и внешность	15	15,5	0,168
5. Отрицательные эмоции	14	15	0,011

Как видно из таблицы 3, показатели КЖ психологической сферы имеют статистически значимые различия между основной группой и группой сравнения только по одной субсфере «Отрицательные эмоции». Показатели остальных субсфер лишь приближаются к статистически значимым.

Помимо этого, одним из показателей качества жизни обследованных больных являются уровни тревожности и депрессии, получившие свое отражение на нижеследующих диаграммах.

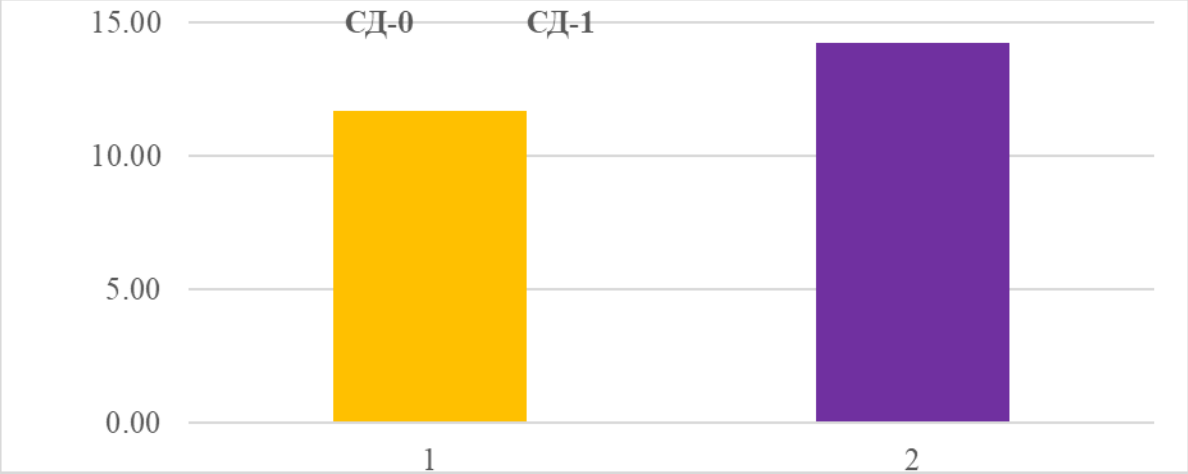

Диаграмма 1. Уровень тревожности у больных основной и группы сравнения.

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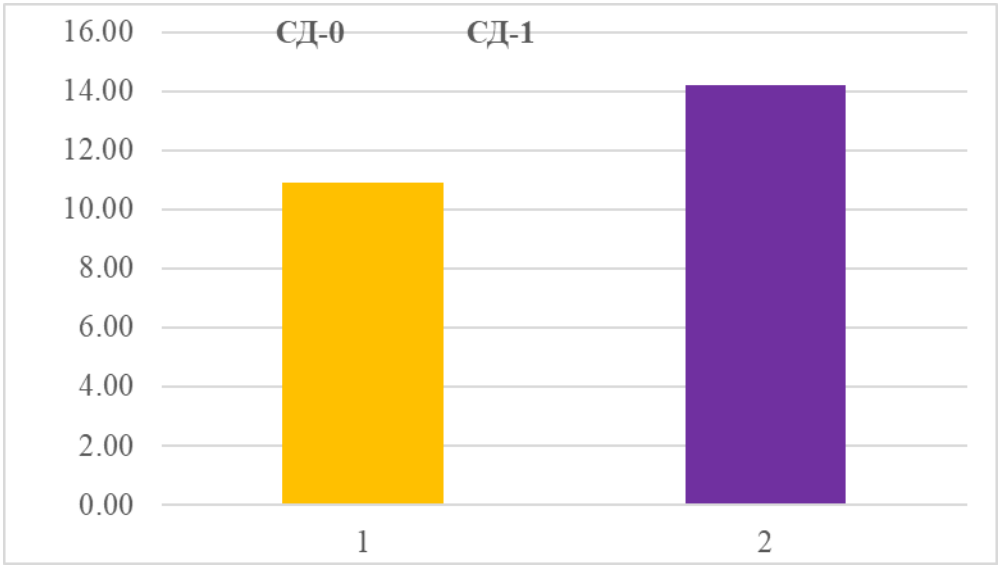

Диаграмма 2. Уровень депрессии у больных основной и группы сравнения

Как видно из показателей диаграмм уровень тревоги и депрессии у больных шизофренией с сахарным диабетом значительно превышал эти показатели у больных группы сравнения.
Сфера КЖ «Уровень независимости» состоит из 4-х субсфер: подвижность; способность выполнять повседневные дела; зависимость от лекарств и лечения; способность к работе. Результаты сравнения показателей качества жизни больных шизофренией по субсферам сферы «Уровень независимости» в зависимости от наличия сопутствующей соматической патологии представлены в таблице 4.

Таблица 4. Сравнение показателей качества жизни больных шизофренией по субсферам сферы КЖ «Уровень независимости».

Субсферы сферы качества жизни«Уровень независимости»	Me_1, осн. гр., баллы	Me_2, гр. сравн., баллы	P
1. Подвижность	15	18	**0,002**
2. Способность выполнять повседневные дела	14,5	16	**0,021**
3. Зависимость от лекарств и лечения	14	16	**0,006**
4. Способность к работе	16	17	0,078

Как видно из таблицы, показатели КЖ «Уровень независимости» имеют статистически значимые различия между основной группой и группой сравнения по трём субсферам из 4-х. Особенно существенные различия можно отметить по субсферам «Подвижность» и «Зависимость от лекарств и лечения».
Сфера КЖ «Социальные отношения» состоит из трёх субсфер: личные отношения; практическая социальная поддержка; сексуальная активность. Результаты сравнения показателей качества жизни больных шизофренией по субсферам сферы «Социальные отношения» в зависимости от наличия сопутствующей соматической патологии представлены в таблице 5.

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Таблица 5. Сравнение показателей качества жизни больных шизофренией по субсферам сферы КЖ «Социальные отношения»

Субсферы сферы качества жизни «Социальные отношения»	Me_1, осн. гр., баллы	Me_2, гр. сравн., баллы	P
1. Личные отношения	14	16	**0,015**
2. Практическая социальная поддержка	15	16	0,202
3. Сексуальная активность	10	13,5	**0,000**

Как видно из таблицы, показатели КЖ сферы «Социальные отношения» имеют статистически значимые различия между основной группой и группой сравнения только по двум субсферам из 3-х. Особое внимание обращает на себя субсфера «Сексуальная активность», показатели которой в основной группе являются минимальными и соответствуют плохому качеству жизни.

Сфера КЖ «Окружающая среда» состоит из 8-ми субсфер: физическая безопасность и защищённость; окружающая среда дома; финансовые ресурсы; медицинская и социальная помощь (доступность, качество); возможности для приобретения новой информации и навыков; возможности для отдыха и развлечений и их использование; окружающая среда вокруг (загрязнённость, шум, климат, привлекательность); транспорт. Результаты сравнения показателей качества жизни больных шизофренией по субсферам сферы «Окружающая среда» в зависимости от наличия сопутствующей соматической патологии представлены в таблице 6.

Таблица 6. Сравнение показателей качества жизни больных шизофренией по субсферам сферы КЖ «Окружающая среда»

Субсферы сферы качества жизни «Окружающая среда»	Me1, осн. гр., баллы	Me_2, гр. сравн., баллы	P
1. Физическая безопасность	13	15	0,002
2. Дом	15	16	0,028
3. Финансы	11,5	14	0,000
4. Мед. и соц. помощь	13,5	15	0,009
5. Новая информация, навыки	15	16	0,072
6. Отдых и развлечения	14	15	0,174
7. Окр. среда вокруг	14	15	0,024
8. Транспорт	14	15	0,017

Как видно из таблицы 6, показатели КЖ сферы «Окружающая среда» имеют статистически значимые различия между основной группой и группой сравнения по 6-ти субсферам из 8-ми.

Благодаря чёткой балльной системе, структурности и многомерности, опросник ВОЗ КЖ-100 позволяет оценивать как общий профиль КЖ, так и детально рассматривать его составляющие. Следует отметить, что показатели качества

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жизни пациентов по опроснику ВОЗ КЖ-100 во многом совпадают с данными других исследователей, изучавших данную проблему [3, 4, 6, 8].

Клинические проявления шизофрении, выраженность психопатологической симптоматики, безусловно, влияют на качество жизни пациентов. По данным большинства исследователей, качество жизни больных шизофренией в большей мере зависит от биологически обусловленных клинических проявлений заболевания [10]. Исследователи ищут клинические проявления, которые имеют наибольшее влияние на качество жизни пациентов [13]. Особое значение при оценке качества жизни имеет преобладание в клинической картине позитивной или негативной симптоматики [7].

Корреляционный анализ в исследуемых группах позволил выявить зависимость между выраженностью психопатологических симптомов и показателями основных сфер качества жизни пациентов. Статистически значимые положительные корреляции в общей выборке пациентов прослеживались между позитивными симптомами и следующими сферами КЖ: физическая сфера - критерий Спирмена (R)=0,244, $p<0,002$; психологическая сфера - R=0,22, $p<0,004$; уровень независимости - R=0,244, $p<0,002$; окружающая среда - R=0,17, $p<0,021$; духовная сфера - R=0,20, $p<0,010$; суммарное значение - R=0,23, $p<0,002$. Статистически значимая отрицательная корреляционная связь между негативной симптоматикой и КЖ была выявлена по следующим сферам: физическая сфера - R= -0,174, $p<0,026$; психологическая сфера - R= -0,177, $p<0,024$; суммарное значение - R= -0,162, $p<0,032$. Таким образом, вне зависимости от наличия сопутствующего сахарного диабета прослеживается прямая корреляционная между позитивной симптоматикой и более высокими показателями КЖ, негативная же симптоматика коррелирует с более низкими показателями качества жизни.

В основной группе пациентов (с сопутствующим сахарным диабетом) положительная корреляция между позитивной симптоматикой и показате-лями качества жизни была более выражена, чем в группе сравнения, и достигала уровня статистической значимости по следующим сферам: физическая сфера - критерий Спирмена (R)=0,366, $p<0,001$; психологическая сфера - R=0,335, $p<0,002$; уровень независимости - R=0,306, $p<0,005$; суммарное значение - R=0,248, $p<0,018$. Отрицательная корреляционная связь негативной симптоматики и показателей КЖ также была более выражена в основной группе (по суммарному значению КЖ $p<0,011$), чем в группе сравнения (по суммарному значению КЖ $p<0,035$). Таким образом, в группе пациентов с сопутствующим сахарным диабетом прослеживается более выраженная корреляционная связь между психопатологической симптоматикой и уровнем качества жизни.

Таким образом, у пациентов обеих групп прослеживается прямая корреляционная связь между позитивной психопатологической симптоматикой и более высокими показателями КЖ (по суммарному значению КЖ $p<0,002$). В основной группе пациентов (с сопутствующим сахарным диабетом) положительная корреляция между позитивной симптоматикой и показателями качества жизни выражена в большей степени, чем в группе сравнения. Негативная же симптоматика у пациентов обеих групп коррелирует с более низкими показателями качества жизни (по суммарному значению КЖ $p<0,032$). Отрицательная корреляционная связь

негативной симптоматики и показателей КЖ также была более выражена в основной группе (по суммарному значению КЖ p<0,011), чем в группе сравнения (по суммарному значению КЖ p<0,035).

Подводя итог оценке качества жизни пациентов сравниваемых групп, мы пришли к выводу, что сопутствующий сахарный диабет существенно снижает качество жизни больных шизофренией. Выявленная более сильная связь между субъективной оценкой своего КЖ и выраженностью позитивной и негативной психопатологической симптоматики у пациентов с сопутствующей соматической патологией позволяет предположить высокую информативность использования опросников по оценки качества жизни у данной категории пациентов для разработки индивидуальных реабилитационных программ.

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PECULIARITIES OF THE INFLUENCE OF CONCOMITANT DIABETES MELLITUS ON THE QUALITY OF LIFE OF PATIENTS WITH SCHIZOPHRENIA

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ABSTRACT

In this article, the features of the quality of life (QL) of patients with schizophrenia with concomitant diabetes mellitus were studied. Conducting this study on the assessment of the quality of life of patients in the compared groups, we came to the conclusion that concomitant diabetes mellitus significantly reduces the quality of life of patients with schizophrenia. The revealed stronger relationship between the subjective assessment of one's QL and the severity of positive and negative psychopathological symptoms in patients with concomitant somatic pathology suggests that the use of questionnaires to assess the quality of life in this category of patients for the development of individual rehabilitation programs is highly informative.
Keywords: quality of life, patients with schizophrenia, concomitant diabetes, positive and negative psychopathological symptoms.

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ELMİ YANAŞMALAR ƏSASINDA SƏNAYE PARKLARININ İQTİSADİ PERSPEKTİVLƏRİ

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XÜLASƏ

Müasir dövrdə elmin inkişafı ilə iqtisadi perspektivliyin təminatı əsas amil olaraq xüsusi dəyərləndirilir. Bunun üçün qabaqcıl ölkələrin fəaliyyətləri və innovasiyaları nəzərə alınmaqla, xarici ölkələrin təcrübələrindən istifadə etməklə, ölkədə dayanıqlı inkişafın təmin olunmasına və iqtisadi inkişafa nail olunur.

Texnologiya, innovasiya və elm birgə Sənaye Parklarının əsas tərkib hissələrindən olduğu üçün, onların Avropada 180-ə yaxın iş şəbəkəsi, innovasiya mərkəzləri layihələrinin sahibkarları öz işlərini hansı formada quracaqlarını, fəaliyyət göstərəcəklərini bilirlər. Texnoparkların fəaliyyət göstərməsi üçün xüsusi sponsorların olması da vacibdir.

Sənaye parkları və texnoparkların yaradılması ölkədə dayanıqlı inkişaf sisteminin təmin olunmasında, ölkədə işsizlik səviyyəsinin azalmasında, əhalının məşğulluq səviyyəsinin artırılmasında, idxal edilən məhsul kütləsinin azaldılmasında və ixrac məhsullarının artırılmasında böyük rola malikdir. Neft və qeyri-neft sektorlarının inkişafı, müasir tipli texnologiyalardan istifadə, sahibkarlığa dəstək və insanlara daha rahat xidmət sahələrinin inkişaf etdirilməsini təmin etmək kimi əlverişli şəraitlər yaradılır.

Müasir texnikaların əsas xususiyyətlərinin öyrənilməsi, sənaye parklarında, texnoparklarda əsas yeniliklərin tətbiqi deməkdir. Yüksək səmərəliliyə nail olmaq məqsədilə inkişaf etmiş ölkələrin ən müasir texnologiyalarının Azərbaycanın sənaye sahələrinə cəlb edilməsi, Sənaye parklarında rəqəmsallaşdırma sisteminin təmini, tətbiqi və idarə edilməsi, idxalın azaldılması və paralel olaraq ixracın artırılması, sənaye sahələrində mövcud texnolgiyanın inkişafında dövlət dəstəyinin təmini, Yapon İqtisadi modelinin ölkə sənayesinə tədbiqi kimi əsas məsələlər nəzərdən keçirilmişdir.

Elm həmişə insanın həyatında mühüm rola sahib olmaqla, onun inkişafı da cəmiyyətin ən əsas göstəricilərindən hesab edilərək, dövlətin davamlı sosial-iqtisadi və mədəni səviyyəsini tam formada təmin edən mühüm amildir.

Elmlə istehsalat arasında olan sıx əməkdaşlığın zəruriliyi biliyi əsas götürərək iqtisadiyyatın inkişafının vacibliyilə müəyyən edir. Ən uğurlu siyasətin əsasını iqtisadi inkişafın mövcud üç komponentinin (elm, təhsil və sənaye) sıx formada tərəfdaşlığının tələb edildiyi təhsil strategiyası təşkil edir və innovativ təhsil sisteminin qurulması insan kapitalının tam formalaşmasının əsas vəzifələrindəndir. Bu sistem yeni innovasiyalara çox həssas, innovativ layihələrin yaradılmasına və reallaşdırılmasına hazır, texnoloji proseslərdə ideyaların reallaşdırılmasına və yeni işləmələrin tez sınaqdan keçirilməsinə hazır olan yeni ixtisaslı mütəxəssislərin yetişməsini təmin etməlidir.

Açar sözlər: elmin inkişafı, texnologiya, innovasiya, Sənaye Parkı, dayanıqlı inkişaf, idxal, ixrac, yüksək səmərəlilik, iqtisadi model, mədəni səviyyə, uğurlu siyasət, texnoloji proseslər, ixtisaslı mütəxəssis.

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Giriş

Qloballaşma kontekstində qlobal iqtisadi göstəricilər müəyyən edilməli, biliyə əsaslanan sənayelərə və informasiya texnologiyaları sektoruna diqqət yetirilməli, iqtisadi inkişaf qabaqcıl texnologiyalarla və heç bir fərq qoymadan bütün bunlarla inteqrasiya edilməlidir.

Sənayenin dünya iqtisadiyyatına, eləcə də iqtisadiyyatın digər sahələrinə inteqrasiyası beynəlxalq iqtisadi münasibətlər sisteminə uyğun olaraq baş verir. Beynəlxalq iqtisadi əlaqələr dünya ölkələri arasında ticarət, kapital ixracı, beynəlxalq borc, əmək miqrasiyası, beynəlxalq valyuta münasibətləri və elmi-texniki əməkdaşlıq nəticəsində yaranan iqtisadi əlaqələrin məcmusudur. Dünya iqtisadiyyatına inteqrasiyanın bu formaları və praktiki istiqamətləri dünya iqtisadi fəaliyyətinin bir neçə sahəsini əhatə edir:

- ✓ Ümumi beynəlxalq ticarəti;
- ✓ Bütün istehsalın və elmi-texniki işlərin tam beynəlxalq ixtisaslaşması;
- ✓ Elmi-texniki informasiyanın geniş mübadiləsi;
- ✓ Ölkələr arasında olan maliyyə-valyuta və kredit əlaqələrini;
- ✓ Kapitalın və işçi qüvvəsinin mövcud hərəkətini;
- ✓ Beynəlxalq formalı informasiya əlaqələrində;
- ✓ İnternetin rolunun əhatəli formalaşması və artmasında, komputer vasitəsiylə kommersiya əməliyyatlarının reallaşdırılmasında.

Nəticə etibarilə, araşdırmalar sayəsində Azərbaycanın xarici iqtisadi əlaqələrinin səmərəliliyinin tam yüksəldilməsinin mümkün yolları və mövcud imkanları üzə çıxarılmışdır: Subsudiya, güzəşt formalı vergi stavkaları, lazımlı maliyyə yardımı və s. kimi həvəsləndirici vasitələr tədbiq etməklə ixrac potensialının inkişafına nail olunması;

- ✓ İdxalın mövcud çevikliyi və elastikliyi tədbiq edilməklə, onun iqtisadi və siyasi cəhətdən səmərəli təşkilinə nail olunması;
- ✓ Milli iqtisadiyyatın sabit formalı artımı, texniki modernizasiya və səmərəlilik səviyyəsinin tam artırılması məqsədiylə xarici investisiyaların cəlb olunması.

Müasir dövrdə Azərbaycan Respublikasının ixracyönümlü xarici iqtisadi sahəsinin formalaşdırılması, təbii-coğrafi amilə əsaslanmış rəqabət sahələrinin seçimi ən optimal yol kimi qiymətləndirilməlidir. Sənaye parklarının yaradılmasında ümumi beynəlxalq təcrübə deyərkən ilk növbədə dünyanın ən nəhəng texnologiyaların istehsalı, dünya ölkələrin istehsalatda istifadə etdiyi bütün yeni texnologiyaların mənbəyi nəzərə alınmalıdır.

Təcrübənin ölkə miqyasında tətbiq olunması makro ölçüdə istehsal sahələrinin bütün fəaliyyətinin planlaşdırılması ilə əlaqədardır. Firmalar və müəssələr arasında mal və xidmət mübadiləsinin güclənməsi üçün yeni məhsulların istehsalını təkmilləşdirmək, sənayeni tamamlayan digər şəhər fəaliyyətləri sənaye parklarının fəaliyyətini tənzimləyir.

Məqsəd

Sənaye Parklarının və texnoparkların ölkə sərhədləri çərçivəsində yerləşdirilməsinin ümumi analizi, şəhər və regionlarda yerləşdirilməsinin nə dərəcə fayda verəcəyi və onların regionlarda daha çox inkişaf etdirilməsinə dair nəzəri və praktiki məsələlərin araşdırılmasıdır. Bu zaman xarici iqtisadi modellərin analiz edilməsi, iqtisadi modellərin qiymətləndirilməsi, uyğun iqtisadi modelin ölkə sənayesinə tədbiqinin araşdırılması, mövcud sənaye parklarının və texnoparklarının fəaliyyətinin qiymətləndirilməsi, texnoparkların sayının bütün regionlarda artırılması, Sumqayıt Kimya Sənaye Parkında yeniliklərin tədbiqi.

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Metodlar

Sənaye müəssisələrində istehsal gücünü yüksəltmək məqsədiylə bir neçə tətqiqat metodlardan istifadə olunur. Funksional metodda istehsal potensialının miqyası istehsal edilmiş məhsulun həcminə bərabərdir; Dəyər metodunda istehsal prosesində iştirak edən bütün elementlərin ümumi dəyəri, sonrakı mərhələlərdə istehsal potensialının tam dəyərinin hesablanması göstərilir; Ekvivalent metodda istehsal potensialının bir element səviyyəsində qiymətləndirilməsi göstərilir; Korelyasiya metodunda istehsal potensialının həcminin müəyyən edilməsində korrelyasiya modelindən istifadə edilir; Matris metodunda istehsal potensialının elementlərindən istifadə edildikdə onların bir yerdə təsir dərəcəsi müəyyənləşdirilir; Qarışıq metodda istehsal potensialının miqdarı hesablanarkən dəyər və digər metodlar bir yerdə istifadə olunur.

Sorğu, müşahidə, reqressiya analizi, iqtisadi-riyazi metodlar və s. kimi tətqiqat metodlarından istifadə olunmaqla, elmin inteqrasiyası modellərinin analiz edilməsilə, ölkə sənayesində səmərəli tədbiq edilməsi.

Sənaye Parkları respublikanın sənaye siyasətinə təsir edən bir vasitə kimi çıxış edir. Sürətli sənayeləşmə məqsədilə sənaye parkları iş imkanlarını tək mərkəzdə cəmləşdirərək ticarət, investisiya, maliyyə məsələləri və maliyyə siyasəti, energetika sahəsi və ətraf mühitin inkişafı siyasəti, eyni anda konsaltinq və inkişaf aid edilməklə dəstək sistemləri, işçi qüvvəsinin inkişafı kimi xüsusiyyətlərə malikdir.

Avropada fəaliyyət göstərən 2 ən əsas əhəmiyyətli sənaye parklarının təcrübələrinə diqqət yetirək:

Kolundborg - 1990-cı ildə ilk Sənaye parkı kimi tanınan Kopanhagenin şərqdə, Danimarkanın dəniz sahili zonasında kiçik bir sənaye parkıdır. Bu sənaye parkı tullantılardan yenidən istifadə edilməsi və su ehtiyatlarından səmərəli istifadənin təşkili olunması prinsipləri əsasında fəaliyyətə başlamış, rezidentləri:

- ✓ Gyproc A.S (Alçipan firması);
- ✓ Novo Nordisk (dərman preparatlarının mövcud istehsalı);
- ✓ Asneas Elektrik Stansiyasi (Enerji E2);
- ✓ Novozymes (ferment istehsalı);
- ✓ Statoil A.S (neft emalı zavodu);
- ✓ Noveren (tullantıların emalı zavodu);
- ✓ Kolundborg bələdiyyəsi.

Şəkil 1. Avropada fəaliyyət göstərən 2 əsas ən əhəmiyyətli sənaye parkları (“Intermediate approach to eco-industrial park planning” materialları əsasında tərtib olunmuşdur).

Kolunborg sənaye parkı yaradıldığı gündən etibarən bu günə kimi hec bir dövlət dəstəyi almadan, hər hansı bir xüsusi dəstək göstərilmədən inkişaf etmişdir. Sənaye parkında müalicəvi kül, kükürd, bioloji palçıq, qarşıq tullantılardan ibarət olan məhsullar istehsal edilir. Bu Kolundborg

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sənaye parkının əsas xüsusiyyətlərindən biri isə onun inkişafının əsas köməkçisi formasında cəmiyyətin quruluşudur. Ümumiyyətlə, rezidentlər arasında mövcud texnoloji əlaqə ilə paralel sistemin etibarlı olması çox vacib amillərdən biridir, çünki bu uğur qazanmaq istəyən sənaye parkı üçün idealdır və bunun üçün fiziki yaxınlıq qurulmalıdır.

Kolundborg sənaye parkının uğurlu olmasının əsas səbəb elementlər:

- ✓ Şəhərdə bir çox yerdə, bir çox sənaye müəssələrinin mövcud olması;
- ✓ Müəssələri arası məsafənin nisbətən kiçik olması;
- ✓ Rezidentlər arası xüsusi harmoniyanın olması;
- ✓ Mövcud yerli maneələrinin olmaması;
- ✓ Mükəmməl olan komunikasiya əlaqələrinin mövcudluğu;
- ✓ İqtisadi bazarda heç bir rəqibin olmaması;
- ✓ İdarəçilərin eyni mühitdə bir-birlərini çox yaxşı tanıması və s.

Styrian - Kolundborg strukturuna oxşar sənaye parklarından biridir və Austriada yerləşir. Ora kağız və taxta məhsullarının istehsalı, müxtəlif növdə metallar, polad istehsalı, maşın avadanlıqları və avtomatlaşdırıcı məhsulların istehsalı ilə fəaliyyət göstərir. Firmaların bir yerdə olmması maliyyə xərclərini azaldır, paralel olaraq da tullantılardan istifadə edən sənaye şirkətlərinin inkişaf etməsinə yardımçı olur və əsasən kağız, kauçuk, yağların təkrar istehsalı kimi məhsullar istehsal edir. Bu ucuz məhsulların istehsalı firmaların istehsala sərf edilən xərclərini azaldır, eyniylə ətraf mühitin çirklənməsinin qarşısını alır, xüsusi faydalar verir və beləliklə bu müəssələrin bir yerdə cəmləşməsi ölkənin dayanıqlı inkişafının təmin olunmasına böyük töhfə verir. [1]

Elm, texnologiya və innovasiyaya (STI) yönümlü siyasət, dövlətlərin iqtisadi və siyasi məsələlərin həllində aktual məsələ olaraq hər zaman diqqət mətkəzindədir.

Elmi və texnoloji tərəqqinin əsasını qoyan tərəfdaşlıq və ekosistem əlaqələrinin xarakterini və onun yeni sənaye sahələrinin inkişafında, yeni məhsulların meydana çıxmasında və müxtəlif və bir-birini tamamlayan peşələrə malik yeni insanlar komandalarının formalaşmasına empirik yanaşılmalıdır. Hər bir ölkənin və regionun multipleksdəki mövqeyini və onun zamanla təkamülünü qiymətləndirmək üçün xüsusi alətlər hazırlamaq, onların səylərini planlaşdırma və qiymətləndirmək lazımdır.

Şəkil 2. İqtisadi inkişafda bilik, texnologiya və mürəkkəblik Harvard Universitetinin materialları əsasında tərtib olunmuşdur.

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Siyasətçilərə, korporasiyalara, STI iştirakçılarına və daha geniş ictimaiyyətə tədqiqatın nəticələrindən faydalanmaq imkanı açmaq. [2]

Azərbaycan Respublikası Sahibkarlığın İnkişafı Fondunun vəsaitinin səmərəli yerləşdirilməsi məqsədilə 2022-ci il üçün iqtisadiyyatın sahələri üzrə mövcud olan prioritetlər mövcuddur:

- ✓ Azərbaycan Respublikası Prezidentinin sərəncamlarında nəzərdə tutulan istehsal, emal və xidmət sahələrinin dəstəklənməsi;
- ✓ kənd təsərrüfatı sahəsinin mövcud inkişafı üzrə istehsal, emal və xidmət yönümlü bütün layihələrin dəstəklənməsi;
- ✓ qeyri-neft sənayesinin inkişafı üzrə istehsal və emal yönümlü layihələrin dəstəklənməsi;
- ✓ xidmət yönümlü layihələrin dəstəklənməsi;
- ✓ logistik mərkəz, taxıl anbarı kompleksləri, fermer mağazalarının yaradılması yönümlü layihələrin dəstəklənməsi;
- ✓ turizmin inkişafı layihələrinin dəstəklənməsi;
- ✓ tikinti sektorunda istifadə edilən maşın, qurğu və avadanlıqların alınması yönümlü layihələrin dəstəklənməsi;
- ✓ qədim xalq sənətlərinin inkişaf etdirilməsi üçün xalçaçılıq, misgərlik, dulusçuluq, ipəkçilik, suvenir istehsalı və sair sahələrin dəstəklənməsi;
- ✓ startap layihələrin dəstəklənməsi;
- ✓ kütləvi formalı informasiya vasitələrinin inkişafı layihələrinin dəstəklənməsi;
- ✓ rəqəmsal, internet, telekommunikasiya xidmətlərinin inkişafı layihələrinin dəstəklənməsi;
- ✓ bərpa edilən enerjinin tətbiqi, bu sahə üzrə xidmətlərin göstərilməsi, avadanlıq və qurğular istehsalının reallaşdırılması yönümlü layihələrin dəstəklənməsi.
- ✓ Layihələrin qiymətləndirilməsi zamanı üstünlük veriləcək meyarlar:
- ✓ qeyri-neft sektorunun inkişafı üçün innovativ texnologiyalara əsaslanan yeni növ istehsal və emal müəssisələrin yaradılması, mövcud müəssisələrin modernizasiyası və genişləndirilməsi;
- ✓ idxaləvəzləyici, ixrac yönümlü qida və qeyri-qida məhsullarının istehsalı və emalı üçün nəzərdə tutulan müəssisələrinin yaradılması və genişləndirilməsi;
- ✓ aqroparkların, həmçinin aqrar sektorda müasir texnologiyaların tətbiqiylə fermer təsərrüfatlarının və emal müəssisələrinin yaradılması və genişləndirilməsi;
- ✓ ətraf mühit, sosial və korporativ idarəetmə yönümlü layihələrin dəstəklənməsi;
- ✓ BMT-nin Dayanıqlı İnkişaf Məqsədlərinə əsaslanan layihələrin dəstəklənməsi;
- ✓ mikro, kiçik və orta sahibkarlığın dəstəklənməsi;
- ✓ işğaldan azad edilmiş ərazilərdə sosial-iqtisadi inkişafa xidmət edən bütün biznes layihələrin dəstəklənməsi. [3]

Texnoparkaların genişləndirilməsi təyin olunmuş layihələrin həyata keçirilməsinə və problemlərin həll edilməsinə köməklik göstərir:

- ✓ İstehsal fəaliyyətinin bütün işinə köməklik göstərmək, müəssələri müasir növ silahlarla təchiz etmək, şirkətin fəaliyyətini rəqabətə davamlı vəziyyətə gətirmək;
- ✓ İnvestisiya qoyuluşunu artırmaq;
- ✓ Elmi-texniki tərəqqinin yüksək inkişafına nail olmaq;
- ✓ Regionun infrustrukturunu tam inkişaf etdirmək;
- ✓ Fəaliyyətini dayandırmış iş yerlərinin tam fəaliyyətini bərpa etmək işsizliyin qarşısını almaq;
- ✓ Ətraf mühitin təmizliyini qorumaq;

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- ✓ Kiçik, orta və iri sahibkarlıq fəaliyyətini və investisiya qoyuluşunu artırmaq;
- ✓ İdxalı azaltmaq və əvəzində ixracı çoxaltmaq;
- ✓ İqtisadi bazara müasir və yeni növ milli məhsullarla çıxmaq.

Sənaye parklarında geniş infrastruktur təchizatı bütün rezidentlərə "birbaşa qoşulma" ("Plug&Play") prinsipi əsasında təklif edilir. Rezidentlərin istifadəsi məqsədiylə sənaye parklarında kanalizasiya xətləri, kimyəvi tullantı, yağış, içməli, texniki, yanğına qarşı su təchizatı şəbəkələri, təbii qaz təchizatı xətti, elektrik verilişi xətti, yarımstansıya, transfotmatorlar, paylanma məntəqələri, avtomobil və dəmir yolları, fiberoptik kabel xəttləri təklif olunur. Bütün sənaye parklarında dövlət vəsaitləri hesabına əsasən müasir infrastruktur yaradılır. Sahibkarların vəsaitlərini investisiya qoyuluşuna yönəltmələri isə təmin edilir.

Azərbaycanda bu imkanlarla paralel olaraq, sənaye parklarının rezidentləri idxal edilən texnika, texnoloji avadanlıqlar və qurğulara əsasən 7 il müddətinə bütün gömrük rüsumlarından azad edilirlər.

- ✓ Mənfəət vergisi - Sənaye parklarının rezidentləri qeydiyyata alındıqları hesabat ilindən etibarən 10 il müddətinə sənaye parkındakı fəaliyyətdən əldə etdikləri bütün mənfəətə görə vergidən azad olunurlar.
- ✓ Əmlak vergisi - Sənaye parklarının rezidentləri qeydiyyata alındıqları hesabat ilindən etibarən 10 il müddətinə sənaye parkındakı əmlaklarına əsasən əmlak vergisini ödəməkdən azad olunurlar.
- ✓ Torpaq vergisi - Sənaye parklarının rezidentləri qeydiyyata alındıqları hesabat ilindən etibarən sənaye parkında istifadə etdikləri torpaqlara əsasən 10 il müddətinə torpaq vergisini ödəməkdən azad edilirlər.
- ✓ İdxal edilən texnika, texnoloji avadanlıqlar və qurğulara əsasən ƏDV və gömrük rüsumu - Sənaye parklarının rezidentləri tərəfindən sənəd əsasında idxal edilən texnikanın, texnoloji avadanlıqların və qurğuların idxalı rezidentin əsas sənaye parkında qeydiyyata alındığı tarixdən 10 il müddətinə ƏDV-dən azad olunur, eyniylə 7 il müddətinə gömrük rüsumlarından da azad edilirlər.

Logistik imkanları:

- ✓ Azərbaycan dünyanın 159 ölkəsiylə, (Ermənistan xaric) bütün qonşu ölkələrlə ikitərəfli diplomatik münasibətlərə sahibdir və dünyanın 195 ölkəsiylə xarici ticarət əməliyyatları aparır.

Azərbaycanın digər xarici investorlar üçün əsas cəlbediciliyini şərtləndirən amillər:

- ✓ Əlverişli coğrafi mövqeyə sahib olması;
- ✓ Logistik imkanlara sahib olması;
- ✓ Siyasi sabitlik;
- ✓ Xarici ölkələrlə olan diplomatik və ticari münasibətlər;
- ✓ Əlverişli investisiya mühitinin olması və s.

Azad ticarət imkanları isə bir çox dövlətlərlə ikitərəfli Azad Ticarət Sazişlərinin mövcudluğudur. Bunlara Rusiya, Gürcüstan, Qazaxıstan, Ukrayna, Belarus, Özbəkistan, Türkmənistan Qırğızıstan, Tacikistan, Moldova və s. daxildir. GUAM iştirakçısı olan dövlətlər arasında da çoxtərəfli Azad Ticarət Sazişləri mövcuddur. [4]

Azad Ticarət Sazişlərinin ən əsas üstünlükləri, kvota və kəmiyyət məhdudiyyətlərinin tətbiqindən yayınmaq barəsində tərəflərin vacib öhdəliklərin, ayrıseçkiliyə sahib olan milli rejim və ölkə rejiminin tətbiqini nəzərdə tutan bütün qaydaların, tranzitin azad şəkildə həyata keçirilməsi prosesinin, malların mənşəyinin tam müəyyən olunması üzrə xüsusi qaydaların mövcud olmasıdır.

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Sənaye Parklarında Tədqiqat və İnkişaf Mərkəzi elm və texnologiya sahəsində əldə olunmuş yeni bilik və təcrübələrin öyrənilməsi, milli innovasiya sisteminin tam formada qurulması prosesində maarifləndirmə işinin icrası, innovasiyalı iqtisadiyyatda sahibkarlıq subyektlərinin, o cümlədən bütün regionların inkişafıyla əlaqədar araşdırmaların aparılması, ən qabaqcıl texnologiyaların, təzə məhsulların və xidmətlərin respublikanın iqtisadiyyatına keçidinin təşkil olunmasını həyata keçirir.
Respublikanın son illərdə sənaye inkişaf tempi artmaqda davam edir.

Cədvəl 1. Müəssisələrin növləri üzrə il ərzində yerinə yetirilmiş elmi-texniki işlərin həcmi (min manat).

	2017	2018	2019	2020
Cəm	114783.9	135145.2	152601	151179.9
Elmi tədqiqat təşkilatları	96266.3	118383.6	128873.2	134657
Ali təhsil müəssiləri	9329.4	13941	18708.7	12029.5
Digər	9188.2	2820.6	5019.1	4493.4

Mənbə: Azərbaycan Dövlət Statistikası Komitəsinin materialları əsasında tərtib olunmuşdur.

Bu nəticələr həm də respublikanın davamlı inkişafını təmin etmək məqsədiylə sənaye zonalarının inkişafına öz töhfəsini verir.
Dünya ölkələri tərəfindən qəbul edilən sənaye parkı memarlığının modelləri olaraq, Meqa model - geniş miqyasda, müxtəlif funksiyalı geniş ərazilərdə universitetlərin, məktəb ərazilərinin yaxınlığında, Kompleks model - abadlıq işləri, sosial yaşayış massivlərindəki binalar, bina qruplarında, əsasən universitet ərazilərinə yaxın yerlərdə, Nöqtəvi model isə - maksimum birləşmiş kompozisiyadır.

Şəkil 3. Sənaye parklarının arxitekturasına görə 3 əsas modeli.

Sənaye Parkının Prinsipləri Rəqəmsal Fəaliyyətə daxil olmaqla fəaliyyətini davam etdirməlidir. Bəzi ölkələrin daxilində bir çox meyarlar, məhsul və xidmətlərə genetik üstünlük təşkil edir ki, bunlara – insan, bazar, kapital, mədəniyyət, infrastruktur, Qanunvericilik və s. daxildir.
Bu ölkələrin ən qabaqcılları ABŞ, Çin, Yaponiya, Sinqapur və Cənubi Koreyadır. Araşdırmalara görə, bu ölkələrin iş prinsipləri Silikon Vadisi ilə eynidir. Unikal bacarıq və qabiliyyətlərin daim inkişaf edən biznes sahələrinə uyğunlaşdırılması, yüksək peşəkarlıq və s. əsas istehsal vasitələrinin, maddi rifahın və fərdin sosial vəziyyətinin mahiyyətidir. İntellektual fəaliyyətə sərmayə qoymaq resursların səmərəli bölüşdürülməsi, istehsalın intensivləşdirilməsi və elmi-

texniki tərəqqinin nəticələrinin tətbiqi, məhsulun və texnologiyanın innovasiya tempinin sürətləndirilməsinə səbəb olur.

Kiçik və orta sahibkarlığın inkişafı dünyanın böyük ölkələrinin mərkəzində dayanır. İnnovativ KOS İmkanlarının Ali Təhsil Müəssisələrinin Elmi Potensialları ilə inteqrasiyası Elmi nailiyyətlərdən yararlanmağın ən təsirli yollarından biri texnologiya innovasiya mərkəzləri, texnologiya transfer mərkəzləri və texnoparkların yaradılmasıdır.

Texnopark nisbətən gənc, dinamik inkişaf edən və mürəkkəb strukturuna görə kifayət qədər müxtəlif konseptlərə malikdir. Bu, texnoparkın mövcud modellərinin bir-birindən kifayət qədər fərqli olması ilə izah olunur. Beynəlxalq Elm Parkları Assosiasiyası (IASP) 63 ölkədə texnoparkların ən yaxşı təcrübəsini təhlil edərək, texnoparklar anlayışını ümumiləşdirən standartlar, qaydalar və tələblər hazırlayıb və onun qlobal xarakter daşıdığını qeyd edib. Elm parkı, texnoloji rayon, tədqiqat parkı və digər qurumlar arasında müəyyən fərqlər olsa da, ümumi məqsədlər, elementlər və metodologiyalar onları bir konsepsiyada qruplaşdırmağa imkan verib: Texnopark konsepsiyası. IASP-ə görə, elmi park innovativ şirkətin rəqabət qabiliyyətini inkişaf etdirmək və elmi müəssisələrin innovativ mədəniyyətini inkişaf etdirməklə şirkətin gəlirlərini artırmaq məqsədi daşıyan ixtisaslaşmış mütəxəssislər tərəfindən idarə olunan qurumdur.

Biznes İnkubatorların Milli Assosiasiyası (NBIA) biznes inkubator anlayışını kommersiya müəssisələrinin inkişafının dinamik prosesi kimi müəyyən edir. İnkubator gənc şirkətlərin fəaliyyət göstərməsinə və inkişafına kömək edir, onları müəyyən dərəcədə qidalandırır. İnkubatorlar startaplara hüquqi yardım, idarəetmə, marketinq, maliyyə resurslarından istifadə, texniki və texnoloji sənədlərin hazırlanması və s. Onlar şirkətlərə bir dam altında ofis xidmətləri, avadanlıqların istifadəsi, nisbətən aşağı icarə haqqı olan məkanlar və genişlənmə imkanı təklif edirlər. [5]

Texnopark universitet və elmi-tədqiqat institutlarının yeni texnologiyalarını kommersiya baxımından tətbiq edən, gənc mütəxəssislər üçün yeni iş yerləri yaradan, şəhərin sosial-iqtisadi həyatında səmərəli rol oynayan güclü institutdur. Texnoparkın strukturları mövcud olduğu 60 il ərzində iqtisadi və elmi-texniki tərəqqinin dəyişməsinin təsiri altında bir neçə dəfə dəyişsə də, sistem aşağıdakı əsas prinsipləri qoruyub saxlamağa nail olmuşdur: İnnovativ kadr hazırlığı, Trans-peşəkar sahibkar və yüksək məhsuldarlıq, rəqabət qabiliyyətli məhsullara və əqli mülkiyyətə əsaslanan qabaqcıl texnologiyaların kommersiyalaşdırılmasıdır.

Texnoparklar ümumiyyətlə böyük universitetlərin bazasında yeni sahibkarlıq növlərini uğurla yetişdirmək üçün təşkil edilir. Texnologiyanın transferi, kommersiyalaşdırılması və iqtisadiyyatda elm tutumlu məhsulların payının artırılması məqsədilə texnoparklarda innovativ şirkətlərin təşkili və inkişafı üçün şərait yaradılır.

Dünya təcrübəsinin təhlili göstərir ki, texnoparkın yaradılması şərti olaraq üç modelə - Amerika, Avropa və Asiya modellərinə əsaslanır. Amerika modelinin ən tipik nümunəsi Stenford Universitetində yaradılmış dünyanın ilk texnoparkı - "Silikon Vadisi"dir. Stenford Texnoparkı hələ də ölçüsünə görə liderdir. O, 280 hektar ərazini əhatə edir və yüksək texnologiyalı şirkətlərə 51 il müddətinə icarəyə verilir. 1981-ci ildə şirkətdə 80 şirkət və 26.000 işçi çalışırdı. Stenford Texnoparkının tikintisini başa çatdırmaq, infrastrukturu qurmaq və bütün ərazini icarəyə vermək 30 il çəkdi. Amerika texnopark modeli funksional bölmələrin funksional vahidlərlə vahid arxitekturada inteqrasiyası ilə xarakterizə olunur. Dünyada ilk texnoparkı iqtisadi, sosial və ərazi şəraitinin harmoniyasının yaratdığı sinergik effektin reallaşmasının nəticəsi hesab etmək olar. Silikon Vadisinin genezisi üçün aşağıdakı şərtlər əsas rol oynamışdır: texnoloji yeniliklərin cəmiyyətə daxil edilməsi zərurəti; Kampusdakı istifadəsiz yerlərin yerləşdiyi şəhərətrafı

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rayonlarla müqayisədə mərkəzi rayonlarda kirayə haqları çox yüksəkdir; Universitetlərdə dövlət tərəfindən maliyyələşdirilən tədqiqatların aparılması.

Bu şərtlərlə universitet istifadəsiz torpaqları və binaları innovativ texnologiyalar üzərində işləyən şirkətlərə icarəyə verməyə başladı. Bu mühit mövcud və yeni yüksək texnologiyalı şirkətlərin fəal inkişafına səbəb olmuşdur. Universitetlə şirkətlər arasında ərazi yaxınlığı və sosial əlaqələr (bir çox alimlər, müəllimlər, məzunlar və tələbələr innovativ şirkətlərdə çalışıblar) Texnopark adlı unikal mühit yaratmışdır.

Texnoparkın Amerika modelinə uyğun olaraq, universitet istifadəsiz binaları, otaqları və laboratoriyaları elmi cəmiyyətlərə icarəyə verir və müvafiq xidmətləri (mühafizə, kommunal xidmətlər) göstərir. Nəticədə Texnoparkın əməkdaşları ilə universitetin alimləri, müəllimləri və tələbələri arasında şəxsi münasibətlər, işgüzar münasibətlər və ümumi maraqlar təbii şəkildə inkişaf edib.

Texnoparkın təşkilat sxemi Amerika modeli ilə müqayisədə çox sadə olsa da, bu arxitektura müsbət sinergetik effekt formalaşdırmaq üçün çox uyğun hesab edilir. Yəni texnopark müəssisələrinin iqtisadiyyatı və rəqabətqabiliyyətliliyi universitetin təhsil xidmətləri, elmi fəaliyyəti və ictimai fəaliyyəti ilə vahid arxitekturada fəaliyyət göstərir. Konsentrasiya edilmiş intellektual potensial və qabaqcıl texnologiyalar texnoparkın bütün innovativ strukturunu təşkil edir. Hazırda ABŞ-da 160-dan çox texnopark var ki, bu da dünya texnoparklarının 30 faizini təşkil edir.

ABŞ-dan sonra inkişaf etmiş Avropa ölkələrində texnoparkların yaradılmasına başlanıldı: İngiltərənin Kembric Universitetinin Elm və Texnologiya Parkı, Fransada Elm və Texnologiya İnnovasiyaları və İstehsalat Zonası, Qrenobl Akademiyası və s.

Avropa təcrübəsi texnoparkın inkişaf strukturunun post-amerikan mərhələsini əhatə edir. Əksər Avropa ölkələrində inkubator tipli texnoparklardan - innovasiya mərkəzlərindən istifadə geniş yayılmışdır. Avropa modelinin ümumi strukturu aşağıdakı spesifik xüsusiyyətlərə malikdir: çoxlu sayda kiçik müəssisələrin ixtisaslaşdırılmış binada yerləşdirilməsi kollektiv xidmət imkanlarını bölüşən çoxlu sayda kiçik və orta müəssisələrin formalaşmasına və inkişafına imkan verir; İdarəetmə mexanizminin mürəkkəbliyinə baxmayaraq, bir neçə təsisçinin olması maliyyələşmə imkanları baxımından daha səmərəli hesab edilir.

Avropa texnoparklarının mühüm xüsusiyyəti onların çoxəsrlik tarixə malik keçmiş universitet şəhərciklərinin ərazisində yerləşməsidir. Məsələn, Kembric Elm Parkı təkcə İngiltərədə deyil, digər Avropa ölkələrində də texnoparkların ənənələrini xarakterizə edir. Texnopark ideyasının formalaşdırılması üzrə Avropa təcrübəsi iş yerlərinin intellektual texnologiyalarla təmin edilməsi, əməyin təşkili mədəniyyətinin yüksəldilməsi, elm, təhsil və biznesin inteqrasiyası üçün daha səmərəli modellərdən və digər müasir metodlardan istifadə üzrə Amerika təcrübəsini tamamladı.

Şərq yarımkürəsinin əksər ölkələrində texnopark obyektləri Asiya modelini izləyir. Asiya modelinin ən tipik nümunəsi olan Yapon modeli texnoparkların, yeni şəhərlərin tikintisinə aiddir. Texnopollar elmi fəaliyyəti prioritet istiqamətlərdə cəmləşdirir, davamlı olaraq innovativ fəaliyyət göstərir, fundamental sahələrdə elmi tədqiqatları tətbiqi işlərlə birləşdirərək elm və texnologiyanın intensiv inteqrasiyasını təmin edir. [6]

Texnopolis termini Yaponiyada 1980-ci illərdən istifadə olunur. Bu konsepsiya Yaponiyanın sənaye strategiyasının əsasında duran iki mühüm ideyanın sintezini xarakterizə edir. Birinci ideya (texnologiya) yapon sənayesinin innovasiya əsasında modernləşdirilməsini nəzərdə tutur, ikinci ideya (polis) isə yunanca "şəhər hökuməti" deməkdir. Amerikanın "Silikon Vadisi" konsepsiyasından fərqli olaraq, Yapon texnopolisi elmə əsaslanan texnologiyaların yaradılmasına

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daha balanslaşdırılmış yanaşmadır. Söhbət təkcə texnologiya ilə məhdudlaşmayaraq, tədqiqat və texnologiya mərkəzləri, universitetlər, yaşayış kompleksləri, parklar və mədəniyyət müəssisələri ilə yeni tipli elmi sahələrin yaradılmasından gedir. Elm parklarının tikintisi zamanı aşağıdakı meyarlar nəzərə alınır: onlar paytaxtdan 30 dəqiqədən gec olmayaraq yerləşdirilməlidir; əhalinin sayı 200.000 nəfərdən az olmamalıdır; onun sahəsi 500 kvadratmetrə bərabər və ya ondan az ola bilməz; müasir elmi-sənaye komplekslərinin, universitetlərin və elmi-tədqiqat institutlarının balanslaşdırılmış arxitekturasına və adekvat infrastrukturuna malikdir.

Hazırda Yaponiyada 19 elm parkı fəaliyyət göstərir. Texnopolis təcrübəsindən dünyanın digər ölkələrində də istifadə olunur. Fransa, Finlandiya, Çin, Hindistan, Malayziya və Sinqapurda elmi parklar yaradılıb.

Daha sonra texnopark ideyası üçüncü dünya ölkələrinə yayıldı. 1988-ci ildə Çində təsdiq edilmiş dövlət elmi-istehsalat proqramının elmi-texniki potensialının bir sıra elm tutumlu sahələrə (mikroelektronika, kompüterlər, fiber optik rabitə, biotexnologiya, tibbi avadanlıq, s.) başlamışdır. Hazırda Çində müxtəlif səviyyəli 120 texnopark var. Onların ümumi illik ixrac gəlirləri 4 milyard dollardır. [7]

Dünya təcrübəsində texnopark ideyası çox vaxt Şanxay və Honq-Konq regionlarında həyata keçirilir. Bu ideyanın əsas prinsipi az sayda işçi qüvvəsi və kiçik sahə tələb edən kiçik istehsal dövrlərini təşkil etməkdir. Texnopark ideyasının gəlirliliyi ondan ibarətdir ki, kifayət qədər bahalı və müasir avadanlıqla təchiz olunmuş biznes inkubatorlar kiçik biznesin inkişafından əldə olunan gəlirdə iştirak edərək işləyir və öz gəlirlərini əldə edirlər. Bu fəaliyyətləri dəstəkləmək üçün texnoparklar üçün xüsusi iqtisadi zonalar yaradılır.

Digər tərəfdən, texnopark tədqiqatlar üçün bir məkandır. Finlandiyada innovativ texnologiyaların tədqiqi üçün ideya modelindən istifadə edilir. Bu modelə görə, dizaynın ilk mərhələsi yalnız müəllif-ixtiraçı və bəzi investisiyalar tələb edir. Bu ideyanı sənaye modeli səviyyəsinə çatdırmağı xahiş edən ikinci mərhələdə daha çox investisiya, digər texnika və texnologiyalar, digər mütəxəssislər, tərəfdaşlar və s. lazımdır. Bununla belə, ən yaxşı ideyanın belə gəlirli bir işə çevriləcəyini proqnozlaşdırmaq çox çətindir. Buna görə də risk maliyyələşdirməsi kiçik biznesdə geniş istifadə olunur. Ən əsası, seçilmiş ideyaların 15-20%-nin həyata keçirilməsi üçün tətbiqi xərcləri ödəyir və sözügedən bank üçün ən sərfəli investisiyalardan biri hesab olunur.

Texnopark həm də yerləşdiyi əyalətə və şəhərə üstünlüklər gətirir. Söhbət şəhər üçün yeni iş yerlərinin yaradılması və yeni texnologiyaların yaradılmasından gedirsə, bu, dövlətin innovasiya və rəqabətə əsaslanan iqtisadiyyat yaratması üçün bir yoldur. Ona görə də bu biznes qurumlarının təsisçiləri dövlət, şəhərlər, bələdiyyələr, universitetlər və şirkətlərdir. Onlar sosial kapitala sərmayə qoyurlar və ya icarə haqqı, torpaqdan istifadə və s. kimi müəyyən üstünlüklərə malikdirlər. Texnoparkın digər üstünlüyü onun kommersiya cəlbediciliyi və sabitliyidir. Məsələn, texnoparkın əsas təsisçilərindən biri universitet olsa da, onun kommersiya strukturu kimi idarə olunması universitet tərəfindən deyil, artıq biznesdə müəyyən uğurlar əldə etmiş və bunu özünün əsas fəaliyyət sahəsi hesab edən sahibkar tərəfindən təmin edilir. Bir sözlə, texnopark ən müasir texnologiyalar və innovasiyalar əsasında fəaliyyət göstərən azad, kommersiya cəhətdən səmərəli və səmərəli müəssisədir.

Texnoparkları idarə edən şirkətlərin hərəkətləri aşağı riskli tədbirlər kimi işə salınır. Kiçik innovativ sahibkarlar üçün vençur maliyyələşdirilməsi inkişaf etmiş ölkələrdə ixtisaslaşmış maliyyə institutları vasitəsilə həyata keçirilir. Bu məqsədlə müxtəlif mənbələrdən (böyük şirkətlərin, bankların vəsaitləri, şəxsi əmanət fondları, pensiya və xeyriyyə fondları, zəmanət vəsaitləri və s.) istifadə etməklə kiçik innovativ şirkətlərin maliyyələşdirilməsi üçün xüsusi vençur

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investisiya fondları yaradılır. Vençur kapitalından istifadə innovasiya prosesində əsas amildir. Bu cür layihələr kiçik texnoloji şirkətlər tərəfindən idarə olunarsa, uğur qazanma şansı var. Çətinlik iri şirkətlərin müxtəlif səbəblərdən yüksək riskli layihələr həyata keçirmələridir. Vençur kapitalı müvafiq maliyyə alətləri vasitəsilə yüksək riskli layihələri dəstəkləməyə kömək edə bilər. Məsələn, burada kompüter texnologiyaları sahəsində ciddi uğur qazanmış şirkətlərin hər biri vençur kapitalı hesabına maliyyələşdirilib. [8]

Avropa texnopark modelinin ən fərqli nümunəsi İstanbuldakı bacı texniki universitetində yerləşən ARI texnopark kompleksidir. Ölkədə 39 texnopark var. Onlardan 27-si akkreditasiyadan keçib. Türkiyə hökumətinin innovasiya və texnologiya siyasəti və 1961-2009-cu illər arasında ITU-ARI Texnoparkının hüquqi bazasının yaradılması bir neçə səviyyə üzrə milli qanunvericilikdə mühüm mərhələlərə çatmışdır. BTİ-ARİ texnopark kompleksinin texniki-iqtisadi göstəricilərinə nəzər salaq:

ARI 1 və ARI 2 - sahəsi 25 000 kvadratmetr, işçilərin sayı 2 000 nəfərdir, 78 innovativ şirkət var, onlardan 12-si beynəlxalqdir;

ARI 3 - sahəsi 60.000 m2, investisiya 40 milyon dollar.

ARI 4 - sahəsi 112 min kvadratmetr, investisiya 5 milyon dollardır;

ARI 5 - 5000 kvadratmetr sahə, investisiya 5 milyon dollardır;

Akademik İnkubasiya Mərkəzi - 2500 kvadrat fut, 2,5 milyon dollar investisiya.

ARI Texnoparkı qanadlı helikopterlər, pilotsuz helikopterlər, elektrik pikaplar, dizel mühərrikləri, nanopeyklər, günəş avtomobilləri, günəş qayıqları və digər innovativ məhsullar istehsal edir. Günəş avtomobili layihəsi 2011-ci ildə ABŞ müsabiqəsində 7 universitet arasında 3-cü, mikrosatellit layihəsi isə 8 universitet arasında 1-ci yeri tutmuşdur.

Rusiyada ilk texnoparklar 1990-cı illərdə yaradılmışdır.Texnoparklar universitetlərdə və iri elmi-texniki mərkəzlərdə yerləşirdi. Daha sonra regional texnoparklar yaradıldı. Bu gün qonşu ölkənin 35 rayonunda 60 texnopark var. [9]

Qabaqcıl texnologiyalara əsaslanan inkişafının əsasının qoyulması istiqamətində uğurlu siyasət aparılır. Qabaqcıl texnologiya bilik iqtisadiyyatına doğru mühüm addımdır. Bu istiqamətdə fəaliyyətin bariz nümunəsi Sumqayıt Texnoparkıdır. TexnoPark ölkə üçün innovasiyaya, elmə və rəqabətə əsaslanan iqtisadiyyatı inkişaf etdirmək üçün yeni iş yerlərinin yaradılması və yeni texnologiyaların inkişafı yoludur. Sumqayıt Texnoparkı 45 hektar ərazidə yerləşir. Bu ərazinin 140 min kvadratmetrini parkın istehsalat binaları tutur. Texnoparkın birinci mərhələsinin tikinti-quraşdırma işlərində 2300-dən çox işçi çalışıb.

Sumqayıt Kimya Sənaye Parkı. Onun məqsədi neft-kimya və digər prioritet sektorlarda rəqabətqabiliyyətli məhsulların istehsalı və emalı üçün şirkətlər yaratmaqdır. Bu məqsədlə parkın xarici və daxili infrastrukturunun, ofislərin, məsləhət, elmi-tədqiqat laboratoriyalarının, biznes inkubasiya, təlim, peşə hazırlığı, sahibkarlıq və digər xidmətlərin yaradılması nəzərdə tutulur.

İnnovasiya və texnopark eyni xarakterli iki anlayışdır. İnnovasiyaya əsaslanan inkişaf konsepsiyası universitetlər üçün də böyük əhəmiyyət kəsb edir. Çünki əksər universitetlərin maliyyə problemləri var və Texnopark ideyası elmi ideyaların məhsuldar məqsədlər üçün kommersiyalaşdırılması üçün çoxlu imkanlar təklif edir.

Azərbaycan Mühəndislik Akademiyası, Milli Aviasiya Akademiyası və Azərbaycan Texniki Universitetinin birgə bazasında növbəti texnoparkın yaradılmasının aktuallığı aşağıdakı arqumentlərə əsaslanır:

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- ✓ Yüksək texnologiyaların inkişafı ilə bağlı dünya təcrübəsi göstərir ki, texnoparkın səmərəli fəaliyyət göstərməsi onun elmin, sənayenin və ali təhsil müəssisələrinin kompakt yerləşdiyi qəsəbələrdə təşkil edilməsinin məqsədəuyğundur;
- ✓ Milli Aviasiya Akademiyasının və Azərbaycan Texniki Universitetinin istehsalat infrastrukturuna malik bina və istehsalat obyektləri var: su, sıxılmış hava, ventilyasiya, enerji, magistral yollara yaxınlıq və s. ;
- ✓ Universitet professorları, alimləri, tələbələri və elmi-texniki personalı kifayət qədər elmi nailiyyətlərə, ixtiralara və patentlərə malikdir, elmi-texniki innovasiyalar üzrə fəal fəaliyyət göstərirlər;
- ✓ Universitetlərin elmi-texniki və innovasiya fəaliyyəti, beynəlxalq əməkdaşlıq və beynəlxalq layihələrdə iştirakda böyük təcrübəsi var;
- ✓ Universitetlər və sənaye KOM-ları geniş spektrli elmi, texniki və innovativ fəaliyyətlər həyata keçirirlər.

Dünyada planlı şəkildə fəaliyyət göstərən çoxlu nümunəvi texnoparklar var. Ən yaxşı nümunələr Ostin, Texas, ABŞ-dır. Asiya regionunda İT texnoparklarına Sinqapur Elm Parkı, Honq Konq Sibir Limanı, Tayvanda Yaşıl Silikon Adası, Hindistanda Banqalor, Çində Zonqonjun Bilik Parkı və Yaponiyada bir neçə elm və texnologiya parkı daxildir. [10]

Sənaye parklarının təşkil edilməsi bütün sənaye sahələrinin inkişafına səbəb olur. Həm neft, həm də qeyri-neft sektorunun inkişafı ölkədə ÜDM-in artmasına gətirib çıxarır. Bu da o deməkdir ki, elmin inkişafı nəticəsində bütün sənaye sahələrinin məhsuldarlığını, səmərəliliyini artırır. O zaman gəlin bütün sənaye sahələrinin yaratdığı əlavə dəyərin ÜDM-ə təsir dərəcəsini araşdıraq və bunun üçün reqressiya modelindən istifadə edək.

Reqressiya modelində əsas olaraq makro göstəricilər istifadə olunur. Bu modeldə bütün sənaye sahələrinin ÜDM-ə təsir dərəcələrini qura bilərik.

Burada - ÜDM asılı dəyişən (Y), bütün sənaye sektoru üzrə əlavə dəyər isə sabit dəyişəndir (X).

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon \quad (1)$$

Reqressiya modeli aşağıdakı model əsasında qurulmalıdır:

- ✓ İlk olaraq reqressiya modelinin qurulması;
- ✓ Modelin tam formada dəqiqliklə qurulması, təxminən 96%;
- ✓ Modelin qiymətinin təyin olunması;
- ✓ Tənliyin tərtib olunması;
- ✓ Əldə edilmiş modelin qiymətlərinin əhəmiyyətliliyinin nəzərdən keçirilməsi;
- ✓ Qrafik tərtib olunması.
- ✓ Reqressiya tənliyi əsasında belə nəticəyə gələ bilərik ki, ölkənin bütün sənaye sahələrinin ÜDM-ə hansı dərəcədə təsiri olub-olmadığını müəyyən etmək üçün reqressiya tənliyini qura bilərik. [11]

ÜDM-ın bütün sənaye sektorundan asılılığını təyin etmək üçün aşağdakı reqressiya tənliyini quraq:

$$Y = 47838.47 + 0.92Xi \qquad R2 = 0.7323 \quad (2)$$

Tənlikdən belə nəticəyə gəlmək olur ki, sənaye sektorunun əlavə dəyər göstəricisinin 0.9 dəfə artması ÜDM-in 47838.47 qədər artmasına səbəb olur. X-dəyişənin bütün illər üzrə nəticələrini Y dəyişənin yerinə qoyub hesablasaq, belə nəticəyə gələrik ki Y göstəricisinə yaxın əlavə dəyərlər

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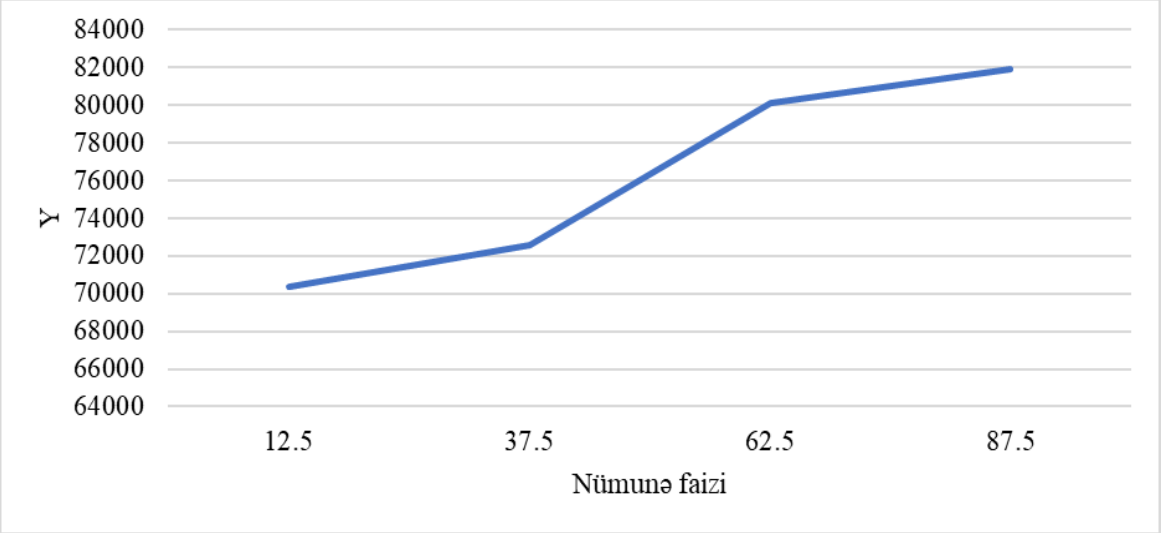
yaranır. Yəni aydın şəkildə sənaye sektorunun il ərzində dəyərlərini hesablasaq ÜDM-ə nə qədər təsir edəcəyini anlaya bilərik.

Cədvəl 2. 2017-2020-ci illər üzrə ÜDM göstəriciləri və bütün sənaye sektorunun cari qiymətlərlə əlavə dəyəri (milyon manatla).

İllər	ÜDM	Sənaye sektoru üzrə əlavə dəyəri
2017	70337.8	28208.5
2018	80092.0	35665.1
2019	81896.2	33885.9
2020	72578.1	24400.6

Mənbə: Cədvəl müəllif tərəfindən ADSK-nin materialları əsasında tərtib olunmuşdur.

Normal Ehtimal Planı



Şəkil 4. Müəllif tərəfindən Exceldə reqressiya materialları əsasında tərtib olunmuşdur.

Azərbaycanın sənaye parkları hələ iqtisadi inkişafın ən ilkin mərhələsindədir. [12]
Təcrübənin təhlili zamanı müəyyən edilmiş keyfiyyət fərqlərinə Azərbaycan və bir neçə xarici ölkələr aşağıdakı fərqləri əhatə etməlidirlər:

- ✓ Sənaye parkların ixtisaslaşması;
- ✓ sosial infrastrukturun tam olmaması;
- ✓ kiçik sənaye parklarının sakinlər tərəfindən tutulmasının dolğunluğu;
- ✓ inzibati resursların yüksək rolu və yüksək vəzifəli ali şəxslərin iştirakı;
- ✓ sakinlər üçün vergi qanunvericiliyinin fərqli şərtləri;
- ✓ müxtəlif inkişaflı idarəetmə strategiyalı parklar.

ABŞ-ın Kaliforniya ştatında yaradılmış texnoloji park olan "Silikon Vadisi" bütün dünyadan alim və elm adamlarını oraya cəlb etmişdir.

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Hər bir mövcud əməkdaş öz şirkətinə yekunda il ərzində 200 min ABŞ dolları qazandırır. Əməkdaşlarının isə orta illik əmək haqqısı təxminən 150 min ABŞ dolları təşkil edir. Mövcud kompüterlərin və digər növ məhsulların dünya ixracının 20 faizi Silikon Vadisinin payına düşür. Vadinin ÜDM-i təxminən 750 milyard dollara yaxındır. Əgər o ayrıca dövlət olsaydı, o dünyada ÜDM-nin həcminə görə 18-ci yerdə dayanardı.

Cədvəl 2

ADSK materialları əsasında tərtib olunmuş reqressiyanın nəticələri

YEKUN NƏTİCƏ								
Reqresiya statistikası								
R korrelyasiya əmsalı	0,8557856							
R kvadrat	0,7323690							
Normallaşdırılmış R	0,5985536							
Standart xəta	3566,8656							
Müşahidələrin sayı	4							
ANOVA-Reqresiya metodu								
	df	SS	MS	F	F əmsalı			
Reqresiya	1	69630136	69630136	5,47297	0,14421			
Qalıq	2	25445060	12722530					
Nəticə	3	95075197						
	Əmsallar	Standart xəta	t statistikası	P dəyəri	Aşağı 95%	Yuxarı 95%	Aşağı 95,0%	Yuxarı 95,0%
Y sərbəst həddi	47838,47	12264,695	3,900502	0,0598856	-4932,251	100609,20	-4932,2515	100609,20
X dəyişəni	0,929519	0,3973256	2,339439	0,144214	-0,780034	2,6390740	-0,7800349	2,639074

Nəticə

İnkişaf baxımından elm insanın imkanlarının genişləndirilməsində mühüm rol oynayır. Müasirləşən cəmiyyətdə bilik və bacarıqlar kapital rolunda çıxış edir və iqtisadiyyatın ən əsas resursuna çevrilir. İntellektual işçilərin daha çox üstünlük təşkil etdiyi cəmiyyətdə insanların ictimai fəaliyyətinə və bütün sosial məsuliyyətinə də yeni tələblər irəli sürülür. Elm hər bir ölkənin kadr inkişafı və elmi potensialı üçün vacibdir. Biz elə sürətlə dəyişən bir dövrdə yaşayırıq ki, elm sahəsində atılan bütün addımlar müasir tələblərə uyğun deyil, çünki, inkişaf gələcəyin perspektivləri üzərinə köklənir, kəmiyyətə deyil, keyfiyyətə yönəlir.

Elmin inteqrasiyası şəraitində bir sıra Sənaye Parklarının yaradılması dünya ölkələri üzrə investorların diqqət mərkəzinə çevrilmişdir. Azərbaycanın ən əsas məqsədi, ölkədə elmin

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inteqrasiyasına nail olmaqla, rəqabət qabiliyyətli Sənaye Parklarını yaratmaqla, ixracı artırmaq və ölkə iqtisadiyyatını daha da yüksəltməkdir. Əsas hədəf isə sənayedə qeyri-neft sektorunun xüsusi çəkisini yüksəltməkdir.

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ECONOMIC PERSPECTIVES OF INDUSTRIAL PARKS BASED ON SCIENTIFIC APPROACHES

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ABSTRACT

In modern times, the development of science and the provision of economic prospects are especially valued as the main factor. For this, taking into account the activities and innovations of advanced countries, using the experiences of foreign countries, sustainable development and economic development are achieved in the country.
Since technology, innovation and science are the main components of the joint Industrial Parks, the entrepreneurs of their nearly 180 business networks and innovation centers projects in Europe know how to build and operate their business. It is also important to have special sponsors for the operation of technoparks.

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The creation of industrial parks and technological parks has a great role in ensuring a sustainable development system in the country, reducing the level of unemployment in the country, increasing the employment level of the population, reducing the volume of imported products and increasing export products. Favorable conditions are created such as the development of oil and non-oil sectors, the use of modern technologies, support for entrepreneurship and the development of more convenient service areas for people.

Studying the main features of modern techniques means applying the main innovations in industrial parks and technoparks. In order to achieve high efficiency, attracting the most modern technologies of developed countries to the industrial areas of Azerbaijan, providing, implementing and managing the digitalization system in Industrial parks, reducing imports and simultaneously increasing exports, providing state support for the development of existing technology in industrial areas, applying the Japanese economic model to the country's industry main issues such as its application have been reviewed.

Since science always has an important role in human life, its development is considered one of the most important indicators of society, and it is an important factor that fully ensures the sustainable socio-economic and cultural level of the state.

The need for close cooperation between science and industry determines the importance of economic development based on knowledge. The basis of the most successful policy is the education strategy, which requires a close partnership of the three existing components of economic development (science, education and industry), and the establishment of an innovative education system is one of the main tasks of the full formation of human capital. This system should ensure the training of new qualified specialists who are very sensitive to new innovations, ready to create and implement innovative projects, ready to realize ideas in technological processes and quickly test new works.

Keywords: science development, technology, innovation, Industrial Park, sustainable development, import, export, high efficiency, economic model, cultural level, successful policy, technological processes, qualified specialist.

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$$f(x) = a_0 + \sum_{n=1}^{\infty} \left(a_n \cos \frac{n\pi x}{L} + b_n \sin \frac{n\pi x}{L} \right) \quad (1)$$

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	Times New Roman, 16 pt, Bold, centred	Times New Roman, 11 pt, Bold, Left aligned	Times New Roman, 10 pt, Bold, Left aligned	Times New Roman, 8 pt, Justified	Garamond, 11 pt, Justified
Line Spacing	1.15	1.15	1.15	1.15	1.15
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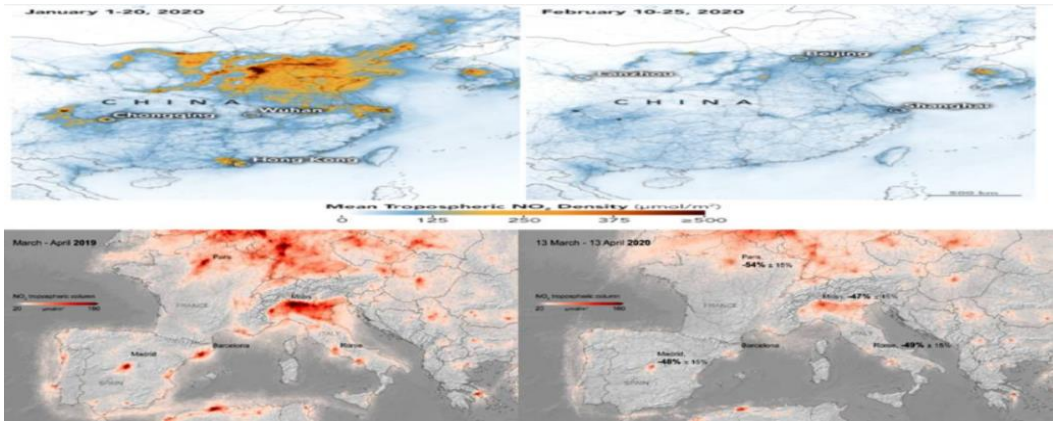

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2. Bahishti, "Peer Review; Critical Process of a Scholarly Publication", J. Mod. Mater., vol. 2, no. 1, pp. 1.1-1.2, Oct. 2016. https://doi.org/10.21467/jmm.2.1.1.1-1.2
3. Bahishti, "A New Multidisciplinary Journal; International Annals of Science", Int. Ann. Sci., vol. 1, no. 1, pp. 1.1-1.2, Feb. 2017. https://journals.aijr.in/index.php/ias/article/view/163
4. W. S. Author, "Title of paper," Name of Journal in italic, vol. x, no. x, pp. xxx-xxx, Abbrev. Month, year. Access online on 20 March 2018 at https://www.aijr.in/journal-list/advanced-journal-graduate-research/
5. W. S. Author, "Title of paper," Name of Journal in italic, vol. x, no. x, pp. xxx-xxx, Abbrev. Month, year. Access online on 5 March 2018 at https://www.aijr.in/about/publication-ethics/
6. M. Ahmad, "Importance of Modeling and Simulation of Materials in Research", J. Mod. Sim. Mater., vol. 1, no. 1, pp. 1-2, Jan. 2018. DOI: https://doi.org/10.21467/jmsm.1.1.1-2

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