

NEW TECHNOLOGY FOR DEVELOPMENT - THE IMPORTANCE OF TECHNOLOGY IMPLEMENTATION

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Abstract

This article analyzes the importance of the introduction of modern equipment and innovative technologies in economic and social development. The main factors of scientific and technological progress, the role of innovative solutions in increasing production efficiency, and ways to ensure resource efficiency and environmental sustainability through the introduction of new technologies are highlighted. It also presents ideas on the adaptation of new technologies to local conditions, their role in the digital economy, and their importance in strengthening national competitiveness. The results of the study showed the possibilities of achieving sustainable development through the implementation of advanced technologies.

Key words: new technologies, technical progress, innovation, resource efficiency, efficiency, digital economy, advanced manufacturing, ecology, modernization, development strategy.

Introduction

Today, the issue of introducing new equipment and innovative technologies as a key factor of competitiveness in the global economy is becoming increasingly important. The sustainable development of each country, increasing its industrial potential and achieving high performance in terms of product quality are closely related to the effective implementation of scientific and technological progress in practice. Large-scale reforms are also being implemented in Uzbekistan in this direction. The President's "Development Strategy of New Uzbekistan" for 2022–2026 identifies the introduction of modern equipment and innovative developments into production as a priority. This requires the introduction of advanced technological solutions and acceleration of digital transformation in the country's industry[1]. The main purpose of the introductory part is to analyze the importance of introducing new technologies on a scientific basis, to highlight its role in economic efficiency and sustainable development.

Research object and methods. The object of research was the process of introducing new technologies and technological processes at industrial enterprises, in particular, innovative solutions in the fields of chemical engineering and building materials.

The following scientific methods are used in the study:

- Analytical method — assessment of the economic and environmental efficiency of existing technologies;
- Comparative analysis method — comparison of the efficiency of using new and traditional technologies in production;

- Economic modeling method — calculation of changes in energy consumption, resource savings and product costs as a result of the introduction of new technologies;
- SWOT analysis method — identification of strengths and weaknesses, opportunities and threats in the introduction of new techniques and technologies [2,3,4].

The role of new technologies in economic development. New technologies are a strategic resource that determines the pace of economic growth. They contribute to increasing production efficiency, improving product quality, saving resources, and creating an innovative economy. Digital industrial systems, automated control programs, and algorithms based on artificial intelligence play an important role in optimizing production processes [2,3,4].

Table 1. Advantages of introducing new technologies

№	Direction	Advantages
1	Economic	Reduces production costs, increases export potential
2	Social	Creates new jobs, increases demand for qualified personnel
3	Ecological	Saves natural resources, allows waste recycling
4	Scientific and technical	Puts innovative developments into practice, increases competitiveness

The scientific and practical significance of introducing new technologies. Science-based technologies ensure the rational use of resources in production, reduce waste, and facilitate human labor through automation. This process guarantees the sustainable and environmentally friendly development of industry [3,4,5].

Problems in introducing new technologies. The following main problems are observed in the process of technological innovation:

- Insufficient financial resources;
- Low capacity of specialists;
- Infrastructure deficiencies;
- Weak mechanisms for stimulating innovative initiatives [4,5,6].

The effectiveness of the introduction of new technologies. When assessing efficiency, economic and energy efficiency coefficients, as well as labor productivity growth indicators are taken into account [5,6,7].

Mathematically, efficiency is expressed as follows:

$$E = (Q2 - Q1) / (C1 - C2)$$

where Q is the volume of production, C is the sum of costs.

The role of education in the introduction of new technologies. Higher education institutions increase the innovative potential of young specialists by studying modern technologies, developing engineering thinking, and connecting theory with practice [1,2,8,9].

The impact of new technologies on society and nature. Modern technologies:

- Reduce the negative impact on the environment;
- Optimize the consumption of energy and raw materials;
- Develop the principles of the "green economy";
- Form a digital culture in society.



In developed countries, the development and implementation of technological innovations is a decisive factor in social and economic development, a guarantee of economic security. Thus, in the United States, due to this factor, the growth of per capita national income is up to 90%. Currently, the United States is the world leader in scientific and technological progress. Over the past 5 years, the number of specialists involved in the development of technological innovations has increased from 0.8 to 1.2 million people in the United States and from 2.4 to 2.7 million in OECD countries. The United States, which has surpassed the member states of the Organization for Economic Cooperation and Development in terms of total spending on the development of technological innovations and the number of highly qualified specialists working in this area, lags behind them in terms of work efficiency due to the concentration of financial resources and established management mechanisms [7,9,10,11,12].

The direct impact of US technological innovations on scientific and technical progress around the world, their global penetration into international economic policy, the dynamics of the technological balance of payments and the scale of export-import operations in high-tech sectors (aerospace, telecommunications, pharmaceuticals, engineering). In assessing the effectiveness of international technology exchange, the coefficient of “technological independence” is of decisive importance - the ratio of the technological balance of payments and income of the country. Over the past 10 years, this ratio in the USA has not fallen below 4 [2,3,4,5,13,14,15].

In the Russian Federation, the number of specialists engaged in scientific and technical research and development is 895 thousand people. Compared to 1992, the number of researchers decreased by 1.9 times, the number of design bureaus decreased by 2.9 times, and design and engineering organizations - by 6.2 times.

Currently, the main types of technological innovation activities of organizations are:

- purchase and development of machinery and equipment related to technological innovations - 25.8%;
- production design, other types of preparation of production for the release of new products, methods of introducing services or their production (transfer) - 15.3%;
- research and development of new products, services and methods of their production, new production processes - 13.5%;
- purchase of software - 11.2%;
- training of personnel related to technological innovations - 9.9%;
- marketing research in the field of technological innovations - 7.8%;
- purchase of technological innovations - 6.5%;
- other technological innovations - 10.0%.

In fact, enterprises spend more than 67% of their development costs on technological innovation and the development of promising technologies [2,3,5,7,16,17].

Statistical data allow us to determine the distribution of research and development costs in the total volume of shipped products, that is, 64.4% of organizations spend up to 1% of the volume of shipped products, 11.7% of organizations - 1-2%, 9% - 3%, organizations - 2-4%, 14.7% of organizations - 4% and more.

Although 56,432 advanced production technologies have been mastered over the past 10 years, only 3,017 organizations have used advanced technologies, which is 0.09% of the total number of organizations in this industry [2,3,4,5,6,18,19,20].

Technological innovations are divided into 6 groups according to their use.



1. Design and engineering;
2. Production, processing and assembly;
3. Automated transport and processing of spare parts;
4. Production information system
5. Automated monitoring and control equipment;
6. Communication, integrated management and control.

That is, in the Russian Federation, as well as in Uzbekistan, there is a significant lag in production in the high-tech complex and a decrease in the average qualification of scientific, technical and production personnel at the world level [2,3,4,5,6,21,22,23].

Research results and analysis. In recent years, the trend of using resource-saving and eco-technological developments in the industry of Uzbekistan has been increasing. For example, efficiency is being increased through the use of waste processing and energy-saving reactors in the chemical industry, automated robotic lines in the construction sector, and renewable sources in energy. Analysis of various forecasts for the development of science, technology and engineering in recent years allows us to formulate the main global trends in the development of mechanical engineering, including its main chemical engineering, machine tool engineering, automotive engineering, and the building materials industry [2,3,4,6,24,25,26,27]:

1. High-speed cutting and high-production cutting:
 - Machining speed of the cutter up to 30 m/s,
 - Diamond cutter - machining speed up to 150 m/s,
 - Depth of cut up to 0.5 mm per tooth:
 - Modern materials and design of cutting tools,
 - Use of high-speed motor-spindles (up to 15-20 thousand rpm for turning and 100 thousand rpm and above for milling).
 - High-speed gears for units moving at speeds of 60-200 m/h.
2. Development of new energy and resource-saving technologies due to new high-tech and combined processing methods with maximum approximation of the workpiece to the finished part.
3. Development of new energy and resource-saving technologies due to new high-tech and combined processing methods with maximum approximation of the workpiece to the finished part.
4. Creation of multifunctional, multi-purpose equipment for the implementation of combined processing methods.
5. Precision (high-precision cutting) and the pursuit of ultra-precision processing (nanotechnology or submicron technologies).
6. The aggregate-modular principle of equipment construction and modular technologies.
7. Industry 4.0 increases the efficiency of processes:
Maintenance (technical maintenance of equipment);
 - Remote control & monitoring (remote control);
 - Deep automation;
 - Smart energy saving, etc. (flexible production).The implementation of Industry 4.0 tools reduces the total cost of production by 8-12%.
2. Industry 4.0 innovative tools and tools:
 - Big Data Analysis (big data);



- Internet of Things (IoT);
- Machine learning;
- Virtual reality and Robotics
- 3D modeling and 3D printing.

3. Benefits of Industry 4.0 innovations:

- Efficient production (up to 10-40%);
- Faster product creation (20~50%) and increased quality up to ~20%;
- Faster modeling and testing (up to 30-50%);
- Increased production flexibility (~55%).

Three important innovations in modern cars require technological innovations in the automotive industry:

1. Full electrification (transition to fully electric vehicles - (PHEV - hybrid) and full (BEV);
2. Autonomization (transition to fully unmanned control);
3. The possibility of sharing a vehicle.

Taking into account these trends, scientific developments are aimed not at improving and theoretically studying modern machine tools, which are proposed abroad, but are absent in the country, but at the ideas of their application, the effective use of machine tools, the creation of special machines and other technological complexes of a new generation that meet world requirements.

In Russia, a special database, the Knowledge Bank “Technological News”, has been created on the Internet for promising developments at the state level. This is a constantly updated fund of scientific and technical solutions and projects implemented by research, experimental design, production and educational organizations and enterprises of the Russian Federation [2,4,6,18,28,29,30,31].

The innovative field of mechanical engineering should develop in the direction of mass application of advanced technologies based on the concept of a promising technological pipeline (ITU), which ensures the transition to a qualitatively new level of industrial production, that is, develops in parallel with the VI technological pipeline (stream) and gradually replaces it.

The methodological approach to describing the structure of vocational schools is based on the formation of a system of priorities that reflects the achievement of the goal of socio-economic development of society, namely, improving the quality of human life in the post-industrial era [3,5,7,32,33,34].

The basis of a promising technological transition is formed by three technological sectors:

1. TS1 - a set of technologies capable of solving a wide range of problems and based on fundamental scientific principles.
2. TS2 - a set of technologies designed to solve a single problem, but based on the use of different elementary laws of nature.
3. TS3 - a set of technologies created at the intersection of sciences.

The change in technical and economic paradigms changes not only the economic aspects of society: the geopolitical situation is changing, profound social changes are taking place. The paradigm shift is preceded by an increase in productivity in an important branch of social production [3,7,15,36,37,49,50,51].

1. It should be noted that radical and improving innovations constantly compete with each other, which is one of the driving forces of the emergence of long Kondratiev cycles.

Emerging new technical ideas and inventions do not balance existing production and, participating in the convergence of science and technology, stimulate innovation through further improvement or more radical innovations. The technology of processing materials by cutting, which makes up the main part of mechanical engineering production, is given as a typical example [2,4,7,38,39,40,49,50].

2. Therefore, it is possible to identify some general trends in the development of mechanical engineering technology (MT), which should be taken into account when planning and planning the development of this most important area of applied science, industrial production and social spheres (human economic activity).

3. The development of mechanical engineering technology demonstrates the role of both radical and improving innovations within various technological structures and speaks not only about their struggle, but also about their unity, thereby realizing the need to develop two innovative directions: new and modernization of existing ones.

Table 2. Some results and prospects of the development of mechanical engineering technology

Boundary of sciences	Implementation result	Result
Mechanical engineering technologies – materials science.	New tool materials: hard alloys, superhard synthesized materials.	Saving resources and reducing production costs. Mechatronics, robotics. Unmanned production.
Chemical engineering – physics, chemistry	New materials and processing methods: laser, electric discharge, plasma chemical, etc. CNC, CNC equipment.	Saving resources and reducing production costs. Creating new types of equipment. Mechatronics.
Mechanical engineering technologies – mathematics, Informatics.	Smart manufacturing	The ability to create new types of equipment. Robotics. Less manpower.

4. Mechanical engineering technology (processing of solid forms of matter) is one of the oldest areas of human creative activity, which has a scientifically based and practically tested methodology. Therefore, one of the important directions of its development should be considered the spread of its technologies, production methods and tools to innovative processes and projects of a new technological order.

5. Convergence (unification at the intersection of science and technology) is one of the main principles of the development of mechanical engineering technology, which in some cases leads to radical innovations. It is in the border areas that the most significant results have been and are being achieved, therefore the role and significance of combined and integrated technologies is constantly increasing, and in the near future their application will constantly expand [4,7,8,9,41,42,49].

The role of science in the development of chemical engineering technology is constantly increasing, the time for the practical development of new scientific ideas and effects is



decreasing. This trend allows us to expect the emergence of new engineering technologies based on physicochemical methods of influencing the material and controlling its properties [2,3,43,44,45,49,50].

Miniaturization of a number of technical products requires technologies that provide the removal of preferences in the range of 10^{-7} ... 10^{-5} m to obtain structural elements with dimensions of 10^{-6} ... 10^{-7} m. The analysis shows that the share of developments in micromachinery technologies is increasing significantly, the corresponding technological equipment [4,5,46,47,48,49,50].

The scientific intensity of mechanical engineering products, as well as the share of research and development costs in the cost of production, is constantly increasing and in some cases reaches 20 ... 30%, the scientific intensity of modern technologies, as well as the share of research and development costs in the process of their development and implementation, also increases relatively.

The results of the study showed that energy consumption at enterprises where new technological solutions were introduced was reduced by 15–30%; raw material consumption was reduced by an average of 10–12%; product costs were reduced by 8–10%; and production capacity increased by 20–25%. These indicators indicate an increase in the technical level and the provision of resource efficiency in the production process [1,5,8,49,50,51].

Conclusions

1. The introduction of new technologies and technological processes is the main driver of economic growth and dramatically increases production efficiency.
2. The introduction of resource and energy-efficient solutions ensures environmental sustainability and reduces production costs.
3. The integration of scientific research and development into practical areas accelerates innovative development.
4. State support for technological modernization increases export potential and ensures the competitiveness of the national economy.

Proposals:

1. Establish a technological audit system at enterprises and re-evaluate production processes every years.
2. Establish technological incubators and innovation clusters based on the experiences of Japan, Korea, and Germany.
3. Strengthen cooperation between research institutes and manufacturing enterprises.
4. Expand tax incentives and credit preferences for the introduction of new equipment and technologies.

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