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CONCEPTUAL FOUNDATIONS OF THE PROCESS OF FORMING THE TECHNICAL AND TECHNOLOGICAL POTENTIAL OF INDUSTRIAL ENTERPRISES

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КОНЦЕПТУАЛЬНІ ЗАСАДИ ПРОЦЕСУ ФОРМУВАННЯ ТЕХНІКО-ТЕХНОЛОГІЧНОГО ПОТЕНЦІАЛУ ПРОМИСЛОВИХ ПІДПРИЄМСТВ

Technical and technological potential in modern conditions determines the competitiveness of enterprises by type of economic activity, states, since it represents a set of material, intellectual, scientific and production resources that allow creating innovative products and providing high-quality services.

The article proves that technical and technological potential should be considered as a holistic system, where an important place belongs to the

relationships between science, production and the needs of society. It is emphasized that the concept of technical and technological potential covers not only fleets of machines and mechanisms, but also the level of knowledge, qualifications of personnel, the presence of a developed laboratory and research base, the ability to design and apply innovative solutions. The formation of technical and technological potential requires the participation of state institutions, private business, scientific institutions and civil society. The formation of potential also involves the creation of appropriate infrastructure, namely technology parks, business incubators, research clusters and industrial centers, which is an important factor in its growth, since these are communities in which it is realistic to implement science in practice and commercialize research.

The key principles, scientific approaches, and methods for the formation of potential are considered. The factors of the internal and external environment that determine the development of elements of the technical and technological potential of enterprises and affect the effectiveness of their use are highlighted. The focus is on the role of the human factor, a high-quality education system, retraining and advanced training of people who already work in production or are engaged in research activities, and the innovation culture prevailing in society in terms of the development of technical and technological potential. It is emphasized that an important component is the mechanism for financing the development of potential, which is formed from a combination of various sources that work in synergy: public funds, private capital, grants from international organizations and industry associations, etc.

A model of the process of forming the technical and technological potential of industrial enterprises is presented. Its application in practice will provide an opportunity to improve the applied tools for assessing the level of its efficiency and develop justified priority areas for its improvement.

Техніко-технологічний потенціал у сучасних умовах визначає конкурентоспроможність підприємств за видами економічної діяльності,

держав, оскільки він уособлює сукупність матеріальних, інтелектуальних, наукових і виробничих ресурсів, які дають змогу створювати новітні продукти й надавати якісні послуги.

У статті доведено, що техніко-технологічний потенціал варто розглядати як цілісну систему, де важливе місце належить взаємозв'язкам між наукою, виробництвом і потребами суспільства. Наголошено, що поняття техніко-технологічного потенціалу охоплює не лише парки машин і механізмів, а й рівень знань, кваліфікацію кадрового складу, наявність розвиненої лабораторної та дослідницької бази, можливість проєктувати й застосовувати інноваційні рішення. А формування техніко-технологічного потенціалу потребує участі державних інституцій, приватного бізнесу, наукових установ і громадянського суспільства. Формування потенціалу передбачає й створення відповідної інфраструктури, а саме технопарків, бізнес-інкубаторів, дослідницьких кластерів та промислових центрів, що виступає важливим чинником його нарощування, оскільки це спільноти, в яких реально впроваджувати науку на практиці та комерціалізувати дослідження.

Розглянуто ключові принципи, наукові підходи, методи щодо формування потенціалу. Висвітлено фактори внутрішнього і зовнішнього середовища, що обумовлюють розвиток елементів техніко-технологічного потенціалу підприємств і впливають на ефективність їх використання. Закцентовано увагу на ролі людського фактору, якісній системі освіти, перепідготовці й підвищенні кваліфікації людей, які вже працюють на виробництві або займаються дослідницькою діяльністю та інноваційній культурі, що панує в суспільстві, в аспекті розвитку техніко-технологічного потенціалу. Наголошено, що важливим компонентом є механізм фінансування розвитку потенціалу, який формується із сукупності різних джерел, які працюють у синергії: державні кошти, приватний капітал, гранти від міжнародних організацій і галузевих асоціацій тощо.

Наведено модель процесу формування техніко-технологічного потенціалу, застосування якої в практиці роботи надасть можливість удосконалити прикладний інструментарій оцінювання рівня його ефективності використання та розробити обґрунтовані пріоритетні напрями щодо його підвищення.

Keywords: *technique, technology, investment, science, resources, competitiveness, development.*

Ключові слова: *техніка, технологія, інвестиції, наука, ресурси, конкурентоспроможність, розвиток.*

Problem statement in general terms and its connection with important scientific or practical tasks. Technical and technological potential in modern conditions determines the competitiveness of enterprises, types of economic activity, states, since it represents a set of material, intellectual, scientific and production resources that make it possible to create innovative products and provide high-quality services. This potential is not limited to certain infrastructure facilities or individual inventions. It should be considered as a holistic system, where an important place belongs to the relationships between science, production and the needs of society. Therefore, the concept of technical and technological potential covers not only fleets of machines and mechanisms, but also the level of knowledge, qualifications of personnel, the presence of a developed laboratory and research base, the ability to design and apply innovative solutions. And the process of forming technical and technological potential is the foundation for ensuring the competitiveness of enterprises in the short and long term. As a result, it becomes clear that the effective realization of such potential can ensure not only economic growth, but also a sustainable improvement in the quality of life of society.

Analysis of recent research and publications. The essence of the definition of «technical and technological potential», its key components, and assessment methods were considered in their scientific works by such scientists as Hotra V.,

Ihnatko M. [1], Mnykh E., Hubskey B. [2], Azarenkova G., Shevchuk D., Fathutdinov R., Semenov V., Kraus K., Svistunov V. [7], Sokolenko L., Honcharova N. [8], Maslak O., Peredereeva O. [4], Yevdokimov F. [3], Antonenko M., Kraus K. [5], Pohoriliy V., Khalin S., Gaidai T., Lebedeva I. [9], Petryk S., Lorenks B., Belenky P., Boyko E., Shevchuk D. [10], Kizera O., and others. However, despite significant scientific developments on the topic under study, in conditions of fierce competition between enterprises, uncertainty and risk, rapid development of technologies, namely constant changes that arise under the influence of external environmental factors, there is an urgent need to further study the process of forming technical and technological potential as the basis for ensuring the effective operation of enterprises.

Formulation of the article's purpose (task statement). The purpose of the study is to generalize and develop the conceptual principles of forming the technical and technological potential of industrial enterprises.

Presentation of the main research material. Clarifying the essence of technical and technological potential involves analyzing several aspects. The first concerns the material component, which includes machines, equipment, information systems and the entire production infrastructure that directly participates in creating added value. The second is related to the intellectual base. These include scientific developments, patents, software, experience in design and process management. Along with this, the human resource component becomes important. No matter how powerful the machines and programs are, without specialists who can maintain them in good condition, modernize and integrate them into new production chains, the potential will not be able to fully unfold. Therefore, the separation of different dimensions and a focus on their interaction allows us to better understand the mechanisms of forming technical and technological potential and develop effective strategies for its improvement.

The conceptual basis of the process of forming the technical and technological potential of enterprises are principles, the key ones of which are

systematicity, integrity, consistency, innovation, competitiveness, flexibility (adaptability), and efficiency.

Regarding scientific approaches. Almost all general scientific approaches considered in the process of forming the enterprise's potential can be used as a basis for forming technical and technological potential. This is a systemic approach, functional, innovative, marketing, normative, dynamic, situational.

Due to the fact that the process of forming the potential of an enterprise is dynamic, aimed at maximum interaction with the external environment in all aspects, and regarding the requests and preferences of consumers for products, increasing competitive advantages over other enterprises in a certain market segment, and increasing risk protection, flexibility, adaptability, an important stage is the determination of factors that determine the development of its elements and affect the effectiveness of their use. The factors of the internal environment that determine the possibilities of developing technical and technological potential include: the state of the material and technical base of the enterprise; the level of automation and digital technologies for optimizing production processes; the competitiveness of technological processes for manufacturing products; the readiness to introduce new equipment and technology; the presence of own developments; the level of professional knowledge of employees involved in the development and implementation of innovative products; the need for training and advanced training; employee motivation for professional development; flexibility in managing technical changes; the ability to make informed management decisions; focusing on technological development in the corporate strategy of the enterprise; availability of financial resources, including investors, loans, etc.

External factors include: consumer demand for new products and services; competition; uncertainty and risks; scientific and technological progress; increasing globalization of the type of economic activity; state programs to support innovation activity, state regulation of scientific and technical and innovative activity, etc.

The main methods for forming the technical and technological potential of an enterprise include the innovative, predictive and analytical, investment method, the use of the Internet of Things, crowdsourcing, outsourcing, benchmarking, analysis of big data (Big Data), etc.

The process of forming the technical and technological potential of an enterprise is shown in Fig. 1.

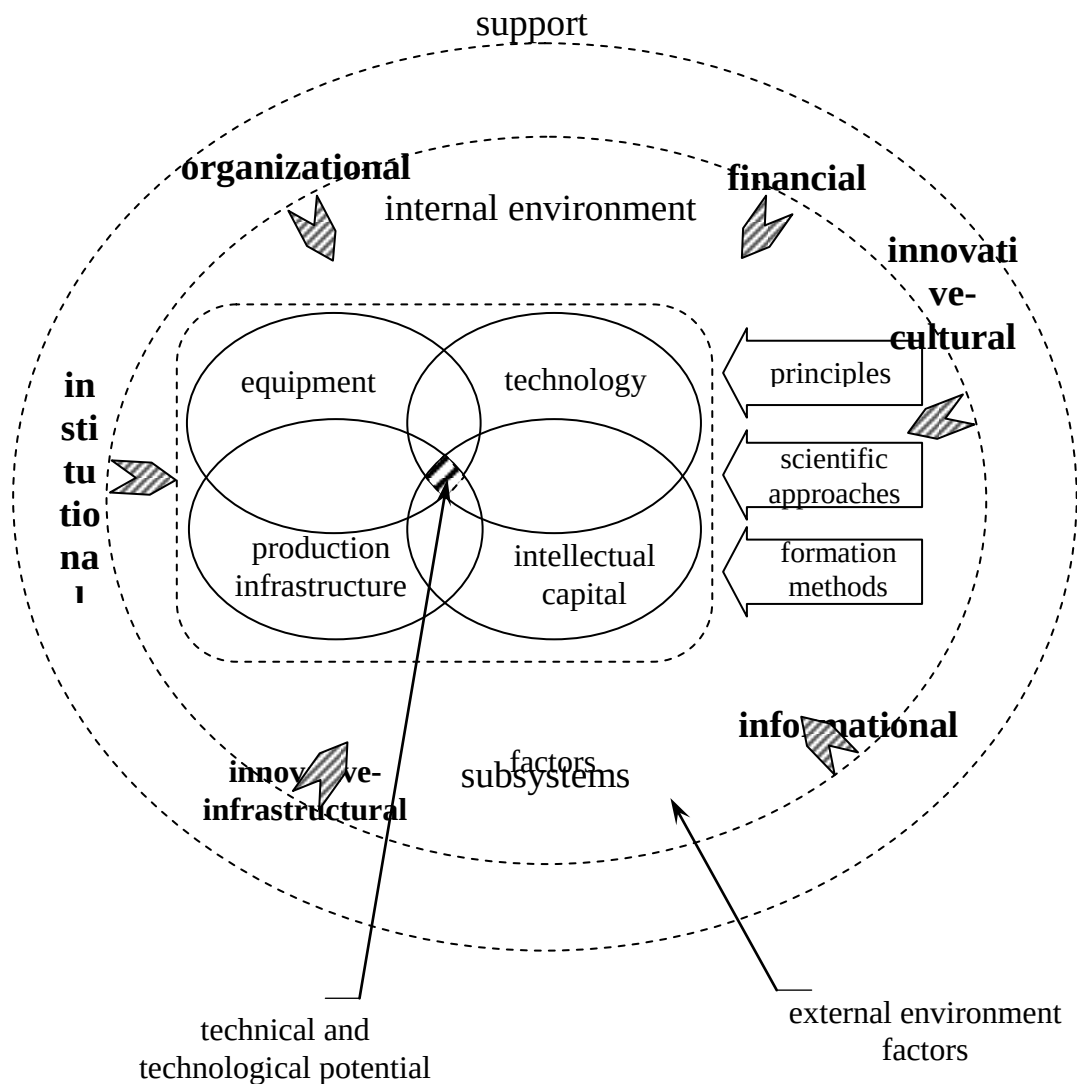


Fig. 1. Model of the process of forming the technical and technological potential of industrial enterprises.

Source: author's development.

When studying the process of forming the technical and technological potential, it is important to emphasize the role of the human factor. Technology make sense only when people know how to use them and develop them further. A

high-quality education system that allows training specialists in innovative areas forms the basis for long-term use of potential. In addition to higher education, retraining and advanced training of people who already work in production or are engaged in research activities are of great importance.

The acceleration of the development of new technologies leads to the fact that professional knowledge quickly becomes outdated. Therefore, creating conditions for continuous learning becomes an important task for employers and the state. The ability to acquire new skills or move to a related industry through fast courses helps maintain high competitiveness of specialists and reduces the risk of technological lag.

The formation of technical and technological potential requires the participation of state institutions, private business, scientific institutions and civil society. At the state level, a regulatory and legal framework is created that stimulates investment in research and development, provides tax benefits to innovative enterprises, regulates patent legislation and protects intellectual property rights. The private sector, for its part, acts as a driving force for investment and stimulates scientific and technological progress through demand for competitive developments. At the same time, the scientific and research base in the form of universities, laboratories and research centers forms the basis for the emergence of breakthrough ideas and the launch of startups. Civil society, including various organizations and communities, often brings initiative, ensures communication between social groups and disseminates information about technological innovations, contributing to a culture of openness and knowledge exchange.

An important component is the financing mechanism: the formation of technical and technological potential is impossible without capital investments in the development of industry, innovation, education and scientific research. Finance can come both in the form of direct state subventions and through mechanisms for attracting private investors. Stimulating venture business is becoming one of the ways that provide a chance to implement risky, but potentially highly profitable

ideas. A large proportion of developed countries invest significant funds in scientific and technological development programs and support partnerships between universities and companies. This increases the chance of the emergence of scientific developments that can give impetus to new technological systems. Thus, the financing mechanism is formed from a combination of various sources that work in synergy: state funds, private capital, grants from international organizations and industry associations, etc.

Capacity building also involves the creation of appropriate infrastructure. This category includes technology parks, business incubators, research clusters, and industrial centers. Such structures bring together specialists of various profiles, provide access to the latest equipment, and create an environment where knowledge spreads from one team to another. Shared space and a large number of contacts accelerate the exchange of ideas, attract university graduates who want to work on projects with high added value. At the regional level, the creation of such centers can be an impetus for the emergence of new jobs, which stimulates economic activity. Therefore, the introduction of technology clusters is an important factor in building capacity, since these are communities in which science can actually be implemented in practice and research can be commercialized.

The use of technical and technological potential covers a number of areas depending on the economic priorities and competitive advantages of a particular state or company. If the sphere is focused on the automotive industry, the implementation of automated production control systems, robotic lines and the latest information solutions for quality control will be appropriate. In the case of orientation on the IT sector, the development of cloud computing, Big Data, and the design of blockchain architecture will become more important. At the same time, there may be a need for biotechnology if the country seeks to strengthen the agricultural and medical sectors. In general, use means combining real production processes with the capabilities of modern science in order to achieve a higher level of productivity and value for the end consumer.

Effective use of potential often involves diversification of the economy. This means that it is desirable to avoid excessive dependence on one type of industry and focus on several promising industries that can reinforce each other. For example, the development of information technology will have a positive impact on the automation of industrial processes, and the modernization of production requires modern software solutions and basic knowledge in the field of artificial intelligence. At the same time, the promotion of environmental innovations can stimulate other areas: engineers are looking for alternative energy sources, biochemists are researching new compounds, and companies working in the field of waste processing are using scientific research to improve environmental performance. Combining these processes within a single strategy forms a sustainable basis for the development of society and the economy.

When it comes to developing technical and technological potential, the issue of the innovation culture prevailing in society plays an important role. If the attitude towards scientific research is positive and it is profitable for business to invest in developments, a favorable environment is formed for the emergence of startups, conducting experimental research and strengthening the knowledge economy. State policy can encourage or restrain these processes through regulation, the taxation system, and support for innovation hubs. A powerful business sector that seeks to commercialize scientific discoveries complements this process with the necessary funding impetus. In such conditions, scientific and technical achievements are more quickly applied, moving from laboratories to the real market. Besides, incentive systems, such as grant programs or interaction with international funds, make it possible to scale ideas that may have global value.

The development of technical and technological potential is directly reflected in the modernization of production processes and the emergence of so-called «smart factories». Modern approaches involve the use of Internet of Thing, when machines constantly exchange data, coordinate their own work and optimize the use of resources. In such workshops, a multitude of indicators are collected in real time, which allows you to identify failures and promptly eliminate them,

guarantee personnel safety and improve product quality. The presence of an appropriate information infrastructure and advanced software becomes a prerequisite. As a result, an innovative ecosystem is formed, where manufacturers, software developers, scientists and system integrators cooperate on a common plane. When such an ecosystem is established, the process of transition to more complex technological solutions occurs naturally and without obstacles.

An important aspect is the cooperation of industry with scientific institutes. As scientists can gain access to real production problems, and enterprises can benefit from the results of research and experiments. Thanks to such interaction, universities update curricula, train specialists who meet the requirements of the modern market. For business, this means that the output is available with high-quality graduates who are able to quickly get involved in work and have the basics of project management, technical literacy and innovative thinking. It is the combination of theoretical basis and practical experience that determines a deeper understanding of technological processes, increasing the level of potential utilization.

Conclusions and prospects for further exploration in this direction. As a result, technical and technological potential is not only an indicator of the current level of development, but also a prerequisite for future transformations. The essence of this potential is revealed through various components: from the presence of a developed scientific base and modern equipment to effective economic mechanisms, a successful educational environment and an innovative culture. The formation mechanism is associated with the comprehensive interaction of state policy, business interests, scientific research and public expectations, which results in new products, services and technological solutions. The ways of using the potential are aimed at increasing competitiveness, improving social and environmental standards, forming our own scientific schools and engineering developments. Development involves constant updating and modernization, mastering the latest achievements of science, introducing flexible management structures and improving educational programs.

Thus, technical and technological potential can be considered a foundation that enables enterprises to respond in a timely manner to the challenges of the external environment and fully use available resources, creating the prerequisites for sustainable growth and progress.

Prospects for further exploration include research and improvement of methodological approaches to assessing the level of efficiency of using the technical and technological potential of industrial enterprises.

Література

1. Готра В. В., Ігнатко М. І. Інноваційний потенціал стратегічного розвитку регіону: сутність та складові. *Вісник Київського національного університету технологій та дизайну*. Серія: Економічні науки. 2020. № 2 (145). С. 85 - 93. URL: <https://er.knutd.edu.ua/handle/123456789/16244> (дата звернення: 20.03.2025).

2. Губський Б. В. Економічна безпека України: монографія. К.: НІСД. 2005. 367 с.

3. Євдокимов Ф. І., Лисяков В. П. Оцінка техніко-технологічного потенціалу високотехнологічного підприємства. *Економіка промисловості*. 2005. № 3. С. 17 - 21. URL: <http://dspace.nbuv.gov.ua/handle/123456789/4229> (дата звернення: 10.03.2025).

4. Коверга С. В., Передерєєва О. С., Кузьменко С. П. Ефективність діагностики техніко-технологічного потенціалу машинобудівного підприємства. *Маркетинг і менеджмент інновацій*. 2011. № 4 (2). С. 205 – 209. URL: <http://essuir.sumdu.edu.ua:8080/handle/123456789/23943> (дата звернення: 10.03.2025).

5. Краус К. М. Світовий досвід науково-технологічної кластеризації в цифрову епоху. *Економіка та суспільство*. 2024. № 53. С. 45 - 52.

6. Краус К. М., Манжура О. В. Технологічний спосіб виробництва індустріального та постіндустріального суспільств: цифрова трансформація та інноваційна модернізація. *European scientific journal of Economic and*

Financial innovation. № 1 (9). 2022. С. 57 – 72. URL: <https://journal.eae.com.ua/> (дата звернення: 06.03.2025).

7. Свістунов О. С. Техніко-технологічне забезпечення стратегії сталого розвитку підприємств машинобудівної галузі. *Вісник Хмельницького національного університету*. 2020. № 5. С. 199 – 202. URL: <https://journals.khnu.km.ua/vestnik/wp-content/uploads/2021/01/38-20.pdf> (дата звернення: 06.03.2025).

8. Соколенко Л. М., Гончарова Н. М. Технологічний потенціал хімічної промисловості України: сучасний стан та перспективи розвитку. *Економіка і прогнозування*. 2023. № 2. С. 112 - 119.

9. Халін С., Гайдай Т., Погорілий В., Лебедєва І. Техніко-технологічні аспекти розвитку та випробування нової техніки і технологій для сільського господарства України. *Науковий вісник*. 2023. № 4. С. 60 - 68. URL: <https://journal.mmi.kpi.ua/index.php/2305-5987/index> (дата звернення: 06.03.2025).

10. Шевчук Д. А. Оцінка техніко-технологічного потенціалу підприємства: монографія. Львів: ЛНАУ. 2013. 188 с.

References

1. Hotra, V. V. and Ihnatko, M. I. (2020), “Innovation potential in regional strategic development: essence and elements”, *Visnyk Kyivs'koho natsional'noho universytetu tekhnolohij ta dyzajnu. Serii: Ekonomichni nauky*, vol. 2 (145), pp. 85 - 93, available at: <https://er.knutd.edu.ua/handle/123456789/16244> (Accessed 20.03.2025).

2. Hubs'kyj, B. V. (2005), *Ekonomichna bezpeka Ukrainy* [Economic Security of Ukraine], NISD, Kyiv, Ukraine.

3. Yevdokymov, F. I. and Lysiakov, V. P. (2005), “Assessment of the Technical and Technological Potential of a High-Tech Enterprise”, *Ekonomika promyslovosti*, vol. 3, pp. 17 - 21, available at: <http://dspace.nbuv.gov.ua/handle/123456789/4229> (Accessed 10.03.2025).

4. Koverha, S. V., Perederieieva, O. S. and Kuz'menko, S. P. (2011), “Effectiveness of Diagnostics of the Technical and Technological Potential of a Machine-Building Enterprise”, *Marketynh i menedzhment innovatsij*, vol. 4 (2), pp. 205 – 209, available at: <http://essuir.sumdu.edu.ua:8080/handle/123456789/23943> (Accessed 10.03.2025).
5. Kraus, K. M. (2024), “World experience of scientific and technological clustering in the digital age”, *Ekonomika ta suspil'stvo*, vol. 53, pp. 45 - 52.
6. Kraus, K. M. and Manzhura, O. V. (2022), “Technological mode of production of industrial and post-industrial societies: digital transformation and innovative modernization”, *European scientific journal of Economic and Financial innovation*, vol. 1 (9), pp. 57 – 72.
7. Svistunov, O. S. (2020), “Technical and technological direction in the strategy of sustainable development of machine-building industries”, *Visnyk Khmel'nyts'koho natsional'noho universytetu*, vol. 5, pp. 199 – 202, available at: <https://journals.khnu.km.ua/vestnik/wp-content/uploads/2021/01/38-20.pdf> (Accessed 06.03.2025).
8. Sokolenko, L. M. and Honcharova, N. M. (2023), “Technological potential of the chemical industry of Ukraine: current state and development prospects”, *Ekonomika i prohnozuvannia*, vol. 2, pp. 112 - 119.
9. Khalin, S., Hajdaj, T., Pohorilyj, V. and Lebedieva, I. (2023), “Technical and technological aspects of the development and testing of new equipment and technologies for agriculture in Ukraine”, *Naukovyj visnyk*, vol. 4, pp. 60 - 68, available at: <https://journal.mmi.kpi.ua/index.php/2305-5987/index> (Accessed 06.03.2025).
10. Shevchuk, D. A. (2013), *Otsinka tekhniko-tekhnologichnoho potentsialu pidpriemstva* [Assessment of the technical and technological potential of the enterprise], LNAU, L'viv, Ukraine.

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