In conclusion, AI is revolutionizing the construction industry by reducing costs, improving safety, optimizing project management, and enhancing post-construction operations. By leveraging AI technologies, construction companies can benefit from increased efficiency, improved decision-making, and enhanced overall performance.

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SAFETY AND INNOVATION. CONTRADICTIONS IN THE IMPLEMENTATION OF NEW TECHNOLOGIES

Over the past fifteen years, it is known that the number of inventors and rationalizers in Ukraine has steadily decreased, and the scientific potential of our country has declined. Enterprises, institutions, and organizations are not fully conducting patent research as stipulated by state standards; societal and state needs for such production are not being studied. The number of enterprises implementing innovative products is consistently decreasing [1-5].

The pace of development, structure, and material support of the research and development sector do not meet the needs of ensuring the National Security and economic independence of Ukraine, nor do they meet the increasing demand for advanced technologies from various segments of the entrepreneurial and state sectors of the economy.

The domestically proposed research sector developments and certain scientific outcomes, even those of international standards, do not find application in the Ukrainian economy due to the imbalance in the national innovation system, 'irrational behavior of the leadership of certain enterprises,' 'unfair competition,' morally and conceptually outdated regulatory framework, and low receptivity to innovations in the entrepreneurial sector of the economy

The raw material model of Ukraine's economy [5], which relied on competitive advantages of cheap labor and low-cost energy resources, has exhausted itself and led to our failure to increase economic potential and undergo technological transformations. This chain of events significantly lowered the international rankings of our state.

According to reports from the Bloomberg agency (Bloomberg Innovation Index) [6], in the last 15 years, our country has not ascended beyond the 43rd position. In the World Economic Global Competitiveness Index 2008-2022 [3], Ukraine has not risen above the 57th position.

According to The Global Competitiveness Index 2023, among 132 countries worldwide, Ukraine ranked as follows in various categories:

- research and Development - 57th position;
- level of patenting developments - 29th position;
- level of innovation-related financing - 125th position;
- level of investment inflow - 107th position;
- capital turnover volume of joint ventures - 122nd position;

- creation of new enterprises - 65th position;
- level of scientific publications - 97th position;
- GDP level per unit of energy consumption - 116th position..."

The comparatively high level of patent activity, on one hand, and the low number of scientific research (developments) and low growth rate of innovative companies, on the other, indicate that a larger part of new innovative technologies and achievements are either not being implemented or are being exported. The rest of the figures speak for themselves.

The consequence of such an 'innovative' development path is a consistent shift in the Ukrainian economy towards low-tech, non-scientific, energy-consuming, environmentally harmful, and morally outdated productions, gradually transforming our homeland into a raw material and food base for developed countries.

Today, in the global economy, rivalry and cooperation, competition, and cooperation are no longer mutually exclusive concepts. Production crosses national borders and integrates nations into the international economy. Consequently, mechanisms for determining the value of production are changing. In order to participate in such processes and benefit from them, Ukraine must have an appropriate level of scientific, technical, and technological development.

This is why domestic scientists constantly strive to formulate and substantiate national innovation priorities, finding effective mechanisms for the engagement and efficient utilization of innovations.

Low susceptibility to innovation questions.

A classic figure in world tribology, Doctor of Technical Sciences, Dmytro Harkunov, has established that 'Expenditures on repairs and maintenance of machines exceed their cost several times: for cars - by 6 times, for airplanes - up to 5 times, for machines - up to 8 times, and prolonging the service life of machines and equipment, even to a small extent, is equivalent to the introduction of a significant amount of new production capacity [7].

Leaving aside the problems of the development of research and development sector, which require a separate comprehensive analysis, let's try to understand the more 'grounded' issue of low susceptibility to proposed innovations. Let's attempt to dissect the specific mechanisms and contradictions of the mentioned 'susceptibility to innovations' using the example of the domestic 'Technology of friction surface non-disassembly engineering' and its products (hereinafter referred to as the Technology).

The mentioned Technology was developed based on fundamental structural research conducted under the guidance of Doctor of Technical Sciences, Professor Rostyslav Didyk. During the research, decomposition products of minerals forming new surface and near-surface structures of tribologically reconstructed friction surfaces were identified.

The Technology evolved, underwent industrial testing over a long period (2003-2020). Hundreds of tests confirmed the effectiveness of using natural and synthesized minerals as 'tools' of the Technology. Technological fillers (hereinafter referred to as TF) in combination with the application technology allowed extending the resource life of mining, metallurgical equipment, machine parts for automotive and railway transport, machines, and equipment in other industries. The products of the technology helped reduce, and sometimes eliminate a significant amount of repair (regulatory) work, improve operational properties of products in the machine-building enterprises."

We have proven that it is due to the penetration of TF (technological fillers) into the friction zone that the effect of restoring the basic parameters of the working condition of industrial machines and mechanisms occurs and demonstrates a significant increase in their reliability, durability, and consequently, safety. The products of the Technology ensure long, reliable, and safe operation of gear transmissions, rolling and sliding bearings, cam mechanisms, guides, hinges, locks, junctions, supports, components of cylinder-piston groups, gas distribution mechanisms, high-pressure fuel pump components, friction pairs like 'wheel-rail' ('shaft-bushing'), and other assemblies whose components experience mutual displacement (friction) in the presence of lubricants [8].

Thus, we have demonstrated that the Technology represents an effective method of non-disassembly restoration of the working parameters and main operational characteristics of machines and

mechanisms without stopping technological and production processes [8], significantly enhancing reliability, consequently ensuring safety, production, and other processes.

Therefore, for the first time, we have proven that during operation (friction) in the presence of TF on the contact surfaces of parts and in their subsurface layer, it is possible to form and actually forms a relatively hard new structure that shares a crystalline framework with the metal of the part, possessing unique anti-wear and lubricant-retaining properties. This process leads to the restoration of the functional state of friction node surfaces by initiating self-organizational processes in plastic deformation [8].

The aggregate estimated potential for saving fuel and energy resources, resources associated with premature failure of machinery and mechanisms, as well as the unrealized profit (due to downtime for repairs), on a countrywide scale, in monetary equivalent, amounts to ≥ 2.5% of Ukraine's GDP.

For example, on the mainline locomotives of Ukrzaliznytsia (Ukrainian Railways), during regular operation, thanks to the reduction in the wear intensity of wheel rims due to the use of products from our Technology, we have demonstrated a technical outcome and economic effect that allow saving over 700,000 UAH per locomotive, between wheel tire replacements. This calculation is exclusive of the unrealized profit for the company due to locomotive downtime for tire replacements, considering there are over 200 locomotives within the company [9, 10].

The main contradiction in the implementation of the Technology lies in the following:

The reduction of operational costs when applying the Technologies ensures significant economic benefits, allowing enterprises to accumulate funds for production modernization or introducing new production capacities. This undoubtedly attracts and interests all parties involved in the innovation process.

However, the insufficient support for such innovative companies and processes by the state, at the regulatory, legal, and financial levels, makes attempts at independent implementation of domestic energy-saving technologies practically hopeless. This negatively affects the national security and economic independence of Ukraine, significantly hindering the development of new branches of science and technology.

The main paradox lies in the fact that a 100% domestic, state-recognized, scientifically substantiated, repair-restorative, and resource-saving innovative Technology, capable of significantly reducing the operational costs of industrial enterprises today, and consequently allowing industry to accumulate resources for production modernization and the introduction of new facilities, does not find worthy application and a proper place in the Ukrainian economy.

The main reasons for this contradiction are:

Owners of budget-forming industrial enterprises seem to desire but are insufficiently interested in state investment in energy-saving and resource-defining innovations, while the leadership of their enterprises seems obligated to implement innovations but lacks a regulated mechanism for their implementation.

For the managers of enterprises (divisions) who directly make decisions regarding the implementation of Technology products, personal benefits are absent (except perhaps formal appreciation for taking energy-saving measures), while additional trouble and the risk of undistributed responsibility are present.

It is evident that state support is essential here. The state's policy on energy modernization exists and is fundamental. The continuation of the state policy towards energy modernization is the Ukrainian Law "On the Introduction of New Investment Opportunities, Guaranteeing the Rights and Legitimate Interests of Business Entities for the Conduct of Large-Scale Energy Modernization" [327-VIII]. We observe that the fundamental complex of energy-saving (energy-efficient) measures has already been developed by our state and, considering the availability and popularity of such measures in the sphere of heat supply, industrial, and civil construction, it has taken the form of law. Unfortunately, the same cannot be said regarding resource-saving (energy-efficient) "friction overcoming technologies," the development of which our team has considerably progressed.

Likely, an effective way to resolve the primary contradiction in implementing the Technology and simultaneously incentivizing the parties' innovative activities could be a new Ukrainian Law, based on the model of the [327-VIII] Law.

The proposed name for the new law could be: "Ukrainian Law on the Introduction of New Investment Opportunities, Stimulation, Ensuring Rights and Legal Interests of Business Entities for the Implementation of Resource-Saving (Energy-Efficient) Technologies and Conducting Large-Scale Energy Modernization of Industrial Enterprises in the Real Sector of the Economy" (hereinafter referred to as the New Law).

The terminology of the Law could be as follows:

Energy resource service - a combination of technical, technological, and organizational resource-saving (energy-efficient) and other measures aimed at reducing operational costs for the operation of industrial machinery, equipment, specialized technology, transport means, and their complexes or elements, compared to the costs incurred in the absence of such measures, as initiated by the customer of the energy resource service.

Object of energy resource service - industrial machinery, industrial equipment, specialized technology, transport means, their complexes, or elements that are in state, communal, or private ownership, for which a decision has been made by the executive authority responsible for their management regarding the procurement of the energy resource service (in the case of state-owned objects), the executive body of the local council or the local executive authority (in the case of communal ownership), another authorized governing body (in the case of private ownership).

The new Law should take into account the interests of all parties involved in the innovation process, provide ways to address all the aforementioned and unspecified contradictions in this article, and be in harmony with the current legislation of Ukraine.

Regarding the stimulation of widespread innovation implementation, in conditions of war and economic instability, an effective and incentivizing step for large private industrial enterprises towards innovation implementation could be tax incentives concerning funds allocated within their internal investment programs for innovation (innovation capital), with unequivocal reporting on the utilization of such funds and innovation implementation, without the possibility of accumulating these funds and mandatory taxation of their remainder at the end of the financial year.

The new Law should provide the management of state-owned enterprises with a clear mechanism for forming innovative capital and possible methods of its implementation. Subsidiary acts should take into account, including issues of direct financial interest of employees in enterprises concerning the search for and implementation of innovations.

Additionally, it is necessary to:

- timely review existing and develop new regulatory and guidance documents that define standards for searching and making decisions regarding innovation implementation.

– distribute responsibility between the owner and employees during the implementation of innovations.

– implement new comprehensive technical tools and technologies for objective monitoring of the condition of machinery (mechanisms, equipment), including processed TF (new technology). Processed equipment always exceeds the intended resource limits; such control will help prevent emergencies and alleviate managers' imaginary fears.

The legislative initiative (the introduction of such a draft law) in this matter, in our opinion, belongs to the President of Ukraine, as the speed of adoption and the quality of execution of the new Law already determine the level of National Security and economic independence of our Motherland.

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USE OF INTELLIGENT ROBOTS IN CONSTRUCTION

Smart robots are essential in construction today. They make work faster and safer. They do routine tasks like lifting heavy materials and cutting materials. This gives workers more time for creative tasks and lowers the risk of accidents. [1]

These robots can do precise work using AI and machine learning. This improves the quality of construction. Using them is also better for the environment. They use less energy and emit fewer harmful substances than traditional methods. [2]

Future studies should look at how to use smart robots in modern construction and how they affect the quality, efficiency, and safety of projects. [3]

Optimization

If you use IoT sensors for remote monitoring of equipment health and combine them with the ability to analyze the movement and operation of construction machines, then you can significantly reduce equipment downtime, thereby minimizing machine maintenance costs and optimizing work productivity. The implementation of artificial intelligence technologies will make it possible to choose the most optimal option for planning work during construction due to the improvement of algorithms by the trial and error method of past projects. In addition, this analysis will allow to simulate the results of construction and the final layout for the period of delivery of the object, as well as to develop an effective distribution of materials on the sites. [4]

Predictive analysis

At the stage of project development, computer programs can be trusted to calculate the occurrence of probable risks, the possibility of compliance with technological standards, as well as to simulate the reliability of the application of certain construction methods. Quality software will speed up the decision-making process for a project, and potentially save time and money troubleshooting potential problems. In addition, this type of analytical platform will help to speed up the testing of construction materials used, reducing the period of downtime at the facilities. Information for analytics is collected through sensors