РОЛЬ МАШИНОБУДІВНОГО КЛАСТЕРУ В ЗАБЕЗПЕЧЕННІ ОБОРОНОЗДАТНОСТІ УКРАЇНИ

Актуальність. Зважаючи на геополітичну обстановку, де Україна стикається з загрозами для своєї суверенітету та територіальної цілісності, забезпечення обороноздатності стає найважливішим завданням. Розвиток сучасних технологій у галузі оборони, включаючи Індустрію 4.0, наголошує на необхідності забезпечення армії України високохімічною іноземною технікою та технологіями. Співпраця з провідними міжнародними корпораціями в галузі оборони відкриває можливість для обміну технологіями, інвестиціями та залучення нових можливостей для розвитку українського оборонного виробництва.

Українські машинобудівні підприємства володіють значним потенціалом у виробництві, ремонті та модернізації військової техніки, що може бути використано для забезпечення потреб армії. Поступове впровадження локалізації виробництва західної техніки в Україні сприятиме зменшенню залежності від імпорту та збільшенню обсягів виробництва. Розвиток сектору обслуговування, ремонту та відновлення військової техніки може позитивно вплинути на зайнятість та соціально-економічне становище регіонів України.

Зокрема, розвиток сучасного оборонного потенціалу є стратегічно важливим завданням для кожного держави. Забезпечення наявності та ефективного використання сучасної військової техніки є необхідністю для збереження мирної атмосфері та національної безпеки. Співпраця з провідними міжнародними компаніями та впровадження сучасних технологій виробництва прирівнює українське машинобудування до світових лідерів, що відкриває шлях до притоку іноземних інвестицій та розвитку нових технологічних галузей в Україні. Впровадження Індустрії 4.0 та співпраці з міжнародними партнерами дозволяє статися покращити технічний рівень та ефективність українських військ, забезпечуючи їхню готовність до викликів та загроз. Розвиток інноваційних технологій управління та культури виробництва надає українським підприємствам конкурентну перевагу на світовому ринку, що сприяє їхньому подальшому розвитку та розвиткові.

Мета та завдання. Метою дослідження є аналіз та оцінка потенціалу машинобудівного кластеру в контексті забезпечення обороноздатності України у складному геополітичному контексті. Завдання дослідження включають: проведення аналізу сучасного стану розвитку машинобудівних кластерів в Україні, а також необхідності впровадження сучасних технологій в машинобудуванні; оцінку ролі та потенціалу машинобудівного кластеру в контексті забезпечення обороноздатності країни; аналіз можливостей співпраці з провідними міжнародними компаніями в галузі оборонно-промислового комплексу; вивчення можливостей українських машинобудівних підприємств у виробництві, ремонту і модернізації військової техніки; розробку головних положень стратегії стабілізації військової заходової техніки в Україні; аналіз впливу розвитку сектору обслуговування, ремонту та відновлення військової
техніки на соціально-економічне становище регіонів країни на підставі впровадження сучасних технологій та управлінських практик для підвищення конкурентоспроможності українських машинобудівних підприємств

Матеріали та методи. В даному дослідженні за допомогою порівняльного, системно-структурного, аналізу, теоретичного узагальнення та емпіричних спостережень досліджене працю та перспективи формування машинобудівних кластерів, їх вплив на соціально-економічний розвиток країни та підвищення обороноздатності.

Результати. В результаті роботи встановлено що машинобудівний кластер в Україні володіє значним потенціалом для забезпечення обороноздатності країни у складному геополітичному контексті. Підкреслено, що співпраця з провідними міжнародними компаніями у галузі оборонно-промислового комплексу надає можливість обміну технологіями, залучення інвестицій та підвищення потенціалу українського оборонного виробництва, оскільки машинобудівні підприємства України мають великий потенціал у виробництві, ремонти та модернізації військової техніки, що може бути використано для забезпечення потреб армії. При цьому, поступове впровадження військової техніки в Україні сприяє зменшенню залежності від імпорту та збільшенню обсягів виробництва.

Висновки. Результати дослідження свідчать про важливість машинобудівного кластеру в контексті забезпечення обороноздатності України. Співпраця з міжнародними партнерами та впровадження сучасних технологій виробництва є ключовим чинником у підвищенні конкурентоспроможності та зростанні потенціалу українського оборонного виробництва. Розвиток цього сектору є стратегічно важливим завданням для забезпечення національної безпеки та укріплення міжнародного статусу України.

Ключові слова: забезпечення обороноздатності, Індустрія 4.0, локалізація виробництва, сучасні технології оборони, машинобудівний кластер, міжнародна співпраця, соціально-економічне становище, інноваційні технології управління.

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THE ROLE OF THE MACHINE-BUILDING CLUSTER IN ENSURING THE DEFENCE CAPABILITY OF UKRAINE

Topicality. Given the geopolitical situation, where Ukraine faces threats to its sovereignty and territorial integrity, ensuring defense capability becomes the most important task. The development of modern technologies in the defense industry, including Industry 4.0, emphasizes the need to supply the Ukrainian army with high-quality foreign equipment and technologies. Cooperation with leading international corporations in the defense sector opens up opportunities for technology exchange, investments, and the integration of new possibilities for the development of the Ukrainian defense industry.

Ukrainian machine-building enterprises possess significant potential in the production, repair, and modernization of military equipment, which can be utilized to meet the army’s needs. The gradual localization of Western technology production in Ukraine will contribute to reducing dependence on imports and increasing production volumes. The development of the service, repair, and restoration sector of military equipment can positively impact employment and the socio-economic situation in regions of Ukraine.

In particular, the development of modern defense potential is a strategically important task for any state. Ensuring the availability and effective use of modern military technology is a necessity for maintaining a peaceful atmosphere and national security. Collaboration with leading international companies and the implementation of modern production technologies equate Ukrainian machine-building to global leaders, opening the way for foreign investments.
and the development of new technological sectors in Ukraine. The implementation of Industry 4.0 and collaboration with international partners allow for a significant improvement in the technical level and efficiency of Ukrainian armed forces, ensuring their readiness to face challenges and threats. The development of innovative management technologies and production culture provides Ukrainian enterprises with a competitive advantage in the global market, promoting their further growth and development.

**Aim and tasks.** The aim of the research is to analyze and assess the potential of the machine-building cluster in the context of ensuring Ukraine's defense capability in a complex geopolitical environment.

The research tasks include: conducting an analysis of the current situation in development of machine-building clusters in Ukraine and the necessity of implementing modern technologies in machine-building; evaluating the role and potential of the machine-building cluster in ensuring the defense capability of the country; analyzing the possibilities of cooperation with leading international companies in the defense industry; studying the capabilities of Ukrainian machine-building enterprises in the production, repair, and modernization of military equipment; developing the key provisions of the strategy for the gradual localization of Western technology production in Ukraine; analyzing the impact of the development of the service, repair, and restoration sector of military equipment on the socio-economic situation of the country's regions based on the implementation of modern technologies and management practices to enhance the competitiveness of Ukrainian machine-building enterprises.

**Materials and Methods.** This study explores the advantages and prospects of forming machine-building clusters, their impact on the socio-economic development of the country, and the enhancement of defense capabilities through the use of comparative, systemic-structural, analytical, theoretical generalization, and empirical observation methods.

**Research results.** The research has established that the machine-building cluster in Ukraine possesses significant potential for ensuring the country's defense capability within a complex geopolitical context. It is emphasized that collaboration with leading international companies in the defense industry provides opportunities for technology exchange, investment attraction, and enhancement of the Ukrainian defense production potential. This is due to the fact that Ukrainian machine-building enterprises have substantial capabilities in the production, repair, and modernization of military equipment, which can be utilized to meet the army's needs. Additionally, the gradual localization of Western technology production in Ukraine will contribute to reducing dependence on imports and increasing production volumes.

**Conclusion.** The research findings attest to the significance of the machine-building sector cluster in the context of ensuring Ukraine's defense capability. Collaboration with international partners and the implementation of modern production technologies are key factors in enhancing the competitiveness and expanding the potential of the Ukrainian defense industry. The development of this sector is a strategically important task for ensuring national security and strengthening Ukraine's international standing.

**Keywords:** defense capability, Industry 4.0, production localization, modern defense technologies, machine-building cluster, international cooperation, socio-economic situation, innovative management technologies.

**Problem statement and its connection with important scientific and practical tasks.** The integration of the machine-building sector with the information technology sector creates a sphere in the global economy with the highest potential for generating and implementing commodity, technical, and technological innovations. In contemporary conditions, this becomes crucial for achieving a high level and ensuring the prospects of socio-economic development for any country. The increasing share of machine-building in the manufacturing industry is strategically important, particularly in most developed industrial countries of the European Union.

The current state of machine-building development in Ukraine significantly lags behind the levels in leading countries worldwide, but it possesses substantial development potential, making machine-building one of the key elements of Ukraine's economy and industry. Ukraine's machine-building sector has extensive experience in producing agricultural equipment, railway carriage construction, shipbuilding and ship repair, aircraft manufacturing, rocket and space industry products, as well as military-industrial complex output. The creation and development of machine-building clusters can provide the necessary impetus for uniting machine-building enterprises, thereby enhancing their efficiency and positively influencing their competitiveness on the global market.

It is also worth noting that machine-building plays a leading role in ensuring the defense capabilities of the state. The opportunity for collaboration with global manufacturers of defense products, arising from the aftermath of war, opens up new prospects for the Ukrainian machine-building sector to enhance its scientific and technical potential, modernize equipment, integrate into global production chains, and implement the best global manufacturing practices.

The development of machine-building, the establishment of machine-building clusters, and the implementation of cutting-edge technologies in production will contribute to the overall economic development of the country, the development of human potential, foster unity, and increase the geopolitical influence of the country globally.

Allocation of previously unsolved parts of the general problem. For the further development of the machine-building complex in Ukraine and ensuring national defense capabilities, it is necessary to consider and substantiate the following aspects of previously unresolved parts of the overall problem, including:
- analysis of the potential of the machine-building cluster in the context of ensuring the defense capabilities of Ukraine in a complex geopolitical environment.
- determination of the role and potential of the machine-building cluster in the aspect of ensuring the defense capabilities of the country.
- evaluation of opportunities for cooperation with leading international companies in the defense-industrial complex and its impact on the development of Ukrainian defense production.
- analysis of the potential of Ukrainian machine-building enterprises in the production, repair, and modernization of military equipment.
- development of a strategy for the gradual localization of the production of Western technology in Ukraine to reduce dependence on imports and increase production volumes.
- analysis of the impact of the development of the service, repair, and restoration sector of military equipment on the socio-economic situation of regions in Ukraine and its significance for the overall development of the country.

Formulation of research objectives (problem statement). The purpose of the study is to analyze and assess the potential of the machine-building cluster in the context of ensuring Ukraine's defense capability in a complex geopolitical context.

The tasks of the research include: conducting an analysis of the current state of development of machine-building clusters in Ukraine, as well as the need to introduce modern technologies in machine-building, assessing the role and potential of the machine-building cluster in the context of ensuring the country's defense capability; analysis of opportunities for cooperation with leading international companies in the field of the defense-industrial complex; studying the capabilities of Ukrainian machine-building enterprises in the production, repair and modernization of military equipment; development of the main provisions of the strategy of gradual implementation of the localization of the production of Western equipment in Ukraine; analysis of the impact of the development of the service sector, repair and restoration of military equipment on the socio-economic situation of the country's regions based on the introduction of modern technologies and management practices to increase the competitiveness of Ukrainian machine-building enterprises.

Materials and Methods. This study explores the advantages and prospects of forming machine-building clusters, their impact on the socio-economic development of the country, and the enhancement of defense capabilities through the use of comparative, systemic-structural, analytical, theoretical generalization, and empirical observation methods.

An outline of the main results and their justification. The modern global experience in enhancing the competitiveness and efficiency of machine-building enterprises confirms that the most advanced and effective method is the implementation of the cluster concept. This method can be defined as the voluntary association of existing machine-building and machine repair enterprises, consumers of their products and services, as well as service and outsourcing companies on a common innovation and investment platform. The basis for consolidation in the cluster should be social capital, ensuring effective endogenous and exogenous production and information links. This allows for achieving maximum synergistic effect, expected to be distributed among the participants and founders of the cluster (Burkinsky B.V., Laiko O.I., Losyev M.I., 2018)).

According to Michael Porter's cluster theory, enterprises in specific sectors, including machine building, tend to concentrate in certain regions of the country. This approach assumes that the most competitive companies actively influence other market participants, such as suppliers, consumers, and competitors. This interaction contributes to the increased competitiveness of the latter, which, in turn, has a positive impact on their activities.

Cluster associations represent a unique combination of scientific, production, and
commercial structures. These associations, utilizing interaction and collaboration, contribute to the formation and effective use of competitive advantages for individual enterprises, industries, and national economies. This is particularly relevant in the face of intensified global competition. At the current stage of economic development in Ukraine, clusters can become an effective tool for increasing the intensity of the development of domestic entrepreneurship and strengthening the market positions of individual economic entities, including defense industry enterprises in Ukraine.

The main criterion for the success of clusters is their high competitiveness in the global market. It is also worth noting that the combination of competition and cooperation in clusters allows them to successfully compete in certain areas by collaborating in others (Kulko I., 2014).

Among the main advantages of clusters are (Osipov V.M., Ganbarov E.S., 2015):

1. providing cluster participants with quick and more economical access to resources, new knowledge, innovative technologies, and suppliers, contributing to increased competitiveness of the system compared to individual enterprises.

2. accelerating the spread of innovations and stimulating innovative activities of enterprises through the concentration of new types of production, techniques, technologies, and highly qualified personnel in a limited territory.

3. creating favorable conditions through the presence of innovative infrastructure and established connections between business partners in the cluster for the development of new types of production.

4. expanding access for business entities to various financial resources and services.

5. expanding connections and cooperation between government authorities, research organizations, and businesses to increase the level of innovation in production.

6. increasing the investment attractiveness of the region through higher investor trust in cluster structures.

7. developing business relationships and collaboration with similar clusters in other industries for exchanging experiences and implementing joint projects.

It is worth noting that the implementation of a cluster approach in machine-building has certain negative aspects (Voynarenko M. P., 2014), including:

1. infrastructure problems can complicate the cluster creation process and require significant expenses for the development of the necessary infrastructure.

2. insufficiency of resources and capital can be an obstacle to the successful implementation of initiatives in the field of clustering.

3. inadequate support from technological institutions may limit access to qualified assistance, such as technical, technological, financial, and advisory support, for enterprises seeking to join the cluster.

4. insufficient information, lack of qualified personnel, and a lack of experience in analyzing the activities of machine-building enterprises can pose difficulties.

5. the presence of hierarchies and competition between existing and newly created clusters may affect the efficiency of the cluster approach.

In countries where cluster systems are implemented in the manufacturing process, the following effects can be observed from their implementation:

- there is a high level of employment in industries that operate based on the principles of the cluster approach.
- the development level of machine-building enterprises in the region increases, especially when industry-regional clusters are created in adjacent regions.
- the competitiveness of products is enhanced due to the attraction of a large pool of skilled labor and the opportunity for scientific research through economies of scale.
- clusters allow the integration of investments and information technologies, concentrating them in both traditional and emerging sectors of the economy.
- the use of the cluster approach ensures the effective utilization of the region's competitive advantages, contributing to the socio-economic development of the territories.

When analyzing the experience of existing clusters and those in the formative stages, it can be argued that a cluster represents an open system where its components interact both within the internal and external environment. At the input of this system, material, financial, labor, energy, and informational resources are supplied, while at the output, we obtain products, services, social responsibility, competitiveness, and innovation (Kuzmin O. Y., Satalkina L. A., 2013).

The main functions of production systems, especially in machine-building and machine repair, are aimed at addressing the following tasks:

- prediction of critical equipment failures and resource forecasting: This involves preventing
sudden equipment breakdowns by forecasting potential issues and estimating equipment lifespan.

- equipment diagnostics during operation: Analyzing a large volume of data is essential to gather information from systematically collected data. However, in industrial settings, real-time data from actual objects may be insufficient. Therefore, the database needs to be supplemented with results from physical and virtual experiments, using engineering analysis based on numerical modeling, and regular calibration to improve prediction quality.

- optimization of equipment operation modes and technological processes: The correct choice of operating modes significantly influences reducing unplanned downtime, increasing equipment lifespan, and, consequently, improving product quality and reducing overall enterprise costs. A system that selects the most optimal scenarios for technological processes and predicts deviations in equipment operation based on statistical models and engineering analysis can be beneficial.

- condition-based maintenance: Transitioning to condition-based maintenance helps increase equipment lifespan and time between repairs. Real-time data enables defect identification, allowing for timely maintenance and repair recommendations.

- defect recognition: Computer vision technologies, employing a signature approach, allow computers not only to process information as a data array but also to perceive and interpret it in a human-like manner.

- continuous production: For instance, in steelmaking, accumulating history is necessary to predict initial characteristics based on current melting conditions. Using machine learning to determine the initial alloy composition and melting parameters to achieve the desired quality can reduce raw material costs.

- machine learning tasks: Analyzing a vast number of parameters to optimize the composition and quantity of input elements and operational parameters to meet quality requirements using neural networks.

- flexible energy consumption management: Machine learning technologies allow reducing equipment operating time at high intensity, minimizing excess inventory, predicting equipment wear and residual resources, reducing waste, and lowering energy consumption by accounting for external environmental conditions.

- failure prediction and preventive maintenance: Forecasting equipment failures and performing preventive maintenance, optimizing supply plans, production processes, and financial decision-making.

Strengthening the position of Ukrainian machine-building in international markets is a key goal of the Export Strategy for the machine-building sector in Ukraine for the period 2019-2023 (Ministry of Economy of Ukraine, 2017).

Among the objectives of this strategy, creating the necessary infrastructure for machine-building enterprises, increasing the level of social capital, transitioning to the production of products and services with higher added value, enhancing the investment attractiveness of the machine-building sector, and expanding its financial capabilities are highlighted.

Proposed measures include the approval of procedures for partial compensation of expenses for research and development in priority machine-building sectors using funds from state, regional, and local budgets. Additionally, consideration is given to defining a list of benefits and preferences for investors in these sectors, such as exemption from value-added tax for the import of complex technological equipment and machinery resulting from research and development activities (Ishchuk S.O., 2022).

Given the existing intellectual potential, Ukraine can be recognized as a regional leader in fields that involve comprehensive and high-tech engineering services in the near future. Special emphasis is placed on the following directions:

- development of software in the field of industrial high technologies, creating new software products, including innovative solutions for Industry 4.0.
- various types of design (electrical, mechanical, electronic, technological, construction, etc.).
- implementation of industrial automation, computerization, and intellectualization (including the launch of industrial sites).
- development and production of complex, small-batch, or unique products.

Ukraine finds it extremely important to actively work towards implementing Industry 4.0 to avoid losing competitive advantages and align its technological development with global trends. Significant steps in this direction are already taking place, such as the creation of the "Industry 4.0 in Ukraine" movement. The Association of Industrial Automation Enterprises of Ukraine (APPAU) is actively involved in developing theoretical and practical foundations for implementing Industry 4.0 policy in Ukraine.

Since June 2019, the Industry4Ukraine platform has been in operation, uniting over 40 business and
industrial associations. This initiative has support at the enterprise and association levels, indicating an understanding of the importance of transitioning to new digital technologies. The Scientific and Analytical Center "Ukrainian Institute of the Future" is actively working on the economic development strategy of Ukraine until 2030, including aspects of developing the digital economy, with a special focus on revitalizing the machine-building industry through the introduction of advanced digital technologies (Industry 4.0 in Ukraine, 2020).

In Ukraine, foreign companies, as well as small and medium-sized enterprises, are making a significant contribution to the development of Industry 4.0 and innovative ecosystems. Many of these entities are united in the Association of Industrial Automation Enterprises of Ukraine (APPAU). In this context, industry players, infrastructure operators, and the state exhibit some passivity, differing from approaches seen in Europe and the world, where large national corporations and states are the main investors in the development of Industry 4.0 in their countries.

At present, Ukraine is only beginning to develop strategic documents that will define approaches to industrial policy. Recognizing the need for the implementation of the technological approach of Industry 4.0, on July 21, 2021, the Cabinet of Ministers of Ukraine adopted a resolution "On promoting the implementation of the technological approach 'Industry 4.0' in Ukraine," which approved the "Regulation on the implementation of the technological approach 'Industry 4.0'" (Resolution of the Cabinet of Ministers of Ukraine, 2021). Following the German experience, the functioning of Industry 4.0 centers is foreseen, identified as a key tool for stimulating innovative development at the regional level.

The main tasks of such centers are:
- popularizing Industry 4.0 in the real sector of the economy, primarily in machine-building.
- facilitating the development of collaboration between enterprises, institutions, and organizations implementing Industry 4.0.
- coordinating the actions of companies, institutions, and organizations that can be developers of innovations in high-tech production and training their specialists.
- providing innovators with access to knowledge and experience from international digital innovation hubs in the field of implementing Industry 4.0.
- supporting the commercialization of results from innovative activities and scientific research in the implementation of Industry 4.0 (including attracting funds on a competitive basis with the support of an innovation hub).
- promoting tasks related to technical regulation and conformity assessment to international and European technical regulations of Industry 4.0, and advocating for prioritizing standardization in the technical policy of economic entities.
- providing advisory services for Industry 4.0 implementation projects, collaborating with local self-government bodies, particularly within the frameworks of development strategies for territorial communities and regional development strategies, considering the smart specialization of regions.
- collaborating with entities in the innovation and research infrastructure, international funds, and organizations, with the aim of attracting investments and international technical assistance.

In the structure of Ukrainian machine-building enterprises in recent years, there has been a significant contribution from international corporations actively expanding their presence by establishing subsidiaries and production units in Ukraine. For example, in 2020 alone, approximately 18 subsidiary companies of well-known global manufacturers of machine-building products operated, accounting for 10,5% of the total machine-building products sales in Ukraine. This activity involved 10,3% of the total workforce in the machine-building sector, with a wage fund share of 12,5%.

Transnational corporations (TNCs) operating in Ukraine mainly focus on the production of specific components, such as cables and parts, for large automotive companies. These enterprises act as intermediate producers and are integral parts of global value chains. Typically, they are small and independent links in these chains.

Most machine-building TNCs in Ukraine also operate on tolling schemes, meaning they use supplied raw materials for production. The end consumers of TNC-produced goods are usually foreign companies. Thus, the share of such production in the export of the Ukrainian machine-building sector is significant.

The activities of transnational corporations engaged in tolling schemes have several systemic effects in Ukraine. In the contemporary period, the most important of these are socio-economic, such as improved employment. In the long term, strategic effects, such as deepening integration into global value chains and reducing labor migration, become crucial.
However, the increase in the number of transnational corporations (TNCs) processing raw materials has its drawbacks, particularly in limiting opportunities for the development of domestic producers. From an economic perspective, the presence of such corporations (in their current format) is only justified in the short and medium term. In the long run, these enterprises need to transform towards integration into the Ukrainian economy. The transformation process can occur through two approaches or their combination:

1. Establishment of National Productions: This approach involves creating domestic productions in Ukraine capable of manufacturing products that can replace imported raw materials. This contributes to the creation of internal reserves and independence from external suppliers.

2. Creation of Processing or Utilization Enterprises: This approach entails establishing enterprises in Ukraine that specialize in the further processing or utilization of finished products made from imported raw materials. This may involve creating new enterprises or upgrading existing ones to incorporate new technologies and materials.

Thus, one of the key directions of state industrial policy, particularly in the development of production based on imported raw materials, should be the expansion of value-added chains formed in Ukraine. This can be achieved by introducing new stages of production or expanding existing ones, thereby creating new links in the production process.

The creation of joint ventures is one possible strategy for this task. However, it is important to establish that the localization coefficient of the internal (Ukrainian) potential in such enterprises should be at least 50%. This will contribute to the maximum utilization of internal resources and promote the creation of sustainable production chains in Ukraine (Ishchuk S.O., 2022).

Currently, in the conditions of war and the transfer of significant volumes of Western weapons and modern military equipment, the question of organizing its maintenance, repair, and restoration on the territory of Ukraine will become increasingly acute. This provides a unique opportunity for domestic machine-building enterprises to be involved in the creation of essentially machine repair clusters for the repair and restoration of modern Western equipment. Already, there is information about the initial steps towards the creation of joint ventures by leading global companies in the defense industry, such as Rheinmetall, Baykar Makina, and BAE Systems, with Ukrainian partners.

For example, the German company Rheinmetall (ranked 27th with sales of $4.24 billion USD in the SIPRI Top 100 Arms-Producing and Military Services Companies ranking for 2020) established a joint venture with the State Concern "Ukroboronprom" on May 13, 2023, for the repair and production of tanks, where 51% of shares and management belong to the German side.

The Turkish company Baykar Makina, a global leader in the production of unmanned aerial vehicles (UAVs), plans to open a UAV production plant in Ukraine by 2025, where the company's entire range of UAVs will be manufactured, along with a service center for repair and maintenance.

The British defense company BAE Systems (ranked 11th with sales of $11.9 billion USD in the SIPRI ranking for 2020) will open an office in Ukraine and deploy facilities for the production and repair of weapons. The Ukrainian army already uses most of the weapons developed and manufactured by this company, and the deployment of service centers in Ukraine is expected to significantly reduce the cycle of maintenance and repair of artillery installations and armored vehicles. BAE Systems can also assist Ukraine with technology transfer and the production of artillery ammunition and missile weapons.

Creation of joint ventures within the machine-building cluster will create conditions for the production and restoration of Western military technology and provide the following advantages for Ukrainian machine-building enterprises:

- increase in the volumes of manufactured products;
- attraction of foreign investments;
- integration into international production chains of leading global companies in the defense industry;
- adoption of the best global practices in management and production culture;
- modernization of equipment;
- possibility of a gradual transition to the localization of Western technology production in Ukraine with a continuous increase in the share of localized production and the potential for export to third countries.

Conclusions and perspectives of further research.

The main conclusions of the presented research provide an important foundation for the further development of the Ukrainian machinery industry in the context of Industry 4.0 and collaboration with international companies in the defense industry. Key aspects include:
1. The implementation of the Industry 4.0 concept is a crucial step for the further development of the Ukrainian machinery industry, allowing the utilization of advanced technologies and the optimization of production.

2. Collaboration with international companies and the implementation of joint projects (such as with Rheinmetall, Baykar Makina, and BAE Systems) open opportunities for the exchange of technological solutions and the attraction of investments.

3. Expansion of repair and restoration volumes for Western technology provides enterprises with the opportunity to enhance production capabilities and increase exports.

4. The gradual implementation of production localization in Ukraine is strategically important for reducing dependence on imports and increasing domestic production.

5. The development of the service and repair sector has the potential to improve employment and the economic situation in the regions.

In general, these conclusions define strategic directions for the further development of the machinery industry in Ukraine. Based on these conclusions, specific tasks for further research have been formulated, aimed at synergizing the development of Ukrainian machinery within the context of Industry 4.0 and collaboration with international corporations in the defense industry:

1. Develop and implement integrated models of machining technological systems to increase productivity in machinery enterprises.

2. Analyze the possibilities of production localization and equipment modernization for the production of modern Western technology in Ukrainian enterprises.

3. Create innovative management and production culture technologies to enhance the competitiveness of machinery enterprises.

4. Develop training programs for skills enhancement aligned with the requirements of Industry 4.0 and modern production technologies.

5. Conduct market analysis in the service, repair, and restoration of military equipment to plan production volumes and expand services.

6. Form integrated machine repair clusters to optimize the servicing, repair, and restoration of modern Western technology.

7. Develop strategies for the development of international partnerships and collaboration with leading defense industry companies for technological exchange and joint production.

8. Analyze and develop integration strategies for component manufacturers into global production chains of leading world companies.

9. Establish scientific-practical centers to promote Industry 4.0 for supporting enterprises and institutions in implementing modern technological solutions.

10. Monitor and analyze legislative and regulatory acts to create a favorable environment for the development of the Ukrainian machinery industry.

These tasks are aimed at creating synergy in addressing key challenges in the field of machinery construction in Ukraine and ensuring its sustainable development in the context of Industry 4.0 and collaboration with international partners.

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