

ORGANISATIONAL FORMS OF DEVELOPMENT OF INTERNATIONAL ECONOMIC CO-OPERATION OF MACHINE-BUILDING ENTERPRISES

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Abstract. The *purpose* of the article is to develop a scheme for the operation of an export-oriented cluster of machine-building enterprises based on innovative development. The scheme includes specific, practical recommendations for the involvement of scientific and educational institutions, as well as various satellite enterprises, according to the development needs of different groups of enterprises. *Methodology.* This study builds on previous research concerning export-oriented development, innovation-driven growth, and foreign economic strategies. Scientific research on existing approaches to understanding various integration structures and the legislative acts that regulate them revealed the main differences among these structures. One important difference is the focus on various programs within the framework of the country's innovation policy and support for different types of projects. This research also identified the advantages and disadvantages of these projects for various enterprises in Ukraine's machine-building industry. The main content of the proposed methodology is the justification of a scheme for a cluster structure of interactions between machine-building enterprises. *Results.* The proposal entails the establishment of a system of clusters of machine-building enterprises, predicated on the principles of innovative activity. This system will involve research institutions and vocational education institutions. The formation of this system will allow for the strengthening of the value-added chain in terms of increasing labour productivity and attracting more qualified employees. It will also allow for the attraction of innovations that are needed "here and now", while using fewer financial resources. In accordance with the principles of management and the stages of formation proposed by the authors, a scheme has been formed for the functioning of an export-oriented cluster of machine-building enterprises based on innovative development. This scheme includes not only the core of the cluster – the main enterprises that manufacture machine-building products and the scientific institutions that ensure the innovativeness of the development vector – but also various satellite enterprises, financial institutions, and internal consumers of products and services. These entities operate under the given conditions of market development, influenced by state and regional authorities, as well as factors of the external environment of the domestic and international markets. *Practical implications.* Practical recommendations have been developed for forming a system of export-oriented clusters with an innovation bias for the studied groups of enterprises. This is reflected in the general scheme of cluster functioning and interaction among the various entities proposed to be involved in organizing and managing the cluster. This is in accordance with the proposed principles and the concept of interaction between the studied enterprises forming the basis of the cluster and the relevant scientific and educational institutions. The goal is to activate innovative activities and increase labour efficiency. *Value / Originality.* The methodological approach developed for the formation of a system of export-oriented clusters serves as the foundation for management decisions and the formulation of export strategies for machine-building enterprises within the context of developing an export-oriented model of the economy.

Keywords: cluster, mechanical engineering, foreign economic policy, innovative component.

JEL Classification: F13, L62, L63, O12, O24

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1. Introduction

Over the past decade, the most significant transformations in foreign economic policy were the result of a shift in approach prompted by Russia's assertive and unfriendly actions. Notwithstanding this dynamic, Russia maintained its status as a significant foreign trade partner, even in the aftermath of 2014. It was only subsequent to a full-scale invasion that trade relations between Ukraine and Russia were entirely severed. In light of the pertinent developments in the country's foreign economic policy that emerged at the outset of 2014, it is imperative for mechanical engineering enterprises to respond with greater alacrity to such alterations.

Mechanical engineering products are extremely diverse, combining a wide range of machines, equipment, units, devices, instruments, assemblies, and components. The goal of industrial manufacturers is to reduce production costs, which is mostly achieved by increasing production scale and automation (the more unified and standardized the products are, and the larger their batch, the lower their production costs). This creates the prerequisites for global standardisation in mechanical engineering. This is most evident in the mass production sectors of mechanical engineering, such as the automotive industry and the production of vehicles, agricultural machinery, road machinery, and industrial equipment.

The mechanical engineering industry has always been the flagship of the Ukrainian economy. It could lay the groundwork for an export-oriented model since enterprises in this industry produce a variety of high-tech products for industrial and final consumption, including exports (Dunska, Bondar, Zhaldak, 2024).

Previous research has shown that most enterprises need to improve their export activities by implementing modern enterprise development methods based on performance indicators and the best practices present in the market.

Since the vast majority of Ukrainian machine-building enterprises are privately owned (around 90%), the organisational structure of a flexible body for developing the industry should facilitate co-operation between entrepreneurs, the management of state-owned enterprises, and the state authorities (central and local) responsible for industrial policy.

The purpose of the research presented here is to examine in detail the process of forming a system of clusters of machine-building enterprises based on innovation. The set goal will be achieved by consistently solving the following research tasks: developing a scheme for the functioning of an export-oriented cluster based on innovative development, and providing specific practical recommendations for attracting scientific and educational institutions, as well as various satellite enterprises, to different groups of enterprises

in accordance with their development needs, based on pre-selected vectors of foreign economic activity development.

The resolution of issues arising from the challenges of globalisation in the domain of achieving sustainable and accelerated innovative neo-industrial development, such as the establishment of a contemporary industry and technological framework, the augmentation of the economy's self-sufficiency and, consequently, the enhancement of the export-import balance, the cultivation of export-oriented and import-substituting industries, the accelerated growth of high-tech industries, the diversification of production on a national and regional scale, and the development of systems for servicing the primary production, necessitates the refinement of organisational and institutional frameworks for coordinating and financing economic and social development in the nation and its regions. This process primarily entails the formulation of a suitable strategy and the enhancement (and establishment of novel) mechanisms for development at various levels of economic functionality.

2. Theoretical Features for Ensuring Foreign Economic Co-operation of Machine-Building Enterprises

Forming industrial and commercial ties with strategically important and complementary partners in foreign and domestic markets for the purpose of producing competitive products, using various modern economic procedures and tools, contributes to the development of industrial enterprises' foreign economic activity. Given the need to consider a significant number of factors in the activities of machine-building enterprises, particularly the volatility of the global market and innovative technologies, which in turn impact the development of the machine-building sector, it is crucial to establish a system of tools to facilitate growth within these enterprises.

While the Industrial Revolution enabled economies of scale and scope in supply, the Digital Revolution has given rise to a different kind of economy. It has made it possible to identify and exploit complementarities between users, machines and sectors by using data, software and networks. Digital technologies allow people to connect with each other and with organisations with minimal friction. Furthermore, companies are no longer required to innovate independently or own all the assets they provide to consumers. Resources outside the firm's remit can be exploited and monitored remotely. This has a profound impact on the main location of value creation and capture, shifting it from the traditional firm and its supply chain to the digital platform (Gawer, 2020).

As outlined in Table 1, companies in different countries often require international co-operation for various reasons.

Table 1

Description of reasons of international co-operation between enterprises

Reason of international co-operation	Description
Access to new markets	International co-operation enables enterprises to expand their reach and access new markets. By partnering with businesses from different countries, they can access local knowledge, distribution networks and customer bases that would otherwise be out of their reach. This can lead to increased sales, business growth and a more diverse range of revenue streams.
Resource sharing	International co-operation allows businesses to combine their resources, expertise and capabilities. This may involve sharing technology, research and development (R&D), manufacturing facilities, and human capital. By collaborating with enterprises from different countries, they can leverage each other's strengths for mutual benefit. For instance, one enterprise may have advanced technology, while another may have a skilled workforce. By joining forces, they can develop innovative products or services.
Cost-effectiveness	International co-operation can help businesses reduce costs and improve efficiency. For example, companies can realise cost savings by outsourcing certain tasks or production processes to countries with lower labour or operating costs. Additionally, collaborative R&D enables enterprises to share the costs of innovation and development, making them more affordable for all parties involved.
Knowledge and learning	International co-operation facilitates the exchange of knowledge, best practices, and industry insights. Enterprises can learn from each other's experiences, gain new perspectives and stay informed about emerging trends and technologies by working with enterprises from different countries. This fosters innovation, competitiveness and ongoing improvement.
Government and regulatory support	International co-operation can give businesses access to government support and incentives. Governments generally encourage cross-border co-operation in order to stimulate economic growth, facilitate trade and attract foreign investment. Enterprises can take advantage of these government initiatives, such as grants, tax incentives and regulatory assistance, by partnering with enterprises from different countries.

Source: compiled by authors

As digital tools and computing resources become increasingly available and cheaper to access, new opportunities are emerging. These opportunities include the use of big data in value creation processes to improve and transform existing activities, such as manufacturing processes that are more intelligent and agile. New business models are also being deployed, which enhance coordination along supply chains and intermediation. Furthermore, new markets are being reached and new products with data-enhanced features and functionalities are being developed (Andreoni, Roberts, 2022).

One possible development path for machine-building enterprises at the meso level is to create special zones and economic structures that rely on leading exporting companies to generate synergies, boost innovative activity and increase exports of machine-building products. Examples of such formations include special economic zones, technology parks and clusters.

The main goal of technology parks is to organise knowledge-intensive production comprehensively by facilitating the creation and introduction of new technologies as much as possible and stimulating the development of specialists' creative potential. By concentrating scientific, production and financial resources, technology parks ensure the full life cycle of innovations is reproduced: research, development, implementation and the mass industrial production of knowledge-intensive, high-tech products that are competitive in world markets. Technology parks are

economic activity zones that bring together universities, research organisations, industrial enterprises and innovation infrastructure entities at regional, national and international levels (Polivanova, 2018).

Governments use special economic zones to attract investment, primarily foreign, to develop industrial production, particularly export-oriented production, to increase employment and to revitalise urban and rural areas. They enable countries to overcome a low level of industrialisation and a reliance on raw materials, increase demand for highly paid and highly skilled labour, and develop profitable types of economic activity with high growth potential, such as processing industries and knowledge-intensive services. Ultimately, they ensure long-term economic growth (Pidorycheva, 2020).

Porter (1998) defines "clusters" as geographically concentrated groups of interdependent companies, specialised suppliers, service providers, firms in related industries, and organisations that are related to their activities. These entities complement each other and concurrently contribute to the attainment of competitive advantages.

Cluster systems are characterised by the following features compared to classical forms of co-operative and economic interactions of small, medium, and large businesses (Horoshko, 2021):

- The presence of a large leading enterprise that determines the long-term economic, innovation and other strategy of the entire system;

- territorial localisation of the bulk of business entities
- participants in the cluster system;
- stability of economic relations of business entities – participants in the cluster system, the dominant value of these relations for the majority of its participants;
- long-term coordination of interaction of the system participants within its production programmes, innovation processes; basic management systems, quality control, etc.

The main difference between a cluster and a random collection of geographically localised enterprises is the formation of a complex combination of competition and co-operation. These two types of enterprise seem to operate on different levels and complement each other, particularly in innovation processes.

There are Scottish and Italian cluster models. In the former, the core of joint production is a large enterprise that brings small firms together, whereas in the latter, there is more flexible and "equal" co-operation between small, medium and large businesses. While the countries of the European Union have adopted the Scottish model, experts argue that the Italian model of cluster organisation is better suited to countries with transitioning economies.

The employment of a cluster approach has been demonstrated to engender enhanced competitiveness and efficiency among enterprises, thereby establishing a foundation for the advancement of the economy.

The role of clusters in the development of international trade is subject to constant augmentation. It is challenging to provide an unambiguous interpretation. Nevertheless, it can be contended that the establishment of clusters constitutes an objective process and exerts a favourable influence on the development of international trade.

Clusters provide a means of overcoming the isolation of domestic markets and undoubtedly contribute to international trade. Information exchange between economic entities increases, as does the openness of their interactions. New approaches to the organisation and management of international trade emerge.

Based on the work of Hanushchak-Yefimenko (2015), a number of systems that have already been tested in practice can be highlighted to promote the formation of clusters:

- Programmes aimed at bringing together representatives of the business community;
- partner selection initiatives, for example, the creation of databases that can be accessed by companies looking for partners in their field of activity;
- funding of intermediary initiatives, for example, a program organised by the Danish Technological Institute and later extended to other countries;
- sponsorship initiatives, when consultants are paid to monitor the process of cluster formation from the very beginning of the first steps of co-operation;

- state funding of some cluster projects on a competitive basis.

As a mechanism for implementing innovative processes in international trade, the cluster operates at both the regional and interregional levels. As a self-regulating non-profit organisation, one of the tasks of an innovation-oriented cluster is to develop uniform standards and regulations for the integration of its participants. To this end, all enterprises included in the cluster provide technical, organisational and economic information to a central database.

The effectiveness of clusters also lies in their cross-sectoral co-operation. This allows innovative projects to be created and implemented at the intersection of different sectors.

The management mechanism of a cluster of machine-building enterprises should be based on principles that enable the formulation of a logical management concept. This concept should include the processes of cluster formation and the selection of criteria for effectiveness. It should also include the formulation of a general management strategy that enables the achievement of results that meet the selected criteria (see Table 2).

3. A Comprehensive Approach to the Formation of Cluster Structures to Ensure the Foreign Economic Development of Machine-Building Enterprises

In this context, it is imperative to undertake a thorough examination of the process of establishing a system of clusters of machine-building enterprises based on the innovative component.

The procedure of creating industrial clusters should involve:

- Representatives of state, regional and local authorities who, having their own interests in the development of territories, have sufficient leverage (legal, financial, administrative) to influence the situation in the region;
- investors, represented by large foreign companies.

The process of cluster formation can be represented in the form of a diagram shown in Figure 1.

The main problems faced by machine-building enterprises are the low productivity of employees, particularly with regard to exports, and the low level of investment in innovation, which leads to a low return on investment and, in a vicious circle, even lower investment in R&D in subsequent periods. Key factors contributing to this are the weak technological infrastructure of post-Soviet industries and the tendency of new industries to produce labour-intensive products (assembly production). Low labour productivity means that domestic machine-building companies cannot pay competitive wages, causing them to lose out in the competition for personnel to IT companies. This issue primarily affects young workers.

Table 2

Cluster management principles

Cluster management principle	Description
Multi-model cluster formation	There are several models of cluster formation, each of which is effective depending on the influence of regional, industry-related, and microeconomic factors.
Maintaining the critical mass of the cluster	A cluster consists of a certain number of participants who each bring their own resources, ideas, production capacities and market assets. The cluster's synergy effect is based on the joint use of these resources. However, if certain threshold values are exceeded or the balance between participants is disturbed, this may have a negative effect. In this case, it may decrease rather than increase the overall benefit to the companies. The principle of maintaining the critical mass of the cluster is based on controlling its power, synergistic effect and scale, in order to prevent negative synergy and reduce interaction effectiveness between cluster participants. This also applies to the composition of participants in integrated education, which aims to form the most optimal cluster structure.
Coexistence of competition and co-operation	This principle distinguishes clusters from other integrated structures, making clusters one of the most effective forms of business interaction and stimulating the innovative development of companies.
Speciality	Clusters are formed around a key activity to which all participants are connected. Enterprises and institutions within a cluster operate within a shared market and utilise comparable management, production, and sales strategies. Their familiarity with the industry's specific features reduces the possibility of errors when choosing a partner. Clusters can develop in various ways.
Flexibility of cluster boundaries/principle of dynamism	A cluster is a permanent, integrated structure. The purpose of forming such associations is to create a unified environment of information, innovation, resources, production and technology for enterprises and institutions to interact within. As any company can easily enter and exit the cluster, its boundaries are fluid and the structure changes to adapt to dynamic external and internal factors. In addition, the interactions within the cluster are determined by competitive and co-operative relations, stimulating the continuity of the innovation process and the implementation and commercialisation of innovative projects.
Diffusion of innovations	This refers to the growth and strengthening of innovation dissemination processes within the cluster, resulting from the formation of a unified information and innovation environment. The diffusion of innovations is manifested in the flow of knowledge from one industry to another during the implementation of joint projects, through personnel migration, and through the exchange of experience between enterprises. Working together on a single problem enables different points of view to be considered, facilitating the discovery of the most creative solution.
Relevance of strategic goals	An accompanying infrastructure necessarily forms during cluster formation. This includes management and related institutions, relevant documents on the creation and functioning of the cluster, and a strategic vision for its development. When developing the cluster's main strategic goals, it is important to ensure they align with regional policy, target guidelines, and the country's overall development strategy. The alignment of strategic objectives is paramount in establishing a robust framework for collaborative enterprises, institutions and institutes. These entities aspire to enhance their individual competitiveness and, concomitantly, augment the efficiency of the collective operations of all participants within the cluster. This collective endeavour also encompasses the enhancement of regional and industry-wide efficiency.
Multi-level emergence of synergistic effect	The principle signifies the establishment of a distinct mechanism of interactions within the cluster, wherein synergy emerges at each stage of accomplishing the strategic objectives of the cluster. The multilevel nature of the emergence of a synergistic effect is manifest in the gradual increase in the efficiency of the structure. Various effects are manifested, including scale effect, resource sharing, risk sharing and innovative interaction. These effects increase the synergy of the cluster as more interactions are formed between cluster participants. This, in turn, leads to the formation of a single information, innovation and production and technological environment.

Source: compiled by authors

That is why, when creating clusters of export-oriented machine-building industries, primary attention should be paid to developing relationships between research and educational institutions at different levels. This will allow a better return on investment in innovation to be obtained and young professionals to be attracted to work.

Increasing stability in management at cluster and enterprise levels is possible through a set of measures

aimed at creating a new organisational structure and reorganising the management system. To achieve this, the following actions must be implemented (Bondar, 2024):

- 1) The number of employees at enterprises must meet the standards of manageability to increase the efficiency of managers;
- 2) the creation of a flexible system of interaction between departments to facilitate the flow of internal information both vertically and horizontally;

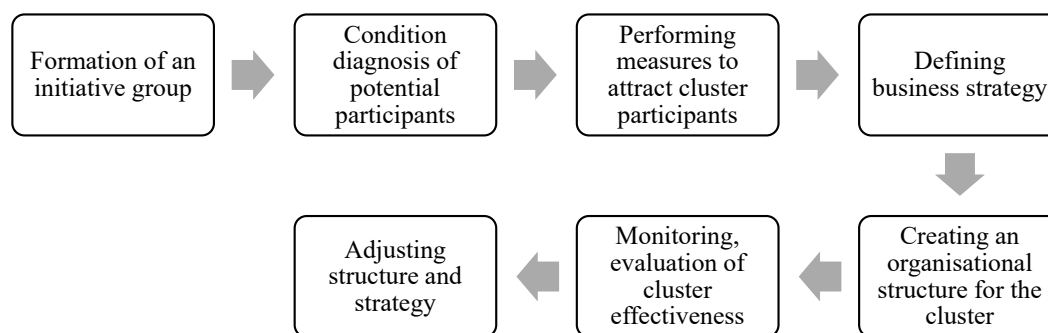


Figure 1. Stages of forming an export development cluster

Source: compiled by authors

3) it is possible to partially transfer a number of tasks outside the enterprise to provide flexibility to the organisational structure;

4) the creation of the foundations of a cluster system in the machine-building industry, which will contribute to the optimal functioning of selected enterprises.

The cluster is based on enterprises that specialise in manufacturing related engineering products. These enterprises are the main customers and consumers of all the related goods and services produced by the cluster.

The second key component pertains to the educational and scientific sphere, encompassing research institutes that specialise in the development of innovative products and processes at the behest of the cluster's primary enterprises. Vocational and technical educational institutions are also integral to this component, as they are responsible for the training of personnel for these enterprises. Furthermore, higher education institutions, which engage in applied research and train higher-level personnel for enterprises, play a pivotal role in this component. In such cases, participating enterprises, having adapted to new conditions, are able to plan innovative developments and, accordingly, advanced training or training of personnel, etc. The institutions of higher education included in the cluster are fundamentally oriented towards the training (retraining) of personnel and the acquisition of contemporary knowledge and skills in the domain of specialisation of the cluster.

The cluster incorporates a specialised services segment, comprising organisations that offer a range of services (e.g., legal counsel, accounting, auditing). This approach engenders a dual effect, yielding two principal outcomes. Firstly, it results in a reduction in costs associated with services of an economic or legal nature. Secondly, it establishes a unified information space, thereby facilitating enhanced accessibility and efficiency. Given that the cluster structure does not function in a closed space, but interacts at the regional, state, and, in the case of foreign economic activity, even international levels, the effectiveness of its activities is influenced by such groups of factors as regional

infrastructure, state authorities, external factors, factors of the international environment and end consumers. The consumer is divided into two categories: internal and external. The term "internal consumers" refers to enterprises and firms that purchase specific cluster products and subsequently sell them onward. The aforementioned factors serve to ensure continuity of supply, reliability of the quality of purchased products (services) and stability of orders for cluster participants. In addition, internal consumers have the capacity to function as investors in a variety of projects that are implemented by the cluster. The term "external consumers" refers to third-party consumers who are participants in the cluster.

A scheme of functioning of a cluster of export-oriented machine-building enterprises is shown in Figure 2.

The core of the clusters should comprise machine-building enterprises, grouped by area of expertise and type of product. Based on their specialisation, research institutions and universities engaged in innovative developments in a given area were selected to provide the appropriate level of R&D necessary to support enterprises' export potential in accordance with their needs. These universities also train the senior specialists necessary to maintain the required level of workforce qualification.

Since co-operation with regional vocational education institutions is based on the concept of dual education for junior specialists, each enterprise selected these institutions individually, taking into account the regional factor and the institutions' ability to provide the required number of specialists with the required level of knowledge.

The regional infrastructure block includes the energy system, as well as the connection and communication systems, and the supply, sales and business infrastructure.

When considering the organizational mechanisms of intracluster integration, we will identify the main advantages that determine the intracluster interaction of enterprises:

- Access to specialised factors of production and labour. Being located within a cluster can provide cheaper

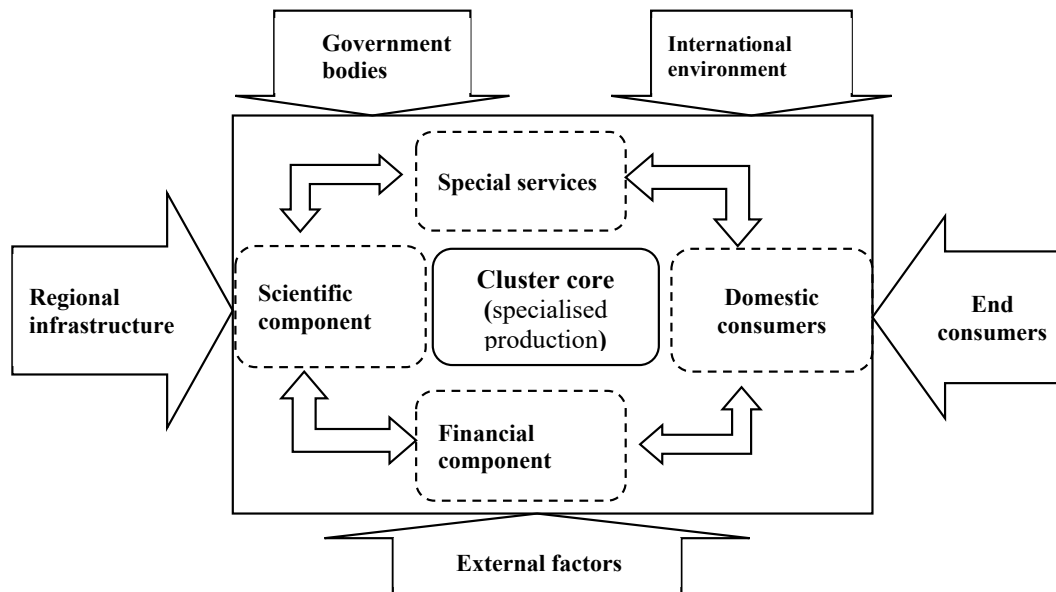


Figure 2. Scheme of operation of a cluster of export-oriented machine-building enterprises

Source: compiled by authors

or more privileged access to such specialised factors of production as components, machinery, business services and personnel, compared to options for remote localisation, such as vertical integration, formal alliances with external structures or the "import" of factors of production. Thus, a cluster is a spatial organisational form that can be more efficient in arranging factors of production in the case of competitive local suppliers being available.

- Access to information. Within the cluster, enterprises and local organisations accumulate extensive knowledge of marketing and technologies, as well as other specialised types of information. Better organisation of access to this information can reduce costs for enterprises within the cluster, enabling them to work more productively and reach an advanced level of productivity. A similar effect is seen in the flow of information between divisions of a company. Proximity, links in supply chains, technologies and constant personal contacts facilitate the movement of information within clusters.

- Complementarity. A cluster increases productivity by acquiring and implementing factors of production and by ensuring complementarity between the activities of its participants.

- Access to organisations and public goods. Clusters generate numerous factors of production that would otherwise be too costly in the context of public or quasi-public goods and services.

- Incentives and productivity. Clusters enable the resolution or mitigation of the negative impact of organisational problems that arise in more isolated geographical regions and in firms with greater vertical integration. Clusters increase the value of incentives

within companies to achieve higher productivity for several reasons. Primarily, this is due to competitive pressure.

Thus, based on the highlighted advantages, we can conclude that clusters increase the productivity of industries as a whole and of the enterprises included in them. They also increase susceptibility to innovation and create additional conditions for stimulating the development of new businesses. It is the opinion of the present authors that the establishment of a collaborative alliance between industrial enterprises, financial institutions, research centres, and state authorities on the basis of voluntary interaction creates additional advantages for each business entity included in it. These advantages include access to specialised factors of production and labour, access to information, complementarity, access to organisations and public goods, stimulation and measurement of productivity. The result of this increased competitiveness in regional, interregional and global markets is, in turn, beneficial to all.

4. Conclusions

As the findings of the conducted research demonstrated, the development of Ukraine's machine-building enterprises is significantly influenced by the country's foreign economic policy. The disruption of long-established trade relations with the Russian market engendered a high level of uncertainty, forcing enterprises to reorient towards alternative foreign markets. Nevertheless, the rate of this reorientation has been inadequate and disparate. Previous empirical analyses confirm the continued dominance of

heavy engineering products in the export structure, while the proportion of high-tech and knowledge-intensive goods remains insufficient. This structural imbalance indicates a reliance on an extensive export model with a low level of technological complexity. Outdated production infrastructure and technological backwardness substantially weaken the competitive position of many enterprises in international markets. Limited investment in research and development continues to hinder innovation-driven export growth.

The results confirm that the cluster-based approach is one of the most effective institutional mechanisms for enhancing the export potential of machine-building enterprises. Export-oriented clusters ensure the concentration of industrial, scientific, educational and financial resources within a unified economic space. Integrating enterprises with research institutions and higher education establishments is identified as a key prerequisite for accelerating innovation processes. Clusters foster favourable conditions for knowledge spillovers, innovation diffusion, and the development of sustainable co-operation networks.

It has been proven that combining competition and co-operation within clusters stimulates productivity

growth and quality improvements. Cluster participants gain access to specialised production factors, advanced infrastructure and relevant market information. This leads to reduced costs, more efficient use of investments, and greater resilience to external shocks. Consequently, the international competitiveness of cluster-based enterprises increases significantly.

The study confirms the necessity of active state and regional involvement in cluster formation, in the form of financial, fiscal and institutional support. Without coordinated public policy, cluster initiatives cannot generate systematic sectoral effects. The development of regional infrastructure is crucial for sustainable industrial co-operation.

It can be concluded that the export-oriented growth of machine-building enterprises in Ukraine is only feasible under conditions of intensified innovation activity and comprehensive technological modernisation. Aligning with global trends such as digitalisation, robotics and electronic engineering is a strategic imperative. Implementing the cluster model provides a solid foundation for increasing the share of high-tech exports, reducing structural imbalances and strengthening Ukraine's integration into global value chains.

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Received on: 30th of November, 2025

Accepted on: 20th of February, 2026

Published on: 10th of April, 2026