

## ЗАПРОШУЄМО ДО СПІВПРАЦІ

Розвиток економіки й зміцнення суспільного господарського порядку є одним з першочергових завдань стабілізаційних процесів у регіонах України. Саме такій широкій проблематиці досліджень у сфері економічної науки присвячено науковий журнал "Економічний вісник Донбасу". Засновники журналу – Інститут економіки промисловості НАН України та Луганський національний університет імені Тараса Шевченка МОН України. Поява такого наукового видання є закономірною, оскільки давно вже виникла потреба в міжгалузевих та міжрегіональних соціально-економічних дослідженнях.

Сподіваємося, що журнал продовжить традиції інтеграції академічної та вузівської науки з практикою, сприятиме поширенню досвіду наукової, науково-педагогічної та виробничої діяльності, становленню кадрів вищої кваліфікації. Тематична спрямованість видання – публікація наукових статей широкого спектра теоретичних і прикладних проблем економіки, оглядових і дискусійних статей.

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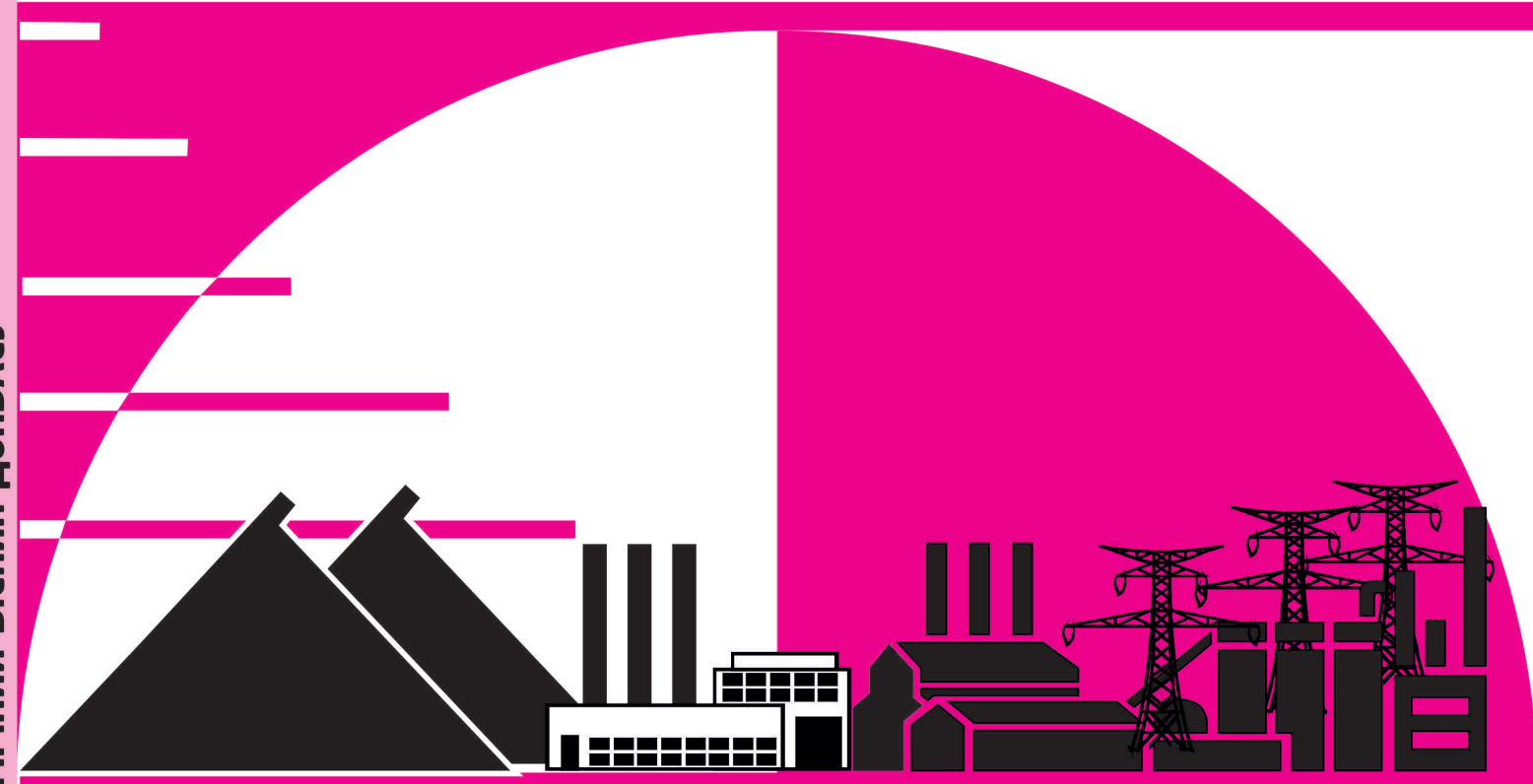
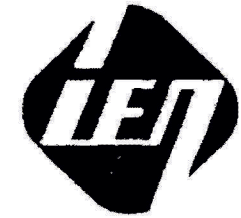
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## OPEN SOURCE: THE CASE OF CHANNELS

The Open Source paradigm is taking over the world: 37% of all companies use Open Source software; large companies are almost twice as likely to use open source software as small counterparts (63% vs. 37%); the number of Forbes Global 2000 companies using open source solutions tripled; 79% of the world's software vendors use open source code to build commercial systems [1].

Open Source is a form of the free software movement, which was founded by Richard Stallman. It was he who in 1983 started the GNU project to create a Unix-like operating system that would have only open source software. In 1984, Stallman left MIT to devote himself fully to the GNU project. In the early 1990s, almost all the necessary components of the system were developed, with the exception of the core. Linus Torvalds, a Finnish student of Helsinki University created it as a hobby. The kernel's name "Linux" was invented by Ari Lemmke, the server administrator of the university network.

Richard Stallman considered and called his software free (free software, software libre) in contrast to proprietary software, which is protected by property and/or non-property copyright. Proprietary software has closed access to the code, does not allow changes, duplication, distribution and resale.

The fact that a program is provided for free does not mean that it is free: there are free software products whose source code is not published or there are restrictions on their use or distribution. And, conversely, open software does not necessarily have to be free:

copies can be distributed for money, but the user cannot be restricted in any of the specified rights.

The most famous example of a proprietary computer operating system is Microsoft Windows. Open source operating system – Linux. An open source Linux system developed by enthusiasts for use on their own computers, thanks to the support of IBM and others. Large companies, gained popularity as a server operating system. It is installed on many hardware platforms, smartphones, tablet PCs, routers, automation devices and other gadgets.

Stallman himself does not accept the alternative name "Open Source", at least in relation to programs under the GNU Lesser GPL licenses, because, in his opinion, this term hides the true purpose of such software, which is freedom. Despite this, the concept of Open Source is catching on even outside the software field.

If you look into history, the activities of Eliezer Ben-Yehuda, a man who spent his whole life engaged in the revival of Hebrew as a modern spoken language, can well claim the place of the forerunner of Open Source. The beer "Voresøl" is worth to be mentioned in this regard also (translation means "Our beer") [2]. The drink was created by Danish students as a challenge to Carlsberg's closed-code beer. To begin with, the students met with the author of a Danish book on home brewing. Then they agreed on the type of beer they wanted, bought the ingredients and brewed about 100 liters of beer right in the university canteen. Thus, according to software traditions, version 1.0 of "Our

beer" appeared. The recipe, as for any software product with open source code, was published with the statute of "license of national creativity", after which people from Mexico, Brazil and even Afghanistan joined the experiments in making the Open Source product.

But an Open Source product, if it is interpreted as any development open to study, modify, replication, distribution and resale, according to the authors of this work, can refer to much larger phenomena that are far from the field of software. The purpose of the work is to demonstrate the moment of open source code as a case studies, in particular, of the maritime transport channels.

**Research methods:** theoretical–analysis, abstraction, synthesis, case studies.

**Case study 1.** Modification and replication of Hohenwarte Dams' design (on the Elbe) during the reconstruction of the Panama Canal.

In 2006, the decision of the Panama Canal administration to increase the capacity of the transport artery of world importance due to the construction of the third line of locks (significantly increasing overall dimensions – 420 m long, 60 m wide and 18 m deep, with the length of each lock up to 2.4 km) was adopted in 2006. It was a technological, but more of an environmental challenge. Regularly filling the locks with water required 8 million tons of fresh water per day. The expansion of the canal with the construction of new locks made it necessary to double the consumption of water resources. This required new reservoirs with new dams, resettlement of residents of entire districts, which is impossible without great political tension. Even in a tropical country where up to 2,500 mm of rain fall annually, saving fresh water becomes the most important task for engineers.

The delegation from the Panama Canal Authority discovered the solution to the problem as a result of studying the design of the Hohenwarthe Dams on the Elbe River in Germany: the water that passed through the lock during lifting and lowering operations is partially returned for reuse, and not, as usual, dumped into the ocean [3].

The borrowed technical-technological solution turned out to be very important against the background of the current drought, from which the Panama Canal is currently suffering. Passing through the old lock system requires about 500 million liters of water per vessel, while the new route requires 200 million liters. As a result, the daily throughput capacity of one set of locks for Panamax class vessels has decreased from 23 to 16, and for many of the larger Neopanamax vessels serving the locks in 2016, has remained at 10 vessels per day [4].

**Case study 2.** Modification and replication of Berendrecht (Antwerp) lock door design during the reconstruction of the Panama Canal.

A solution to the maintenance problem for the 730 t double-leaf flood gates has been found in Europe, where locks were already capable of passing the vessels of Post

Panamax size. The Belgian Berendrecht Lock in Antwerp became an analogue. The gate has wheels and can roll out and block the airlock chamber. Particularly attractive in such a design is the possibility of turning any of the niches into a miniature dry dock, which allows you to carry out all the necessary preventive and repair work with the mechanisms of lock gates without stopping the movement of ships along the canal.

**Case study 3.** Adaptation and replication of the procedure for the passage of vessels with a large sediment through the Suez Canal in Ukraine.

Unlike the Panama Canal, the Suez Canal has no locks, so the only limiting parameter is sediment. Ships capable of passing through the Suez Canal with a full load of 150,000 tons are called Suezmax. The passage of ships with a larger tonnage makes it necessary to unload a part of the cargo when entering the canal and load it on board after leaving the canal [5].

The scheme developed for the Suez Canal was implemented in a certain way for the handling of Capesize vessels in the Black Sea ports of Illichivsk and South. The name Capesize was given to ships that are not able to pass through the Suez and Panama Canals due to their dimensions and therefore have to go around Cape Horn in South America or the Cape of Good Hope in South Africa. Transformations of the global economy contribute to the increase in the size of the Capesize class fleet.

This is what exacerbated the problem of port servicing of heavy cargo ships in the ports of Ukraine, which are relatively shallow, and sparked interest in the experience of shipping supertankers through the Suez Canal.

Modernization of the specified scheme found two types of implementation in Ukrainian practice. First, it is incomplete loading of ships near the quay wall with additional loading of materials on the outer road. The first application of such experience took place in 2016 in the Illichiv port (now the commercial port of Chornomorsk) during the maintenance of the Capesize Greek bulker "Anangel Astronomer". 176.5 tons of iron ore raw materials were to be loaded. At the first stage, directly in the water area of the port, more than 121,000 tons were loaded, the rest (55,000 tons) was loaded at the external roadway at a depth of 20 m [6].

Experts consider the processing of a Capesize vessel completely at the berth of a Ukrainian port, without operations on an external roadway, a new method of domestic logistics. The first experience of using the scheme, which was developed on the basis of foreign experience by the company "Metinvest", was the loading operation in 2016 of the bulk carrier "Frontier Youth" with the acceptance on board of the initial part of the ship's batch (110.5 thousand tons of iron ore concentrate of the company "Metinvest") in the port of Chornomorsk with further loading of the second part (64.2 thousand tons) in the port of Pivdenny. The commercial port of Chornomorsk and the port of

Pivdenny are part of the port economy of the so-called Great Odesa. The total volume of cargo on the vessel "Frontier Youth" amounted to 174.7 thousand tons of ore concentrate [7].

#### Case study 4. Möbius forms.

Scientists from Manhattan David Stark and Elizabeth Anne Watkins (Columbia University, USA) proposed a way of doing business, according to which the subject does not create (bade) assets, does not acquire (buy) them, does not use them cooperatively (cooperate), – it co-opts them (co-opt), that is, to make use of for one's own purposes [8]. Thus, the Amazon company, which at the stage of the Internet trade development did not have its own stores, used the stores of the retail giant Best Buy as its storefront. The retailer was losing revenue because any owner of the app installed on their mobile phone could buy an item they liked from a Best Buy retail store on Amazon at a significant discount.

In the context of Möbius forms, the expression of E. Lorenz (Edward Lorenz) regarding the flapping of a butterfly's wings in Panama (in the original Brazil), which is capable of causing a tornado in Texas [9], becomes appropriate. The case of the modernization of the Panama Canal actualized the idea of "Post Panamax" – container ships with a capacity of up to 12,000 TEU instead of the existing "Panamax" with a capacity of 4,000 TEU (twenty-foot equivalent unit). But the arrival of one such container ship can paralyze the workings of the entire port economy. To avoid this, a major reconstruction was needed, in particular, the Bayonne Bridge, which since 1931 has been among the five largest structures of its kind in the world. The Bayonne Bridge connects Staten Island, New York, and Bayonne, New Jersey, and under its spans the Kill van Kull Channel, ships pass to the two (New York and New Jersey) busiest ports on the east coast. It took a major project launched in 2013 to raise the road surface 215 feet (over 65 m) above the water.

The Panama Canal reconstruction project cost \$5.25 billion [10], Americans spent 1.3 billion dollars at work on raising the Bayonne Bridge roadway and modernizing the New York harbor.

Hands-on maintenance of vessels of the new series is available at one or two ports in Northern Europe, two or three ports in Asia and one port in North America [11].

The decision to modernize the canal, which was supported by 79% of Panamanians who came to the referendum, was the most satisfied with the Chinese business structures, both managing the canal and those that accelerated the supply of Venezuelan oil to China for themselves. The task of paying for the consequences of the "historic" transformations is left to Staten Island-bound drivers, who each pass on the bridge costs them from \$12.50 to \$15.00 [12].

Actors-builders of economies of Möbius forms [13], seek to co-opt the activity of open-sourcers. However, the importance of the Open Source phenomenon is growing more and more in the context of ecology and sustainable development. The international community should promote the transformation of proprietary forms into Open Source forms of nature, with their openness, economic attractiveness, and wide availability. Open Source approaches are more suited to the Industry 5.0 paradigm.

#### Conclusions

Open Source is gaining more and more popularity in the software industry. Open source computer programs, the same as Linux, place on a large number of hardware platforms, embedded in smartphones, tablet PCs, routers, automation devices and other gadgets. But the authors of this work, using the case of sea channels, prove that the phenomenon of Open Source is much more powerful and wider in terms of implementation than the software world.

The following cases studies are presented: 1) modification and replication of Hohenwarte Dams' design (on the Elbe) during the reconstruction of the Panama Canal; 2) modification and replication of Berendrecht (Antwerp) lock door design during the reconstruction of the Panama Canal; 3) adaptation and replication of the procedure for the passage of vessels with a large sediment through the Suez Canal in Ukraine.

The content of the given cases demonstrates compliance with Open Source principles. In conversation, canal officials make it clear that they see themselves as carrying on a grand engineering tradition. Speaking of the original builders, Alberto Alemán Zubieta, CEO of the ACP, says, "If you look at this canal through the eyes of an engineer, it is still so impressive what they did, how imaginative they were." He and other officials stress that, in contrast to the original construction, the challenges facing the expansion mostly involve well-known technologies [3].

The case of the reconstruction of the Panama Canal in the light of the Möbius forms, i.e. management methods based on the principles of asset co-optation, is considered separately. It was concluded that actors-builders of economies of Möbius forms are able to co-opt the activity of open-sourcers. However, the importance of the Open Source phenomenon is growing more and more in the context of ecology and sustainable development. The international community should promote the transformation of proprietary forms into Open Source forms of nature, with their openness, economic attractiveness, and wide availability. Open Source approaches are more suited to the Industry 5.0 paradigm.



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### Череватський Д. Ю., Липницький Д. В., Мишанов А. Ю. Open Source: казус судноплавних каналів

У світовій практиці феномен Open Source звичайно асоціюється з програмним забезпеченням. Але насправді поняття відкритого коду набагато ширше. Є навіть приклади пива з відкритим кодом. Дослідження присвячено прикладу морських каналів (Панама, Суец) у контексті демонстрації особливостей, характерних для феномена Open Source. На тлі вимог щодо забезпечення сталого розвитку підхід Open Source може стати вирішальним у плані промислового розвитку, реструктуризації інфраструктури та зменшення впливу на навколишнє середовище в цілому. Робота має характер теоретичного дослідження, зокрема з використанням методів абстрагування, аналізу, синтезу, кейсів.

*Ключові слова:* Open Source, відкритий код, морські канали, промисловий розвиток, реструктуризація інфраструктури.

### Cherevatskyi D., Lypnytskyi D., Myshanov A. Open Source: the Case of Channels

In global practice, the Open Source phenomenon is usually associated with software. But in reality, the concept of open source code is much broader. There are even examples of open source beer, etc. The study is devoted to the case study of the sea canals (Panama, Suez) in the context of demonstrating the features characteristic of the Open Source phenomenon. Against the background of the requirements for ensuring sustainable development, the Open Source approach can become decisive in terms of industrial development, infrastructure restructuring, and reduction of the environmental footprint in general. The work was carried out by the method of theoretical research, in particular, using the methods of abstraction, analysis, synthesis, case study.

*Keywords:* Open Source, open code, sea channels, industrial development, infrastructure restructuring.

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## DEVELOPMENT OF THE MECHANISM OF DIVERSIFICATION OF RESOURCES USED BY ENTERPRISES OF THE AGRICULTURAL COMPLEX IN A STRATEGIC PERSPECTIVE

**Problem statement and its connection with important scientific and practical tasks.** In the context of globalization of the world economy, enterprises of different industries, associated with the interpenetration of technology and capital, are diversifying their financial and economic activities. The effectiveness of its implementation directly depends on the timely focus on the types of goods, works, services that are in demand and competitive.

Research on the competitiveness of products of various sectors of the economy is becoming increasingly important. One of the main branches of agriculture in small and medium-sized businesses is and remains animal husbandry. The production of competitive products and ensuring the sustainable position of small and medium-sized enterprises in the agricultural market requires a change in production costs by creating a perfect management accounting system, which provides internal users with information for effective management. After all, the level of competitive products and the results of economic activity of the enterprise largely depend on the level of costs.

It is the rational, balanced and reasonable application of the diversification strategy that allows the company to obtain a number of additional benefits and competitive advantages. Economic practice confirms the expediency of creating diversified economic entities that would function as complex, multifaceted economic systems.

**Analysis of recent publications on the problem.** Well-known domestic and foreign scientists have made a significant contribution to the development of issues related to the mechanism of diversification of used resources, cost management system and methods of accounting for agricultural production costs in the management accounting system in small and medium business: F. Butynets [1], I. Belova [2], S. Holov [3],

O. Hutsaliuk [4], I. Davidovich [6], V. Len [7], I. Luka-va [8], N. Tkachenko [9], V. Farion [10], R. Zhovnovach [15] and some others.

**Allocation of previously unsolved parts of the general problem.** Despite the large number of scientific studies, the issues of improving the organizational and economic mechanism of diversification of resources used, regulation and optimization of agricultural production costs in the management accounting system of small and medium businesses remain uncertain. Therefore, there is a need for further in-depth study of theoretical and methodological developments aimed at determining methods of regulation and optimization of production costs in the management accounting of small and medium-sized businesses, which determines the relevance of the chosen topic. The purpose of the article is to study the issue of regulation and optimization of production costs in the management accounting system of small and medium business, expanding the concept of «costs», consider methods of accounting for production costs and emphasize the main points of management accounting of small and medium businesses.

**Formulation of research objectives (problem statement).** The purpose of writing this study is to identify areas for improving the mechanism of diversification of resource use and cost management in small and medium-sized businesses.

**An outline of the main results and their justification.** Trends in the development of the country's economy indicate the presence of motivational factors for the formation of diversification policy in the development of various sectors of the economy. The search for a mechanism to diversify the use of resources and cost management should determine the direction of restructuring of existing capacity, structural changes

based on reducing production costs, in order to select the most profitable option for the development of industries.

In order to effectively implement the diversification mechanism in the complex of agricultural enterprises, it is necessary to solve a number of micro- and macroeconomic problems. Particular attention should be paid to determining areas for improving the organizational and economic mechanism for diversification of resources used and cost management.

It should be noted that diversification is a form of production organization that characterizes the simultaneous development of different activities of small and medium-sized businesses. The emergence and development of diversification as a specific form of organization of production are due to the real level of production, the division of social labor. Diversification is an important factor that ensures significant stability of small and medium-sized enterprises, because it serves as a guarantor of the risks of reducing demand for one type of product. Adapting in this way to the conditions of uncertainty and ensuring the stability of enterprises in the external environment, diversification equalizes or minimizes deviations from equilibrium, gives the system a new look and a new property – summation.

Diversification of production performs a number of functions:

- First, it determines the movement of the current state of supply and demand in the direction of a new equilibrium, but at a different level.

- Secondly, the redistribution of capital and the implementation of new types of business activities objectively changes, or rather expands the area in which previously took place the circulation of funds of the enterprise.

- Third, diversification draws the company into a broader system of general circulation, covering the intertwined cycles of different independent parts of social capital as a set of circulations of capital.

Thus, the diversification of production, as one of the forms of concentration and redistribution of capital, creates the preconditions and direction of structural adjustment. Diversifying their production, companies penetrate into new industries and areas, expand the range of goods and gradually become multidisciplinary complexes. Therefore, diversification is nothing more than the desire of enterprises to survive in conditions of uneven economic development: the rapid growth of some industries and the stagnation of others.

The functioning of agricultural enterprises in modern economic conditions necessitates the improvement of both the production process and its management mechanism. In this case, the role of the main driving force in the information support of enterprise management and production and economic activities of modern agricultural enterprises in general, performs the system of management accounting.

According to the Law of Ukraine «On Accounting and Financial Reporting in Ukraine» management

accounting is a system of processing and preparation of information about the activities of the enterprise for internal users in the process of enterprise management [11]. In general, management accounting can be understood as the process of identifying, measuring, accumulating, analyzing, preparing, interpreting and transmitting information used by management to plan, evaluate and control within the enterprise.

Particularly acute is the issue of creating a system of accounting and cost control for the development of effective strategic management decisions in order to timely anticipate the occurrence of adverse situations and direct the activities of units of agricultural enterprises to achieve positive end results.

It should be noted that the costs of the enterprise are the main objects of management accounting, control of which belongs to the competence of the enterprise. Methodological principles of cost formation in accounting are determined by the Regulation (standard) of accounting 16 «Costs» [12].

This problem arises for enterprises whose activities constantly have a seasonal impact on the production processes and the formation of demand for products, in particular, agricultural enterprises, which have a decisive role in shaping the country's food security and export potential. Seasonality of agricultural production directly affects the intensity of use of financial, material and technical, labor, energy and other resources of the enterprise in certain periods of time during the calendar year. Taking into account the fact that agricultural enterprises are a proactive link in the real sector of the economy, the seasonal nature of production determines the parameters of the activities of industries that produce and maintain agricultural products, carry out harvesting, preservation, processing and sale of agricultural products [15].

The issue of building an optimal cost management system is important for any business entity, as well as for agricultural enterprises.

Today, the problem of defining the essence of the categories of «costs» is the subject of heated scientific debate. Based on the analysis of methodological provisions and economic literature, we can identify the main statements about the content of the concept of «costs» (table).

Thus, the creation of a scientifically sound system of costs due to the need to optimize the production process of livestock products, which includes the organization of production, its stimulation, control of operating costs, improving production relations in structural units, strengthening the analytical data of accounting registers for planning, forecasting and solutions. It is necessary to build a modern concept of costs for the production of livestock products in agricultural enterprises, which would take into account their industry specifics and meet the requirements of effective management.

**Scientific views on the definition of the essence of the category «costs»**

Author	Definition
V. S. Len [7]	Costs should be seen as effort, and net revenue as the result of that effort. Efforts are accumulated in inventories, work in progress, and their comparison with the results is possible only at the time of sale or signing a contract of sale. To compare the efforts and results, the cost of production is calculated
V. Ya. Farion [10]	The set of resources used in the process of the main and other ordinary activities, expressed in value terms, calculated according to the rules adopted in the industry and motivated by the purpose of profit, as well as reducing the company's liabilities to the budget, banks and other creditors
N. M. Tkachenko [9]	Costs as consumed in the production process means of production that embody past labor (raw materials, fuel, etc.) and means of labor (buildings, structures, machinery and equipment) in the form of depreciation, which transfer their value to the newly created product
S. F. Holov [3]	Costs are treated as a multifaceted category, and its definition in economic theory and for accounting purposes may differ significantly. Moreover, in management accounting in the classification of costs must be guided by the principle – «different costs for different purposes»
R. I. Zhovnovach [15]	In management accounting, only current expenses incurred in the reporting period are classified, and the costs of acquiring assets that will become current expenses in the future are not considered in the classification. They represent a separate aspect of management accounting and are reflected through the observation of the processes of capital investment and cash flows accumulated for the acquisition and formation of assets
I. M. Lukava [8]	To make current management decisions (management cycle - up to 1 year) costs can be divided into fixed and variable. The constants do not depend on the volume of output, and the variables depend, although this dependence is rarely strictly functional. Variable costs, pre-grouping them into proportional, progressive, degressive, regressive, stepped (hopping), stock and flexible. For making operational management decisions, the implementation cycle of which is from several hours to several days, the division of costs into fixed and variable is of no practical importance at all

In turn, for effective management accounting and information management needs in livestock enterprises, the classification of costs must be carried out on target requests, as it allows to distinguish from a wide range of classification features those features and types of costs that will not only solve the problem of tactical and strategic nature of the management of the agricultural enterprise, such as forecasting activities for the future, increasing the level of profitability of production and will have a direct impact on cost accounting, evaluation of finished livestock products and work in progress.

For many agricultural enterprises, animal husbandry is the leading industry. Recently, it is in crisis. Implementation of measures to increase livestock productivity depends, first of all, on the creation of an effective cost management system, namely: analysis of animal productivity; forecasting the optimal structure of the herd, livestock yield, optimal feeding rations in terms of groups of animals, production costs and livestock output; development of budgets for costs and output of livestock products; accounting for livestock, costs and output; accounting and distribution of overhead costs of livestock; control and analysis of the efficiency of livestock production, determination of deviations from the budgets of costs and output, identification of the causes and culprits of negative deviations; making management decisions to identify reserves and ways to reduce costs, improve production and quality of livestock products; material incentives for employees based on the results of control.

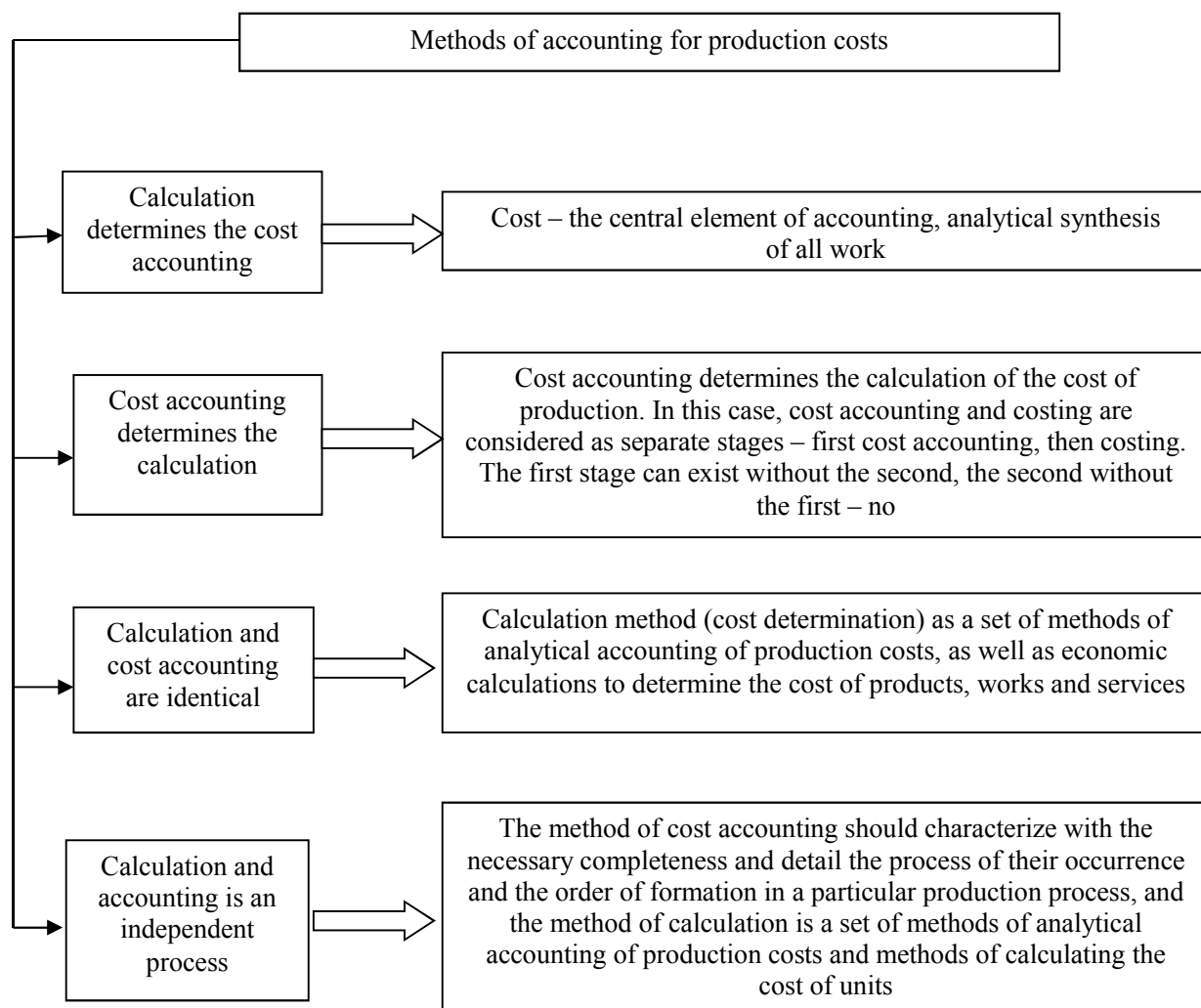
Significant influence on the cost accounting methodology is exerted by the organization and technology of production, types of gross and marketable products. These factors in most cases determine the choice of cost accounting methods.

The method of accounting in the practical sense is the use of various methods of processing the data, which are documented (observation, measurement, systematization and registration generalization), a set of techniques and methods that allow accounting to perform control, analytical and managerial tasks. The main methods of management accounting are the elements of the method of accounting.

The method of cost accounting is a reflection of the ways of grouping and systematizing information about the costs incurred in the process of achieving goals, ensuring the achievement of the goal. In turn, the method of calculation is a reflection of the distribution of costs of the enterprise according to the established items of calculation to determine the cost of certain types or groups of products (see figure).

It should be noted that for all agricultural enterprises is characterized by the allocation as objects of accounting of technological groups of animals by their species: the main herd of cattle; cattle for breeding and fattening; main herd of pigs; pigs on rearing; pigs for fattening; the main flock of sheep; sheep for breeding and fattening; adult flock of birds (if necessary – by species of birds); young birds, etc. Separate analytical accounts are opened for each such





**Figure. Approaches to understanding the methods of accounting for production costs of livestock products**

Source: generalized on the basis of [1; 2; 10].

group of animals, which reflect the costs of keeping animals and the output of livestock products.

Accounting for costs and output of livestock products in terms of each technological group of animals is conducted on a separate analytical account as part of sub-account 232 «Livestock» synthetic account 23 «Production». The debit of this account takes into account direct material, labor and other direct costs incurred in the production of livestock products, and the credit – output at fair value less expected costs at the point of sale, or at planned cost (if it is impossible to determine the fair value of the received products) [14].

According to Instruction № 291 [4], the costs accumulated on the debit of account 91 «General production costs» are debited monthly to accounts 23 «Production» and 90 «Cost of sales», distributed among the objects of cost accounting. Due to the peculiarity of agricultural production, which is the predominance of manual processing of accounting data and the complexity of calculations for the distribution of

overhead costs in practice overhead costs are not distributed monthly, but accumulate in account 91 and are distributed and written off at the end of the year [10]. Allocated overhead costs are debited to the cost items by correspondence: Debit 23 – Credit 91, the unallocated amount is debited to account 90 «Cost of sales».

Today, the article overhead costs is legally enshrined as a mandatory component of the production cost of production. Thus, the order of reflection of overhead costs in the cost of production is an element of the accounting policy of the enterprise. Therefore, there is no need to indicate this in the order of the accounting policy of the enterprise. In any case, this document should reflect only those principles, methods and procedures of accounting, the right to choose which is provided by accounting standards.

**Conclusions and perspectives of further research.** Based on the study, it can be stated that the improvement of the diversification mechanism should be defined as a set of methods and forms of management

activities aimed at identifying and rational use of the most profitable opportunities to achieve the goals. The management system of production diversification includes methods and procedures of analysis, planning and control, as well as feedback, which allows to improve the quality of management decisions.

It should be noted that in theory and practice there are a number of features for the classification of costs, which take into account various aspects of agricultural enterprises of small and medium-sized businesses, as well as form a variety of information for effective management decisions. Thus, experience and research show that the organization of management accounting

within specific agricultural enterprises, focused on meeting the specific information needs of the management system, will ensure its success in dynamic economic conditions and help solve a wide range of problems to optimize production costs of small and medium businesses.

Thus, further study of the formation of the system of accounting for production costs of small and medium-sized enterprises in the agricultural sector, able to generate information flows for management decisions, which requires a sound approach to determining the objects of accounting and costing, establishing their relationship and interdependence.

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**Мутерко Г. М., Гаврилов О. С., Рябка В. А. Розвиток механізму диверсифікації використаних ресурсів підприємствами агропромислового комплексу в стратегічній перспективі**

**Актуальність.** В умовах глобалізації світової економіки підприємства різних галузей, пов'язаної з взаємопроникненням технологій та капіталів, проводять диверсифікацію власної фінансово-господарської діяльності. Ефективність її здійснення безпосередньо залежить від своєчасної орієнтації на види товарів, робіт, послуг, які мають попит та є конкурентоспроможними. Все більшого значення набувають дослідження щодо конкурентоспроможності продукції різних галузей народного господарства. Виробництво конкурентної продукції та забезпечення стійкого становища підприємств малого та середнього бізнесу на сільськогосподарському ринку потребує зміни методів витрат виробництва продукції шляхом створення на підприємствах досконалої системи управлінського обліку, що дозволяє забезпечити внутрішніх користувачів інформацією для ефективного управління. Адже рівень конкурентної продукції та результати від господарської діяльності підприємства багато в чому залежать від рівня витрат.

**Мета та завдання.** Метою написання даного дослідження є визначення напрямів щодо удосконалення механізму диверсифікації використання ресурсів та управління витратами виробництва в малому та середньому бізнесі.

**Результати.** Для ефективного впровадження механізму диверсифікації в комплексі сільськогосподарських підприємств необхідно вирішувати низку проблем мікро- та макроекономічного характеру. На особливу увагу заслуговує визначення напрямків удосконалення організаційно-економічного механізму диверсифікації використаних ресурсів та управління витратами виробництва.

Досліджена сфера сільського господарства як тваринництво, яка залишається однією з основних галузей сільського господарства малого та середнього бізнесу, стосовно виробництва конкурентоспроможної продукції. Незважаючи на велику кількість наукових досліджень, питання регулювання та оптимізації витрат на виробництво тваринництва в системі управлінського обліку залишаються незрозумілими. Поглиблено вивчено теоретико-методологічні розробки, спрямовані на визначення методів регулювання та оптимізації витрат на виробництво тваринництва в системі обліку управління, що визначає актуальність обраної теми.

Розглянуто регулювання та оптимізації витрат на виробництво тваринництва в системі обліку управління, розширення поняття «витрати», розглядаються методи обліку витрат на тваринництво та наголошуються основні моменти обліку витрат у виробництві.

Виробництво конкурентоспроможної продукції та забезпечення стабільної позиції підприємств на сільськогосподарському ринку вимагає зміни собівартості продукції тваринництва шляхом створення досконалої системи обліку управління, яка дозволяє надавати внутрішнім користувачам інформацію для ефективного управління.

Зазначено, що в теорії та практиці існує ряд особливостей класифікації витрат, які враховують різні аспекти сільськогосподарського підприємства та формують різноманітну інформацію для ефективних управлінських рішень. Таким чином, досвід та дослідження показують, що організація управлінського обліку в межах конкретного сільськогосподарського підприємства, орієнтована на задоволення конкретних інформаційних потреб системи управління, забезпечить його успіх у

динамічних економічних умовах та допоможе вирішити широке коло проблем для оптимізації виробництва тваринництва витрати.

**Висновки.** На підставі проведеного дослідження можна констатувати, що удосконалення механізму диверсифікації варто визначати як сукупність методів і форм управлінської діяльності, спрямованих на виявлення і раціональне використання найбільш вигідних можливостей для досягнення поставлених цілей. Система управління диверсифікацією виробництва містить у собі методи і процедури аналізу, планування й контролю, а також зворотні зв'язки, що дає змогу підвищити якість управлінських рішень.

Сформовано подальші дослідження щодо формування системи обліку собівартості продукції тваринництва, здатної генерувати інформаційні потоки для управлінських рішень, що вимагає обґрунтованого підходу до визначення об'єктів обліку та калькулювання витрат, встановлення їх взаємозв'язку та взаємозалежності.

*Ключові слова:* диверсифікація ресурсів, розвиток, виробництво продукції, витрати, калькулювання, підприємства АПК, стратегічні перспективи.

### **Muterko H., Havrylov O., Riabka V. Development of the Mechanism of Diversification of Resources Used by Enterprises of the Agricultural Complex in a Strategic Perspective**

**Topicality.** In the context of globalization of the world economy, enterprises of different industries, associated with the interpenetration of technology and capital, are diversifying their financial and economic activities. The effectiveness of its implementation directly depends on the timely focus on the types of goods, works, services that are in demand and competitive. Research on the competitiveness of products of various sectors of the economy is becoming increasingly important. The production of competitive products and ensuring the sustainable position of small and medium-sized enterprises in the agricultural market requires a change in production costs by creating a perfect management accounting system, which provides internal users with information for effective management. After all, the level of competitive products and the results of economic activity of the enterprise largely depend on the level of costs.

**Aim and tasks.** The purpose of writing this study is to identify areas for improving the mechanism of diversification of resource use and cost management in small and medium-sized businesses.

**Research results.** In order to effectively implement the diversification mechanism in the complex of agricultural enterprises, it is necessary to solve a number of micro- and macroeconomic problems. Particular attention should be paid to determining areas for improving the organizational and economic mechanism for diversification of resources used and cost management.

The sphere of agriculture as animal husbandry, which remains one of the main branches of agriculture of small and medium business, in relation to the production of competitive products, is studied. Despite the large amount of research, the issues of regulation and optimization of livestock production costs in the management accounting system remain unclear. Theoretical and methodological developments aimed at determining the methods of regulation and optimization of costs for livestock production in the management accounting system, which determines the relevance of the selected topic.

The regulation and optimization of costs for livestock production in the management accounting system, the expansion of the concept of «costs», methods of accounting for livestock costs and the main points of cost accounting in production.

The production of competitive products and ensuring a stable position of enterprises in the agricultural market requires a change in the cost of livestock products by creating a perfect management accounting system that allows internal users to provide information for effective management.

It is noted that in theory and practice there are a number of features of the classification of costs, which take into account various aspects of the agricultural enterprise and form a variety of information for effective management decisions. Thus, experience and research show that the organization of management accounting within a particular agricultural enterprise, focused on meeting the specific information needs of the management system, will ensure its success in dynamic economic conditions and help solve a wide range of problems to optimize livestock production costs.

**Conclusions.** Based on the study, it can be stated that the improvement of the diversification mechanism should be defined as a set of methods and forms of management activities aimed at identifying and rational use of the most profitable opportunities to achieve the goals. The management system of production diversification includes methods and procedures of analysis, planning and control, as well as feedback, which allows to improve the quality of management decisions.

Further research has been formed on the formation of a system of accounting for the cost of livestock products, capable of generating information flows for management decisions, which requires a sound approach to determining the objects of accounting and costing, establishing their relationship and interdependence.

*Keywords:* resource diversification, development, production, costs, costing, agribusiness enterprises, strategic perspectives.

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## TRANSFORMATIONAL PROCESSES OF LOGISTICS ACTIVITIES OF CORPORATE ENTERPRISES IN INTEGRATION WITH THE DIGITAL ECONOMY

**Introduction.** Modern economic conditions encourage corporate enterprises to strengthen their positions in the market environment of enterprises. Almost any line of business today is characterized by a high level of competition. In order for companies to be competitive, they must intensify investment processes. An important role in the above-mentioned processes is played by investment attractiveness, which is a catalyst for the expansion of corporate enterprises. These opportunities must meet the conditions of investors. For corporate enterprises, one of the priority tasks of improving investment activities is the search for potential investors and providing them with information about the feasibility of investing.

Determining the level of one's own investment attractiveness is not the ultimate goal of an investment-seeking enterprise. It is necessary to develop and implement measures to increase investment attractiveness, which are aimed at attracting new investors and improving investment conditions. If there are better prospects for the development of the enterprise, then investors will be ready to invest even more funds in the enterprise.

Among the factors and reserves of increasing investment attractiveness, we have identified and studied in detail four groups: financial and economic, social, informational and environmental.

Issues of sustainability of transport and logistics enterprises, development and implementation of innovations, use of investments are becoming more and more relevant. However, globalization processes, the orientation of society and the governments of developed countries to solving the issues of transport infrastructure actualize the research of problematic aspects and

prospects for the introduction of innovations and investment of enterprises.

The purpose of the study is to determine the transformational processes of the logistics activities of corporate enterprises.

**Theoretical framework.** Determining the level of one's own investment attractiveness is not the ultimate goal for corporate enterprises seeking investment. It is necessary to develop and implement measures to increase investment attractiveness aimed at attracting new investors and improving investment conditions. If there are better prospects for the development of a corporate enterprise, then investors will willingly invest.

An increase in investment attractiveness can result from direct improvements in productivity, such as increased working capital through debt reduction, and indirect, such as increased staff motivation, which ultimately leads to improved financial performance. But the relationship between such factors and financial ratios is much more difficult to trace.

Among the active factors and reserves for increasing investment attractiveness, we identified and studied in detail four groups: financial and economic, which directly affect the level of attractiveness of the enterprise, and three groups of factors: social, informational (fig. 1).

Fixed assets are used in a variety of ways. It is directly determined by the ratio of the dynamics of equipment prices to labor productivity; liquidation value of fixed assets; equipment quality; cost structures of fixed assets, aging structures; the level of material and technical support and components; the degree of participation of new modern equipment, the level of loading of equipment in the production process, the term and interval of maintenance of fixed assets, etc.



**Fig. 1. Factors of increasing friendliness, innovativeness and investment attractiveness**

Source: compiled by the authors [1; 3].

Reducing the working capital cycle is achieved primarily by reducing the time spent on accounts receivable, current accounts and the cash register. It is also important to monitor the timely transfer of working capital from the sphere of circulation to the sphere of production and vice versa.

A certain degree of liquidity of the company's assets is always present, but potential investors are interested so that if there is an immediate need, they could get the invested funds as soon as possible. If all the assets of the enterprise consist of cash, ie are absolutely liquid, the possibility of immediate return of funds to their depositors is resolved. However, the implementation of the maintenance process and, as a consequence, the increase in value added is impossible. Therefore, in the process of increasing liquidity, its measure is very important. Quantitatively, this is achieved by complying with the established limits of liquidity.

Analyzing financial stability, usually consider its main characteristic, namely the ratio of own and borrowed funds. Thus, in the US the ratio of 70% of equity and 30% of loan capital is considered optimal, in Europe – 50% to 50%, the Japanese model considers optimal to have only 20 – 30% of equity in total capital, emphasizing that the most efficient companies who enjoy the trust of banks – the main investors in the country. We usually recommend a share of 60-70% of equity. Finding this indicator within the specified limits indicates complete independence from creditors, along with the effective use of borrowed funds.

In the presence of profit, its effective use is the key to the high popularity of the company among potential investors. Thus, for joint-stock companies, the stable payment of dividends is a very important characteristic, as it allows to have a high level of the company's stock potential. However, an increase in dividends leads to a decrease in self-financing of the enterprise, which in the

future may become an obstacle to further income growth.

The influence of another economic factor on the company's investment feasibility – marketing activity – is a rather significant problem. Stimulation of the wide provision of services through the appropriate advertising policy of motor vehicle services in various market segments, which will allow the enterprise to significantly increase all indicators.

No less important is the factor of improving the efficiency of pricing management for the services of a trucking company.

A separate factor in increasing the investment attractiveness of the enterprise is the availability of adequate information on prices for raw materials and components. Therefore, it is necessary to form special institutions on the market, the main activity of which would be monitoring. They will be able to give trucking companies the opportunity to get accurate information about prices in the market of trucking services and choose the best option.

**Methodology.** The theory of fractal analysis is most often used to forecast the state of the markets. The application of this technique is based on the cyclic nature of market processes, when the development process does not develop linearly, but has a cyclical repetitive nature [4].

In the study, it is proposed to use the R/S analysis method (normalized swing method) for fractal analysis. As a result, the fractality of the dynamic series will be calculated and the hypothesis about the possibility of forecasting the indicator will be confirmed or rejected, and mathematical methods of forecasting will be determined. The factor analysis algorithm for the development of monetary, economic and social investment results is reflected in the following formulas, namely [4]:

Calculation of root mean square deviation according to formula 1:

$$S = \sqrt{\frac{1}{n} \sum (x_i - x)^2}. \quad (1)$$

Calculation of the range of variation according to formula 2:

$$R = X_{\max} - X_{\min}. \quad (2)$$

Determination of the Hurst index according to formula 3:

$$H = \frac{\log(R/S)}{\log(n\pi/2)}. \quad (3)$$

Calculation of the indicator of fractal dimension according to the formula  $D = 2 - H$  and its analysis in order to determine the dynamics of this function under different conditions:

1. The trend nature of the dynamics – the indicator maintains an upward or downward trend (that is, growth in the current period means growth in the future). Determination of the indicator trend equation and use of the trend extrapolation method:

$$D < 1.33; \\ 0.68 < H < 1.$$

2. The anti-persistent nature of the dynamics – the indicator changes the trend of growth or decline to the opposite (that is, growth in the current period means a decrease in future ones). There is no regularity of dynamics and forecasting is impossible:

$$1.5 < D < 2; \\ 0 < H < 0.35.$$

3. The random nature of the dynamics – the indicator does not have an upward trend:

$$1.33 < D < 1.65; \\ 0.35 < H < 0.67.$$

Determination of the distribution law based on the analysis of the value of the virtual volume NF:

$$NF = \left(\frac{R}{S}\right)^2 \quad (4)$$

When using this method of analyzing the dynamics of development factors of oriented entrepreneurship, the following designations should be taken into account:

$X_i$  – the value of the indicator predicted in the  $i$ -th year;  $X$  – the average value of the predicted indicator;  $n$  – size of the dynamic series;

If  $NF = 4$ , then the indicator is distributed according to the bimodal law, if  $NF = 8$  – according to arcsine, if  $NF = 12$  – according to uniform, if  $NF = 21$  – according to Simpson's law, if  $NF = 28$  – according to Rayleigh's law, if  $NF = 32$  – by normal, if  $NF = 36$  – by Laplace's law, if  $NF = 42$  – by exponential distribution law.

Summarizing the results of the above, the procedure for analyzing the dynamics of indicators characterizing the state and readiness for activation of the development of transport entrepreneurship should be carried out with the help of analysis and economic interpretation of the nature and peculiarities of the dynamics of the relevant indicators using regression analysis methods (to construct a high-order polynomial trend function) and its differentiation, as well as analysis

of the fractality of the dynamic series of the indicator and decision-making regarding the possibility and methods of forecasting. The Hurst coefficient can be interpreted as the probability that after the growth of the studied indicator, its further increase will continue.

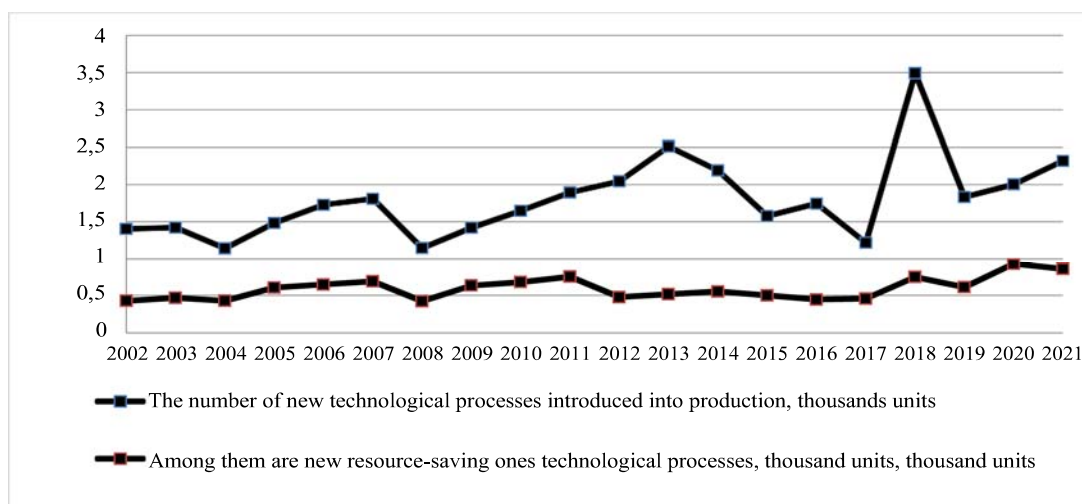
An important factor affecting the competitiveness of corporate transport companies is quality improvement. This requirement involves not only improving the quality of the services provided, but also their compliance with international quality standards. The presence of a large number of quality requirements significantly increases the costs associated with the provision of services and their testing, which allows you to enter international markets at the price of world-class services.

Social factors and reserves of increasing investment attractiveness include the implementation of effective models of high-performance motivation, progressive forms of salary incentives, incentives and compensation payments, which ultimately lead to the improvement of the financial and economic activity of the enterprise. Their influence is monitored when calculating the investment attractiveness rating and is reflected in its final value.

**Results.** With the growth of global economic problems, there is a growing interest in innovations that can be implemented in enterprises. Such innovations are able not only to ensure social and economic responsibility in the field of business, but also to provide enterprises with competitive advantages. Transport innovations implemented in companies give them competitive advantages. The culture of consumption and the principles of sustainable development form new approaches to the functioning of transport and logistics enterprises of the economy. In confirmation of the above, starting from 2018, the number of resource-saving technological processes implemented at enterprises, albeit slightly, is increasing (fig. 2). This indicates the intensification of the processes of awareness of the need for changes under the influence of limited resources, improvement of pollution control, updating of technical and technological support of enterprises with emerging technologies.

Among the innovative components of the formation of the investment attractiveness of corporate enterprises, it is worth highlighting innovations in the spheres of activity of the transport enterprise. First of all, these are innovations in the production activity of the enterprise. The next group should include innovations in changing the composition of products, namely the creation of products from environmentally friendly materials or secondary raw materials.

When considering the information flows of the enterprise, they should not be considered as a closed system. What is most required is not only a good education, but also his vigilance and purposefulness. Within the framework of the country's economy, the most necessary measures are the simplification of relations with the tax administration, the transition to exclusively electronic settlements with counterparties.



**Fig. 2. Number of implemented new technological processes at enterprises of Ukraine, thousands of units**

Source: compiled by the authors [9].

The increase in the level of management of investment activities of corporate enterprises is the result of the creation of a mechanism for identifying and optimally using reserves to increase investment attractiveness. The simultaneous use of all reserves to increase investment attractiveness is practically impossible, primarily due to the lack of funds, qualified specialists, the full range of information necessary for the implementation of relevant measures. Practice proves the ineffectiveness of dispersing efforts in many areas of investment activity. Everything should be focused on individual, most important investment projects. This requires the development of specific recommendations for identifying the most influential aspects, measuring the degree of influence and final consequences.

It is proposed to increase investment attractiveness in stages (fig. 3).

At the first stage, the actual value of the investment attractiveness of the potential recipient company is assessed.

The second stage involves determining the list of factors and reserves for the growth of investment attractiveness of corporate enterprises in accordance with the organizational and legal form of the enterprise, the field of activity and specific business conditions.

At the third stage, the significance of certain specific factors for increasing the investment attractiveness of the enterprise in the conditions is assessed. Among the identified factors and reserves for the growth of investment attractiveness, those that do not require significant capital investments and do not require a large expenditure of time are selected first of all in the following stages. Below are the measures that should potentially have the greatest impact, but involve significant costs and a large loss of time.

The fourth stage is related to the formation of a specific set of measures to increase investment attractiveness.

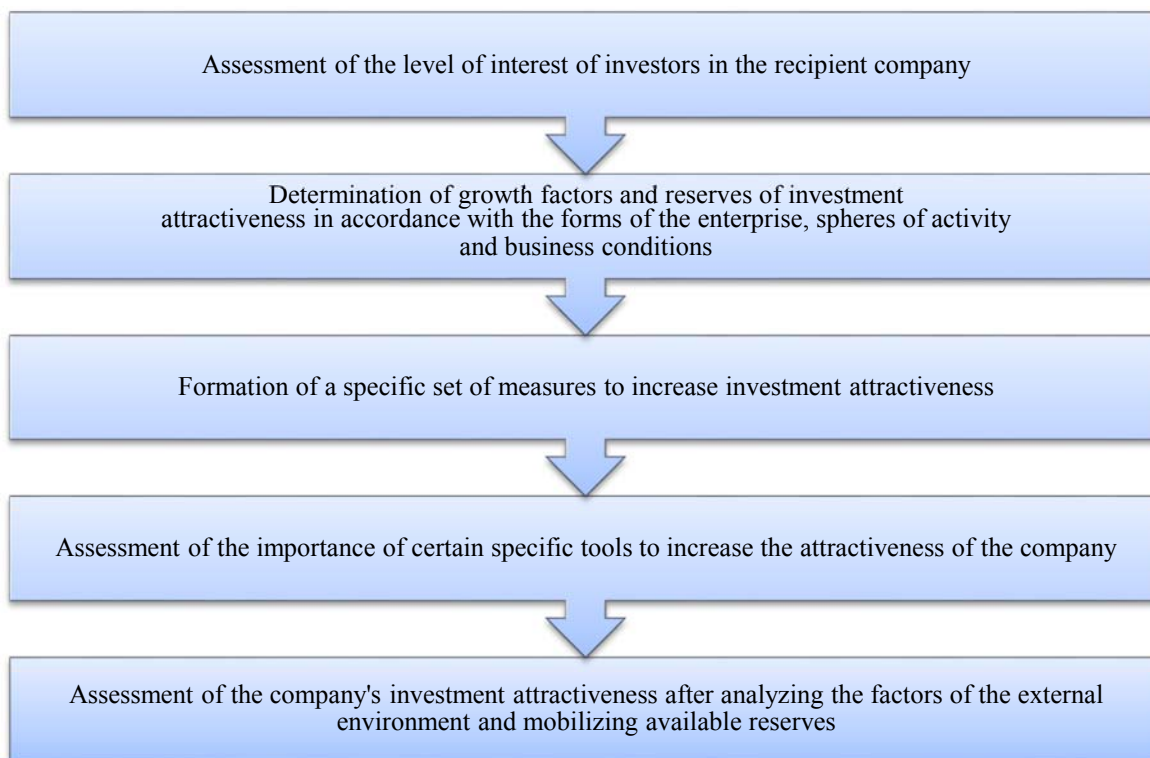
At the fifth stage, the investment attractiveness of the corporate enterprise is assessed after the influence of certain factors and the mobilization of available reserves. The evaluation should be carried out according to the same methodology as in the first stage. This allows you to monitor the effect of taking appropriate measures. The use of reserves to increase investment attractiveness leads to a change in financial ratios, the value of which, in turn, is reflected in the general indicator of the attractiveness of a corporate enterprise. After the implementation of these measures to increase investment attractiveness, if they are effective, the enterprise will receive a higher rating than at the first stage.

The investment favorability of the enterprise largely depends on the creation of a strategy related to the realization of its investment potential in the future, as well as ensuring compliance with the general strategy of financial and economic development and the main goals of the enterprise. enterprises. The investment strategy should be formed with a focus on existing and potential financial, organizational, personnel, technological, raw material, energy and other resources that are at the disposal of the enterprise and that can be attracted on favorable terms.

The determining factors of investment activity include: economic growth rates, investment growth rates, efficiency and institutional security of mechanisms for regulating oriented investment processes, the state of the market for investment resources, the investment climate and the country's investment attractiveness. country, regions, quality of labor force, political and legal stability, state of property rights protection and insurance, various types of risks, including development of investment infrastructure, level of risks, etc.

The importance of forming an investment activity strategy is:





**Fig. 3. Stages of increasing the level of investment attractiveness**

Source: compiled by the authors [2; 7].

– activation of the targeted investment process and growth of the economic effect of investments;

– ensuring the implementation of the long-term goal of achieving balanced development based on the identification of investment priorities for the most urgent environmental problems;

– creation of a regime of stimulation of various types of targeted investments;

– strengthening the innovative orientation of economic investments;

– increasing the resource security of the country and economic systems due to the coordination of strategic and tactical actions and prediction, forecasting of long-term consequences and results of investments;

– establishment of inter-level relationships between the course of investment processes aimed at reproduction of capital and provision of resource security at all levels.

Among the principles of the strategy of investment activity, we highlight the following:

– hierarchies of interconnection of the developed strategy at the macro-, meso- and micro-levels;

– consistency and complexity of strategy formation and its stages;

– focus on long-term goals of sustainable development and achieving global efficiency;

– reasonableness and multivariate choice;

– evolutionary, which includes a system of elements and includes constant growth of the potential and result of investment processes.

The basis of developing a strategy for the investment activity of transport enterprises is the

definition of the mission (goals, tasks), the structure of production and economic activity and the general strategy of the economic development of the enterprise [8]. The diagram of the investment genesis strategy of the motor vehicle industry is presented in fig. 4.

Subordination to economic imperatives requires the creation of a strategy of investment activity that combines its main components: principles of development, definition of goals and objectives, priorities, mechanisms for achieving set goals, control, diagnosis and evaluation of implementation results. The development of the capital investment strategy of corporate enterprises should be coordinated from a single center and be distinguished by a strong integration potential in relation to different hierarchical levels of implementation (at the macro level – state strategy, at the meso level – regional, at the micro level – regional), level – the strategy of individual corporations and enterprises) and short-term practical and tactical actions.

The main principles of forming the investment strategy of transport corporate enterprises should be [5]:

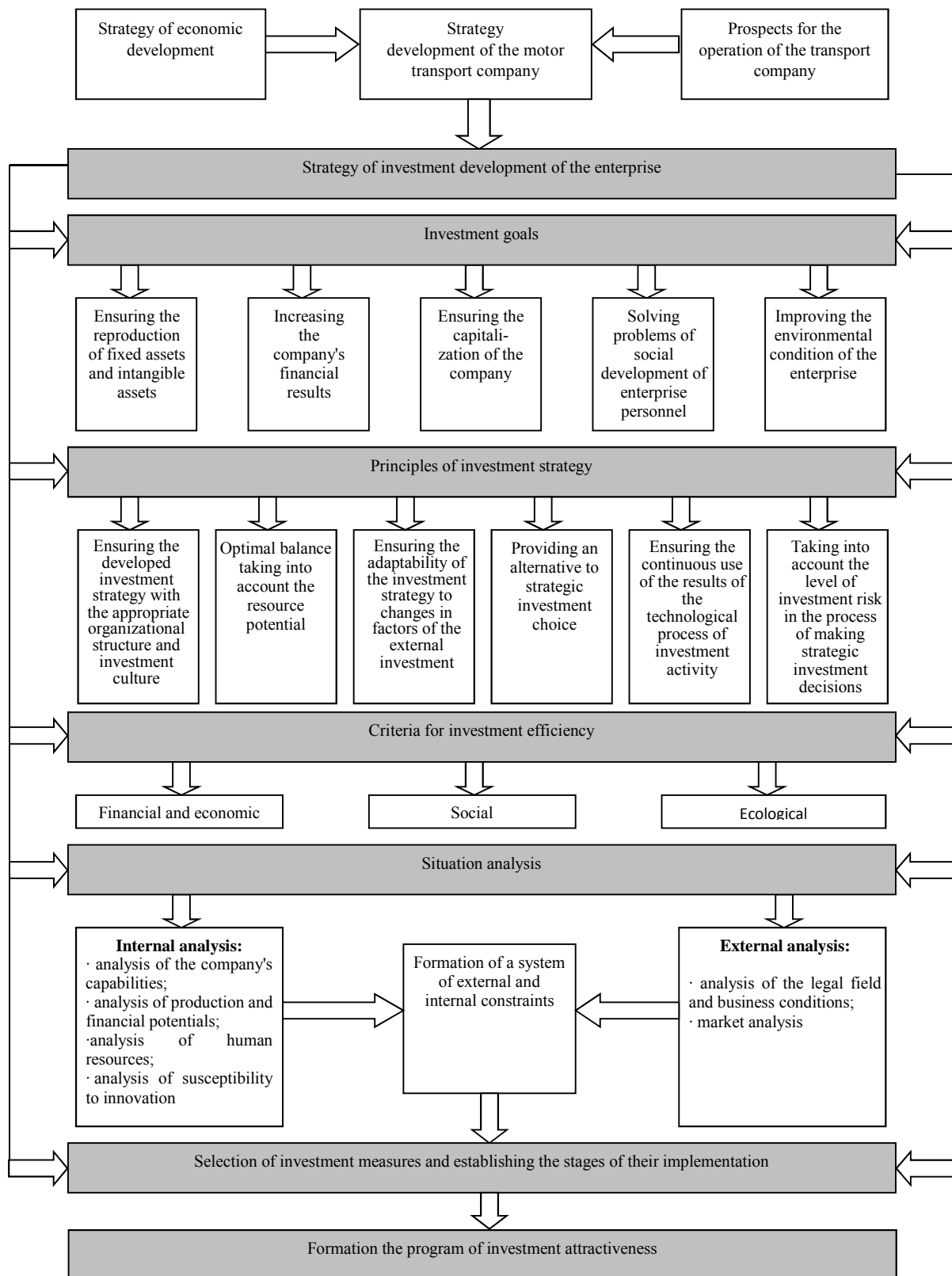
– consideration of the enterprise as an open system capable of self-regulation;

– taking into account the main strategies of the enterprise's operational activity;

– predominant focus on the entrepreneurial style of strategic management of investment activities;

– coverage of all levels of management of the enterprise's investment activities;

– adaptation of the investment strategy to changes in environmental factors;



**Fig. 4. Creation of strategy for the investment genesis of a transport company**

Source: author's development.

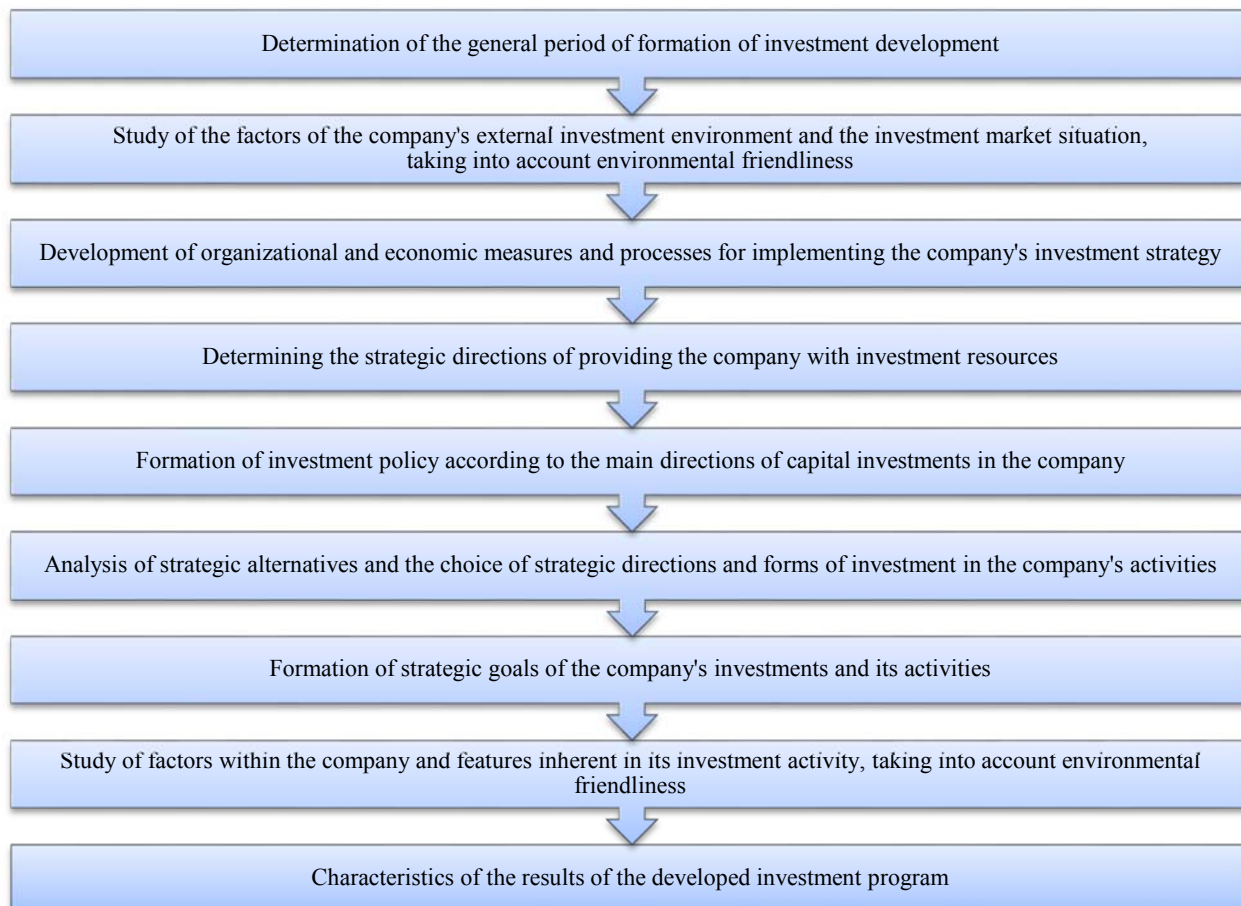
- provision of alternative options for strategic investment;
- taking into account the level of investment risk in the process of making strategic investment decisions;

- focus on the professionalism of the company's investment managers in the process of implementing the company's investment strategy.

The development of the strategy of investment activities of transport enterprises is carried out in stages (fig. 5).

In the process of forming the investment perspective of a corporate enterprise, the existing system of goals of the overall economic development strategy should be taken into account (for example, capital growth, a change in the ratio of real and financial

investments, a change in sectoral and regional focus, etc. investments programs). At the same time, one should proceed from the statement that the level of development and dynamism of investment processes in modern conditions constitute the strategic basis of sustainable economic growth. And the policy of sustainable economic growth should replace the existing policy of growth of a predominantly restorative nature.



**Fig. 5. The sequence of developing a strategy for investment activities of transport enterprises**

Source: author's development.

The main strategies include strategies aimed primarily at the introduction of innovations to reduce production risks, the strategy of responsibility for the consequences of investment activities for society, nature, etc.

Undoubtedly, the strategy of investment development of motor transport enterprises should be focused on strengthening the innovative component and increasing labor productivity [6].

The intensive development of investment activities and the increase of competitiveness of domestic product manufacturers is an extremely urgent task, since its solution contributes to the entry of Ukraine into the world product markets and the creation of currency reserves necessary for the modernization of production. This increases interest in developing a strategy for investment and innovation activities and economic growth.

The defining provisions of an effective state investment policy the strategy of investment activity are the following:

- the basis for determining the amount of direct public investment should be the demand for transport services both in the current period and in the long run;
- in conditions of acute limited resources, selective support should be carried out on the basis of the choice of individual objects of investment direction;
- each priority area should be implemented in public investment programs, because one of the factors increasing the investment potential of economic development is the centralization of public funds in the budget;
- the strategy of investment activities should have a clear legislative support.

An urgent issue today is the development and adoption of a new program to stimulate investment in

the economy of Ukraine, which will determine the directions for the country's economy to exit the investment crisis and intensify investment activity. This document should provide the prerequisites for increasing the volume of investment and tasks to stimulate them, areas of state support for investment activities and organizational and legal mechanism of investment [10].

The main principles of successful implementation of the investment strategy should be:

- increase in the volume of capital investments of enterprises due to profit and depreciation;
- improvement of credit principles of investment financing;
- increase in the amount of investment resources formed on the stock market due to the savings of the population;
- introduction of an economic mechanism for investment risk insurance;
- ensuring the stability of legislation governing the investment regime.

Before choosing an investment strategy for the enterprise, it is necessary to form a set of alternative strategies and conduct a thorough analysis. Within the chosen basic strategy, several areas of action are possible, which are called strategic alternatives.

Basic strategies in investment management can be formed in relation to this branch of management as a whole, or in relation to any of its subsystems (real or financial investments). The most well-known basic strategies: growth, stabilization, reduction (crisis).

When stabilizing, the main strategic priorities are the desire to reduce costs, to the stability of external and internal support.

During the crisis (reduction) the main strategic priorities are the restructuring of the existing investment management system, reducing the intensity of investment, redistribution of investment resources.

In the end, the development of the investment strategy of the motor vehicle enterprise should be aimed at ensuring the stability and reliability of its production and economic activity, improving the quality and increasing the volume of transportation, expanding the types of transport services.

The development of an investment strategy the motor vehicle enterprise is considered as an integral part of the planning system of its activities in the current and long-term periods. In this regard, considerable attention should be paid to the use of some types of financial planning, control - budgeting. Capital budgeting itself involves planning an enterprise's investment in fixed and current assets to ensure that the return on those investments is estimated over the long term, that is, over several years. Each element of capital budgeting should be designed as a separate investment project, for which a cash flow forecast is made. The conclusion on the feasibility of investment is made on the basis of comparing the volume of investment and projected cash flows, taking into account the cost of capital that is planned to raise to finance investments [5].

In general, the initial components of investment planning are the search and formation of investment options, determining the relative and absolute size of their profitability, establishing funding opportunities from various sources, assessing the reliability of implementation and success of a particular investment option. To solve such complex, and sometimes uncharacteristic of management problems, it is advisable to involve research and consulting firms or temporarily hire scientists in this field of scientific and practical knowledge. The correctness of the adopted scientific and technical decisions is confirmed by the favorable impact of investment on the quality of transport services, expanding their range, increasing the profits of truckers.

The company determines the volume and direction of investment, the limits of expansion of its activities, the principles and conditions of investment, the line of conduct in the investment market in connection with possible changes in the economic situation in the country and regions.

The strategy of investment activity and attractiveness is developed on the basis of the established investment policy of the enterprise, the essence and direction of which is to choose the most rational ways of preserving and expanding the production potential. Therefore, the following should be highlighted as its main provisions [6-8]:

- achievement of economic, scientific-technical and social effect of investment;
- application for each investment object of specific methods of efficiency assessment, based on the results of which the selection and implementation of investment projects that ensure maximum efficiency of the enterprise;
- the company receives the largest return on invested capital;
- the company's use of state support for the efficiency of the use of investments in the form of budget appropriations;
- ensuring the minimization of risks of investment projects. Protection of projects from non-commercial risks by providing state guarantees and investment insurance;
- ensuring the liquidity of investments. This provision should be followed when the external investment environment changes. Due to this, the profitability of individual investment objects can significantly decrease, which will negatively affect the investment attractiveness of the company.

When creating a strategy the investment activity of a transport company, it is necessary to pay attention to the following factors:

- technical level of production;
- the impact of the company's activities on the environment;
- the company has both its own financial resources and the ability to raise loans in the form of loans and borrowings;
- financial conditions for investing in the capital market;



– commercial and budgetary efficiency of investment projects to be implemented;  
– conditions of insurance and obtaining appropriate guarantees against non-commercial risks.

Successful implementation of the directions of the company's investment operation strategy is possible under the condition of supporting the intellectual potential of investment activity, stimulating the increase of its creative return, establishing criteria for choosing the most effective strategies, the formation of an economic mechanism that would make the process of implementing scientific and technical progress vital and profitable. Therefore, there is a need in society for the development of investment activities as part of the general plan for the balanced genesis of motor transport companies.

The infrastructure sector is important in shortening the duration of the investment cycle and increasing its efficiency. From these positions it is necessary to strengthen the repair and maintenance base of motor transport enterprises, the system of production and technological equipment, warehousing and other production services.

**Conclusion.** Considerable attention should be paid to the development of social and domestic infrastructure: housing construction, children's out-of-school institutions, clubs, sanatoriums. All this will create the necessary conditions for the stabilization of

labor collectives of road transport enterprises and will increase the efficiency of their work.

Therefore, based on the above, it is safe to say that the investment strategy of trucking companies is one of the most important components of strategic management and is to develop a system of measures that are mutually consistent in time, resources and performers and aimed at making a profit through investment in the most promising, from the standpoint of market conditions, areas of transport enterprises.

Strategic development of investment activities in the field of road transport should focus on creating a highly efficient socially oriented and receptive to STP economy, ensuring a high quality of life of the population of Ukraine, effective motivation for entrepreneurship, strengthening equal partnerships in global economic communication.

Implementation of innovations and investments is a tool for solving economic problems of domestic transport enterprises. The choice of such development will enable them, first of all, to ensure the capacity for sustainable development, to increase competitiveness not only in the domestic market, but also in the markets of other countries. Implementation of such sustainability of innovations and investments will improve the economic status of corporate associations of the transport industry, both high-tech and low-tech, providing potential opportunities for increasing economic indicators.

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### Гуцалюк О. М., Бондар Ю. А., Кравченко М. С. Трансформаційні процеси логістичної діяльності корпоративних підприємств в інтеграції до цифрової економіки

Стаття присвячена визначенню трансформаційним процесам логістичної діяльності корпоративних підприємств. Визначено фінансово-економічні фактори підвищення інвестиційної привабливості транспортно-логістичних підприємств корпоративних об'єднань. Обґрунтовано підхід до оцінки ефективності інноваційної діяльності на транспорті, використання якого дозволило встановити стан процесів регулювання у цій сфері, системи підтримки прийняття рішень та цілепокладання, інституційного забезпечення запропоновано розвиток міжнародної транспортно-логістичної інфраструктури.

Визначено стан транспортної безпеки регіонів, запропоновано організаційну модель Національного інноваційного транспортного ХАБу та підхід до оцінки його функціонування. Надано пропозиції щодо діагностики інвестиційної привабливості об'єктів транспортної інфраструктури, відбору пріоритетних проектів для державного фінансування та формування моделей державно-приватного партнерства для інноваційного розвитку транспортної інфраструктури. Розробляється інвестиційна стратегія, яка розробляється на основі сформованої інвестиційної політики підприємства, суть і спрямованість якої полягає у виборі найбільш раціональних шляхів збереження та розширення виробничого потенціалу.

Слід зазначити, що інвестиційна стратегія транспортних підприємств є однією з найважливіших складових стратегічного управління і полягає в розробці системи заходів, узгоджених за часом, ресурсами та виконавцями і спрямованих на отримання прибутку шляхом інвестування в найбільш перспективні, з точки зору ринкової кон'юнктури, сфери діяльності транспортних підприємств та є інструментом вирішення економічних проблем вітчизняних транспортних підприємств є впровадження інновацій та інвестицій. Визначено, що реалізація такої стійкості інновацій та інвестицій дозволить підвищити економічний стан корпоративних об'єднань транспортної галузі, як високотехнологічних, так і низькотехнологічних, надаючи потенційні можливості для підвищення економічних показників.

*Ключові слова:* логістична діяльність, трансформація, корпоративні підприємства, інтеграція, цифрова економіка.

### Hutsaliuk O., Bondar Iu., Kravchenko M. Transformational Processes of Logistics Activities of Corporate Enterprises in Integration with the Digital Economy

The article is devoted to defining the transformational processes of logistics activities of corporate enterprises. The financial and economic factors of increasing the investment attractiveness of transport and logistics enterprises of corporate associations are determined. The approach to evaluating the effectiveness of innovative activities in transport is substantiated, the use of which made it possible to establish the state of regulatory processes in this area, the system of support for decision-making and goal setting, institutional support, and the development of international transport and logistics infrastructure is proposed.

The state of transport security in the regions is determined, the organizational model of the National Innovative Transport Hub and an approach to assessing its functioning are proposed. Proposals are provided for diagnosing the investment attractiveness of transport infrastructure objects, selecting priority projects for state funding and forming public-private partnership models for the innovative development of transport infrastructure. An investment strategy is being developed, which is developed on the basis of the formed investment policy of the enterprise, the essence and direction of which is to choose the most rational ways of preserving and expanding the production potential.

It should be noted that the investment strategy of transport enterprises is one of the most important components of strategic management and consists in the development of a system of measures coordinated in terms of time, resources and performers and aimed at obtaining profit by investing in the most promising, from the point of view of the market situation, spheres of activity of transport enterprises and is a tool for solving the economic problems of domestic transport enterprises is the introduction of innovations and investments. It was determined that the implementation of such sustainability of innovations and investments will improve the economic status of corporate associations of the transport industry, both high-tech and low-tech, providing potential opportunities for increasing economic indicators.

*Keywords:* logistics activity, transformation, corporate enterprises, integration, digital economy.



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## THEORETICAL AND APPLIED PRINCIPLES OF STRATEGIC MANAGEMENT OF COMPETITIVE ADVANTAGES OF ENTERPRISES IN THE CONTEXT OF DIGITALIZATION

**Problem statement.** Given the extremely high level of instability of the domestic economy provoked initially by the pandemic, its consequences, prolonged and intensified by Russia's full-scale invasion, the consequences of a protracted war, the dynamism of socio-economic, political, and other processes has a rather negative impact on the activities, development, and participation in the competitive struggle of domestic enterprises.

The management of domestic enterprises is simply forced to make decisions under conditions of critical uncertainty, in the absence of practical experience in wartime, dynamic development of innovative technologies, digitalization of the economy, etc. All of this is happening in the context of increased competition in the foreign market, considering its globalization. This enhances the role of strategic management for business entities. That is why strategic management of the competitive advantages of enterprises in the context of digitalization has become a relevant issue for research, improvement, and harmonious development [1; ; 11]. Digitalization (which determines the dynamic nature of activities), the active introduction of the latest technologies in the activities of these enterprises will also entail changes in approaches to ensuring and further retention, development of the competitive position of the enterprise. Adaptation to changes of domestic enterprises should be ensured by internal changes in their systems of activity, reflected in their strategic development [2; 6; 8; 15; 18].

**Analysis of recent research and publications.** A review of the literature sources has shown considerable interest in the topic of strategic management of the competitive advantages of enterprises in the context of digitalization. This issue is highlighted in the scientific achievements of such scientists as: L. Artemenko [1], V. Balkovska [3], I. Bulakh [5], O. Hudzynskyi [7], T. Hurenko [7], V. Dzenis [8], O. Dzenis [8], M. Ihna-

tenko [9], V. Kyfiak [11; 20], L. Levaieva [9], L. Marmul [9], Yu. Petruk [1], S. Sudomyr [7] and others. The issues of digitalization of the economy are covered in the works of the following economists: T. Archypova [2], O. Hrybinenko [6], A. Koriuhin [2] and many others. The problems of strategic management of competitive advantages at the macro level have been studied by such scientists as: O. Bobrovska [4], I. Polska [4], T. Savostenko [4] and many others. Leading foreign scholars have also studied the issue. Among them, it is advisable to single out the following: I. Ansoff [19], M. Porter [13] and others. However, the high level of dynamism of the external environment, scientific and technological progress, and globalization of the economy lead to the emergence of new tools for the formation, further development (retention) of competitive advantages of enterprises that require detailed research.

**Formulation of the goals of the article (statement of the task).** The current conditions of the global crisis, Russia's military aggression require the continuation of detailed scientific research on the development of technologies, methods of strategic management of processes and competitive advantages of domestic enterprises to strengthen their competitiveness. The purpose of the article is to study the theoretical and applied principles of strategic management of competitive advantages of enterprises in the context of digitalization.

**Presentation of the main research material.** The process of development of an economic entity in a highly competitive environment involves ensuring sustainable advantages over other market participants, the use of which can guarantee the long-term and efficient existence of an enterprise. The concept of «competitive advantages» is used to characterize such advantages. Economic processes are dynamic in nature [8]. It is the dynamics that causes fierce competition and the need for enterprises to adapt to it. And the one that

adapts faster will win the competition. After all, «competition» in translation from English means «contest». A significant number of domestic enterprises were unable to respond to changing market conditions (in particular, due to the pandemic, war), to study and analyze the market, its conditions, threats, needs, etc. Because of this, many of them were simply not ready for the «contest» – competition [7] in the new business environment. That is why the essence of competitive advantage is extremely relevant for enterprises of the domestic economy.

After analyzing the achievements of specialists, we will define the essence of «competitive advantage» – this is «a concept that arose in the field of strategic management to describe and analyze how its effective use, application by enterprises, organizations or even countries can ensure success in the market, maintain and improve their own position in a highly competitive environment» [13]. The term/concept of «competitive advantage» was first introduced by Michael Porter [13]. In his well-known and popular book «Competitive Advantage: Creating and Sustaining Superior Performance», published in 1985, according to M. Porter, «competitive advantage is the ability of an enterprise (organization) to create (form) greater value for its customers (consumers) than other competitors in such a way as to allow her (him) to make a profit» [13], to maximize it. It is clear that, despite the conceptual nature of these studies, the processes of managing the competitive advantages of enterprises in the context of digitalization remain insufficiently researched, especially in the context of the high dynamism of these processes.

Ukrainian scientists and business practitioners have significant achievements in the field of studying the development of strategic directions for managing competitive advantages. According to scientists, the strategic prospects for the innovative and digital development of domestic production should be considered in terms of significant resource constraints, structural reorganization of industries, formation of favorable prices for products (services) and pricing processes. When developing strategies for the development of domestic enterprises, their competitive advantages, and business, domestic scientists pay special attention to the formation of economic, technological, technical, environmental, biological, and social effects. After all, the level of responsibility of enterprise management systems for preserving the environment, natural resources, environmental friendliness, etc. is increasingly growing in the world. Due to the development of inflationary processes in Ukraine, in particular due to Russian invaders, in connection with an unjustified increase in the level of prices for material and technical values, the cost level of products (services) is also increasing at a significant rate. And due to the use of significantly physically and morally outdated technical and technological assets, domestic enterprises suffer significant losses of fixed

assets and products (against the background of the destruction of large areas and infrastructure by Russian invaders, this is an extremely negative trend). In addition, domestic products do not always meet European quality standards and safety standards, due to a significant mismatch in technical, technological, material, and financial support [3; 5].

Given the competitive environment, imperfect state regulation levers in the political, economic, regulatory, and legal systems, ongoing military operations (killing people, destroying businesses, organizations, etc.) throughout our country, and the negative impact of quarantine measures due to the global pandemic, the growth rate of domestic business is sharply declining. In order to remedy this situation, domestic business, especially manufacturing, must effectively implement management strategies, and do so at the national level. These actions are possible due to the formation of an ecosystem of domestic business based on the integration of the goals (against the background of European integration) of enterprises, taking into account factors of the internal/external environment, etc.

Therefore, the main direction for strategic management of competitive advantages should be the development of a necessarily adaptive system of management of competitive advantages, business processes using the latest tools, measures, etc. This also includes the latest, innovative methodologies for strategic analysis, implementation of logistics, business, and communication models using networking tools, other techniques, and innovative technologies, etc.

The basis for the formation of strategic competitive advantages of domestic enterprises, in accordance with the process approach, is the allocation of a competitive advantage (value for the consumer, taking into account current challenges such as pandemic, military operations, uncertainty, digitalization, etc.). For domestic business, it is advisable to use digital tools to form and further develop (maintain) the competitive advantages of enterprises (see Figure).

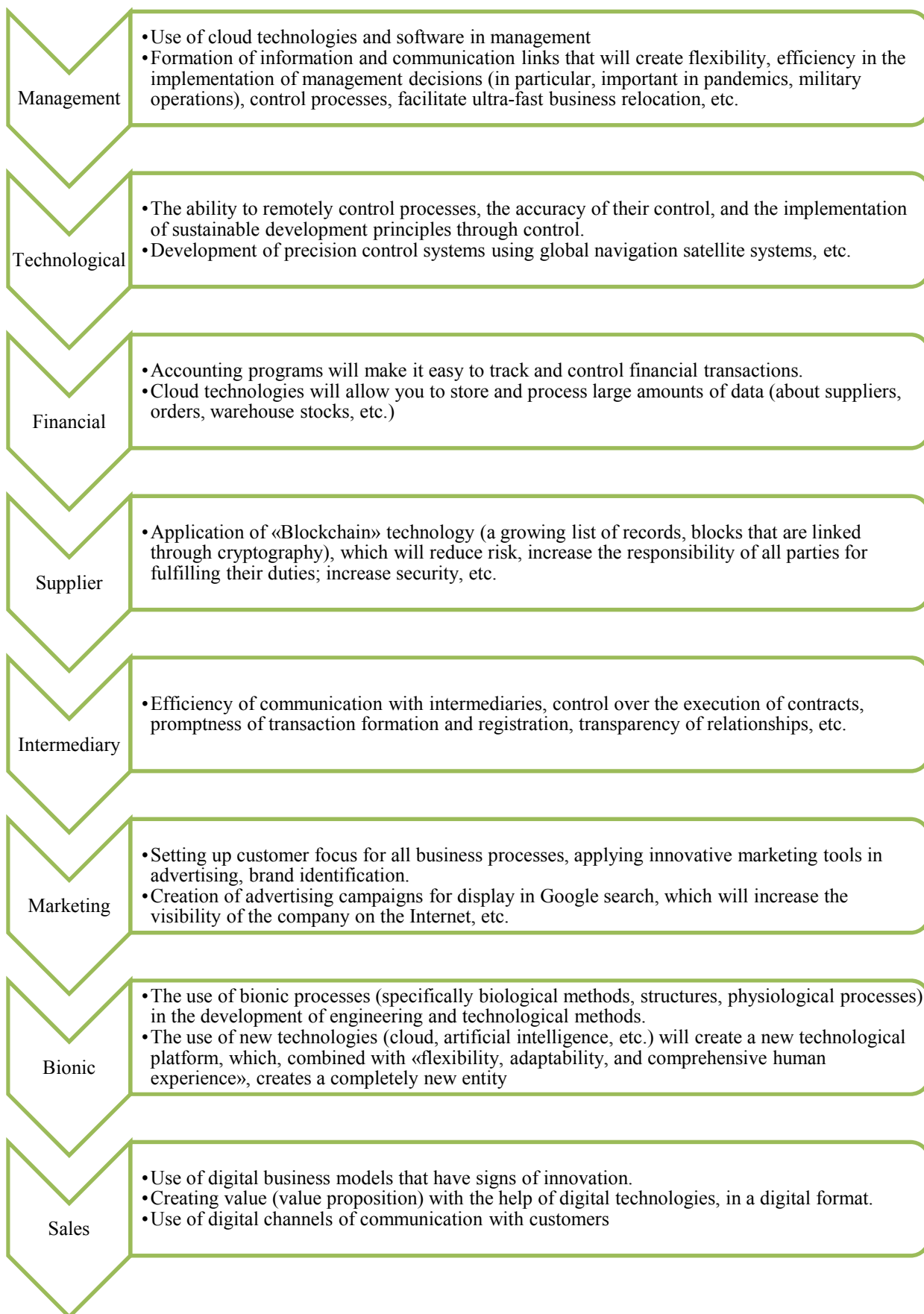
In general, digitalization has a significant impact on the level of competitiveness. The following effects can contribute to improving its level of efficiency, ensuring competitive advantage [1, 6, 9-12, 14-18]:

1. Increasing levels of productivity and efficiency of production processes. Digital technologies will allow enterprises to increase work productivity, reduce losses, and increase the level of production efficiency, which ensures competitive advantages.

2. Improving the level of quality of products, services, works. Digital technologies make it possible to increase the quality of products, reduce deviations in the quality level, and ensure the maximization of the return on production.

3. Use of data and analysis. With the help of data analytics and other digital tools, domestic businesses will understand the current needs of the market(s), learn about current/future trends in production/sales, etc.





**Figure. The structure of digital tools for the formation and further development (retention) of competitive advantages of enterprises**

Source: systematized based on [2; 11; 18; 20].

4. Improving management and communication processes. Digital technologies, such as cloud technologies and business management programs, will allow to better manage processes and improve communication processes between different departments.

5. Improving relations with customers, partners, and other stakeholders. Digital technologies will allow increasing the number of relationships with customers, partners, and stakeholders, improving, and developing their quality parameters.

Conclusions from the conducted research. To summarize, we must state that the current highly dynamic pace of development of the economic environment will primarily be reflected in enterprises. Digitalization, active introduction, and development of the latest technologies in the activities of these enterprises will also entail changes (dynamics) in approaches to ensuring the competitive position of the enterprise in the markets. Adaptation to changes of domestic enterprises should be ensured by internal changes in their systems

of activity, reflected in their strategic development. Economic processes are dynamic in nature. It is the dynamics that causes fierce competition and the need for enterprises to adapt to it. Domestic enterprises were unable to respond immediately to changing conditions, market needs, etc. Because of this, many of them were simply not ready for the «contest» – competition.

In general, digitalization has a significant impact on the level of competitiveness. The effects that can contribute to improving their level of efficiency and ensuring competitive advantage have been highlighted.

Therefore, the mechanism for implementing a strategy for achieving competitive advantages by domestic enterprises in the context of digitalization is a set of areas, measures, and tools aimed at achieving a competitive position of an enterprise in the market by introducing advanced technologies into business processes, which will allow achieving a cost leadership position, differentiating products and services in the market, or a strategy for entering foreign markets, etc.

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### **Завербний А. С., Пушак Я. Я. Теоретико-прикладні засади стратегічного управління конкурентними перевагами підприємств за умов цифровізування**

У статті висвітлено основні теоретико-прикладні засади стратегічного управління конкурентними перевагами підприємств за умов цифровізування. В роботі проаналізовано проблеми стратегічного управління конкурентними перевагами на макро та мікро рівнях.

Оскільки керівництво вітчизняних підприємств просто вимушене ухвалювати рішення за умов критичної невизначеності, за відсутності практичного досвіду роботи у військовий час, динамічного розвитку інноваційних технологій, цифровізації економіки, тому актуальною проблематикою є дослідження, удосконалення стратегічного управління конкурентними перевагами підприємств в умовах цифровізації.

Встановлено, що сучасні високо динамічні темпи розвивання економічного середовища перш за все відображатимуться на підприємствах. Цифровізація, активне запровадження, розвиток новітніх технологій у діяльність даних підприємств спричинятиме також зміни у підходах щодо забезпечування конкурентних позицій підприємства на ринках. Визначено, що адаптування до змін вітчизняних підприємств має забезпечуватися внутрішніми змінами у системах їх діяльності, відображаючись у стратегічному розвитку. Обґрунтовано, що динаміка спричиняє гостру конкуренцію, потребу підприємств адаптуватися до неї. Вітчизняні підприємства виявилися нездатними відразу реагувати на зміни умов, потреби ринку тощо, через що багато із них виявилися просто не готовими до такої конкуренції.

В роботі визначено, що в загальному цифровізування володіє значним впливом на рівень конкурентоспроможності. Виокремлено ключові ефекти, що зможуть посприяти поліпшенню їх рівню ефективності, забезпеченню конкурентної переваги. Механізм реалізування стратегії досягнення конкурентних переваг вітчизняними підприємствами в умовах цифровізації є комплексом напрямків, заходів, інструментів спрямованих на досягнення конкурентної позиції підприємства на ринку шляхом впровадження передових технологій у бізнес-процеси, що дозволить досягати позиції лідерства за витратами, диференціювання продукції, послуг на ринку чи стратегію виходу на зовнішні ринки тощо.

В статті запропонована структура цифрових інструментів яка може застосовуватися на практиці при формуванні та подальшому розвитку конкурентних переваг підприємств.

*Ключові слова:* конкуренція, конкурентні переваги, стратегія, стратегічне управління, цифровізація, менеджмент, цифрові інструменти в управлінні, система стратегічного управління.

### **Zaverbnyj A., Pushak Ya. Theoretical and Applied Principles of Strategic Management of Competitive Advantages of Enterprises in the Context of Digitalization**

The article highlights the main theoretical and applied principles of strategic management of competitive advantages of enterprises in the context of digitalization. The paper analyzes the problems of strategic management of competitive advantages at the macro and micro levels.

Since the management of domestic enterprises is simply forced to make decisions under conditions of critical uncertainty, in the absence of practical experience in wartime, the dynamic development of innovative technologies, and the digitalization of the economy, the study and improvement of the strategic management of competitive advantages of enterprises in the context of digitalization are topical issues.

It has been established that the current highly dynamic pace of development of the economic environment will primarily be reflected in enterprises. Digitalization, active introduction, development of the latest technologies in the activities of these enterprises will also entail changes in approaches to ensuring the competitive position of the enterprise in the markets. It is determined that adaptation to changes in domestic enterprises should be ensured by internal changes in their systems of activity, reflected in their strategic development. It has been substantiated that the dynamics cause fierce competition and the need for enterprises to adapt to it. Domestic enterprises were unable to immediately respond to changing conditions, market needs, etc., which is why many of them were simply not ready for such competition.

The paper determines that, in general, digitalization has a significant impact on the level of competitiveness. The key effects that can contribute to improving their level of efficiency and ensuring competitive advantage are allocated. The mechanism for implementing a strategy for achieving competitive advantages by domestic enterprises in the context of digitalization is a set of directions, measures, and tools aimed at achieving a competitive position of an enterprise in the market by introducing advanced technologies into business processes, which will allow achieving a cost leadership position, differentiating products and services in the market, or a strategy for entering foreign markets, etc.

The structure of digital tools that can be used in practice in the formation and further development of competitive advantages of enterprises is proposed in the article.

*Keywords:* competition, competitive advantages, strategy, strategic management, digitalization, management, digital tools in management, strategic management system.

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## ECONOMIC AND MATHEMATICAL MODELING IN BUDGETING

### Introduction

Budgeting is an indispensable mechanism for organizations to allocate resources judiciously, set financial priorities, and achieve fiscal sustainability. The integration of economic principles and mathematical models empowers decision-makers to enhance the precision and reliability of budgetary forecasts, thereby enabling more informed and strategic financial planning.

**Analysis of recent research and publications and selection of unsolved parts of the general problem.** The integration of economic and mathematical modeling in budgeting has witnessed a surge in scholarly interest in recent years.

The analysis of scientific sources by such experts as O. Kuzmin, G. Tsehelyk, M. Yastrubskyy [1], Devajit Mohajan, Haradhan Kumar Mohajan [2], Raquel Sanchis [4; 5], Alfonso Duran-Heras and Raul Poler [4], L. Canetta, R. Poler [5] and others [6-10] allows us to state that economic and mathematical methods and models provide the following opportunities:

- accurately and compactly state the provisions of economic theory;
- formally describe the relationships between economic variables;
- solve the problems of optimization of planning and management, reflecting the specifics of production processes;
- timely respond to changes in goals, resource constraints, dependencies between parameters and adequately adjust plans and management decisions;
- to obtain information about the facility and its operation;
- to predict the object and its behavior in the future.

The current issue is to determine the possibilities of business analytics based on the use of economic and mathematical modeling tools to form an effective budgeting system. For effective budgeting, it is worth using modeling tools that allow enterprises to get a better visualization of existing processes for effective cost management and, accordingly, to identify opportunities for their optimization, as well as to provide a better understanding of the data obtained on the current situation and future forecasts, which will

help to establish cooperation between different business units and ensure more effective communication with key stakeholders (beneficiaries, business owners, etc.) in the context of providing.

A scrutiny of recent scholarly investigations and published works [1-10] has brought to light that the outstanding aspect of the overarching issue lies in examining the potentialities for establishing a robust enterprise budgeting system within Ukrainian companies through the adept utilization of economic and mathematical modeling tools.

**The purpose of the article** – analyze the possibilities of forming an effective enterprise budgeting system based on the successful implementation of economic and mathematical modeling tools for Ukrainian companies.

**Presentation of the main research material.** The convergence of economic theories and mathematical modeling within the domain of budgeting constitutes a critical nexus that demands rigorous exploration. As budgeting remains a linchpin in the financial management apparatus, the nuanced integration of economic insights and mathematical methodologies emerges as an indispensable facet in enhancing the precision and efficacy of fiscal planning. This discourse delves into the bedrock of economic and mathematical modeling in budgeting, dissecting the essential components, methodological frameworks, and implications for decision-making processes.

The effectiveness of the budgeting system at an enterprise based on the use of economic and mathematical modeling tools (Table 1) will improve resource planning, including taking into account the existing capabilities, priorities, needs and constraints of a particular enterprise and its external business environment.

During the review of modern approaches to the formation of the enterprise budget management system, a procedure for the formation of the budgeting system was proposed [11].

Within the stages of budget development and allocation of resources and monitoring of budget implementation in real time, issues of allocation of

Table 1

**Economic and mathematical modeling in budgeting: key aspects**

Key aspects	Explanation of the aspect
Economic foundations of budgeting	The economic underpinnings of budgeting involve understanding the macroeconomic environment, including factors such as inflation rates, interest rates, and overall economic growth. Economic modeling aids in predicting the impact of these variables on revenue generation, enabling organizations to make realistic projections for budgetary purposes.
Mathematical modeling techniques	Various mathematical modeling techniques contribute to the robustness of budgetary frameworks. Time series analysis, regression analysis, and optimization models are among the key tools employed in economic and mathematical modeling for budgeting. These techniques enable the identification of patterns, correlations, and optimal resource allocation strategies.
Revenue forecasting	Accurate revenue forecasting is a cornerstone of effective budgeting. Economic models, coupled with mathematical algorithms, facilitate the prediction of revenue streams based on historical data, economic indicators, and market trends. This foresight enables organizations to establish realistic revenue targets and mitigate the risk of budgetary shortfalls.
Expenditure planning and optimization	Mathematical optimization models play a crucial role in expenditure planning. By considering various constraints and objectives, these models assist in determining the optimal allocation of resources across different operational areas. This ensures that budgetary allocations align with organizational goals and priorities.
Challenges and considerations	While economic and mathematical modeling enhances the precision of budgeting, it is not without challenges. Data accuracy, model complexity, and the dynamic nature of economic variables pose significant hurdles. Addressing these challenges requires a combination of advanced modeling techniques, robust data governance, and continuous refinement of models.

resources, operational improvements, optimization of activities, etc. arose.

Economic and mathematical modeling enhance the precision and effectiveness of these stages of budgeting by providing tools to analyze, forecast, and optimize

financial decisions based on a thorough understanding of economic and financial processes (Table 2).

Taking into account the possibility of improving the efficiency of the budgeting process at enterprises, the authors suggest developing a model of the future state of the process.

Table 2

**Direction of application of economic and mathematical models in the process of budgeting (the stages of budget development and allocation of resources and monitoring of budget implementation in real time)**

Direction of application of economic and mathematical models	Purpose and procedure of application
1	2
Forecasting Economic Variables	Economic models help forecast key variables such as inflation rates, interest rates, and economic growth. These forecasts are essential for estimating future costs, revenues, and overall financial conditions that can impact budget planning
Revenue Projection	Mathematical modeling is used to project future revenues based on historical data, market trends, and economic indicators. Regression analysis and time series analysis are common techniques to predict revenue patterns
Cost Estimation	Mathematical models assist in estimating costs associated with various activities, projects, or programs. Cost functions are developed to understand how costs vary with changes in different factors. This helps in setting realistic budgetary targets
Sensitivity Analysis	Mathematical models are used to perform sensitivity analysis, assessing how changes in specific variables impact budget outcomes. This helps in identifying potential risks and uncertainties in the budgeting process
Optimization	Mathematical optimization models are employed to find the best allocation of resources to maximize desired outcomes while adhering to budget constraints. This is particularly useful when there are limited resources and competing priorities
Scenario Planning	Economic and mathematical models enable organizations to create different scenarios to assess the potential impact of various economic and financial conditions on the budget. This helps in developing contingency plans and risk mitigation strategies
Resource Allocation	Mathematical models aid in optimizing the allocation of resources across different departments or projects, ensuring that the budget is distributed efficiently to achieve organizational objectives

1	2
Decision Support	Economic models provide a framework for decision-making by evaluating the financial implications of alternative courses of action. This helps in making well-informed decisions that align with the organization's strategic goals
Budgetary Control	Mathematical models are used in monitoring and controlling budgets by comparing actual financial performance against budgeted figures. Deviations from the budget can be analyzed to understand the reasons and take corrective actions
Risk Assessment	Economic and mathematical models assist in assessing financial risks associated with budgeting decisions. This includes identifying potential market risks, operational risks, and external economic factors that may impact the budget

Systematized by the authors based on the results of the study [12-16].

In this case, the AS IS model is considered to be the model provided in [11].

The TO BE model involves the integration of economic and mathematical modeling tools at stages A2 and A3 (see figure). New elements (improvements) are marked in red.

It should be noted that the use of economic-mathematical modeling tools in budgeting will require

the involvement of specialists with appropriate qualifications. The issue of involving relevant specialists, detailing the models and determining the responsible persons who make decisions based on the results of modeling will be the subject of the authors' subsequent research.

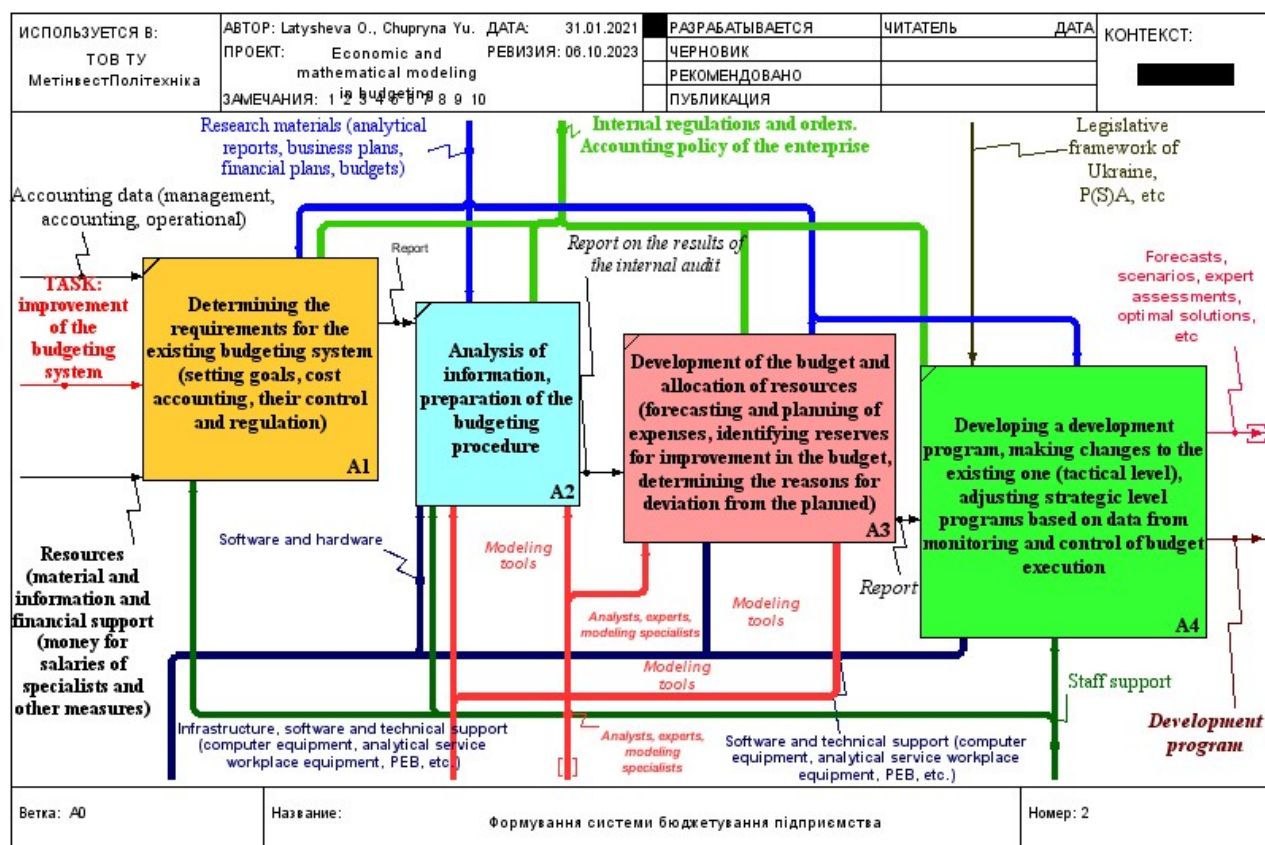


Figure. Stages of budgeting system formation (TO BE model. Integration of economic and mathematical modeling tools at stages A2 and A3) on the Ramus business process modeling platform in IDFO notation

**Conclusion**

Economic and mathematical modeling in budgeting represents a sophisticated approach to navigating the complexities of financial management. As organizations strive for greater precision and

foresight in resource allocation, the integration of economic principles and advanced mathematical techniques offers a powerful toolkit. The continuous refinement of these models, coupled with advancements in technology, promises a future where budgeting

becomes not only a strategic necessity but also a dynamic and adaptive process in the face of evolving economic landscapes.

The evolving landscape of technology and data analytics presents opportunities for further refinement

of economic and mathematical models in budgeting. Machine learning algorithms, artificial intelligence, and big data analytics hold the potential to revolutionize the accuracy and efficiency of budgetary forecasting and decision-making processes.

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### Латишева О. В., Чуприна Ю. В. Економіко-математичне моделювання в бюджетуванні

Стаття присвячена огляду сучасних підходів моделювання для ефективного управління бюджетами підприємства. У статті досліджено інструментарій економіко-математичного моделювання, який може застосовуватися в системі бюджетування. Запропоновано підвищити ефективність процесу бюджетування шляхом застосування інструментарію економіко-математичного моделювання на стадіях розробки бюджету та розподілу ресурсів, а також у процесі бюджетного контролю та моніторингу. Для підвищення наочності процедури та результатів моделювання представлена візуалізація моделі TO BE в нотації (мові моделювання) IDF0 на платформі «Ramus».

Зазначено, що ефективність системи бюджетування на підставі використання інструментарію економіко-математичного моделювання дозволить покращити планування витрат ресурсів з урахуванням можливостей, пріоритетів, потреб та обмежень конкретного підприємства та його зовнішнього бізнес - середовища. Обґрунтовано необхідність впроваджувати інструментарій діджиталізації та економіко-математичного моделювання в системі бюджетування.

Метою статті є аналіз можливостей формування дійової системи бюджетування підприємств на підставі успішної імплементації інструментарію економіко-математичного моделювання.

Автори орієнтуються на потенціал використання бізнес-аналітики як результату використання інструментарію економіко-математичного моделювання для формування ефективної системи бюджетування.



У статті аргументовано можливості ефективного використовувати інструментарію моделювання у процесі бюджетування, що дозволяє підприємствам приймати якісні управлінські рішення на підставі прогнозів, сценаріїв, рекомендацій оптимізації, візуалізації поточних проблемних ситуацій тощо.

*Наукова новизна даної статті полягає в тому, що рекомендації та висновки, надані авторами, можуть стати корисними для вітчизняних підприємств в існуючих умовах жорстких обмежень наявних ресурсів, нестачі вільних коштів, існуючих та потенційних ризиків. Загалом, ця стаття є корисною для тих, хто бажає більш детально ознайомитися з можливостями використання інструментарію економіко-математичного моделювання в системі бюджетування.*

*Ключові слова:* бюджетування, інструментарій моделювання, економіко-математичне моделювання, метод моделювання, управління витратами.

### **Latysheva O., Chupryna Yu. Economic and Mathematical Modeling in Budgeting**

The article is devoted to an overview of modern modeling approaches for effective management of enterprise budgets. The article examines the toolkit of economic and mathematical modeling that can be used in the budgeting system. It is proposed to increase the efficiency of the budgeting process by applying the tools of economic and mathematical modeling at the stages of budget development and resource allocation, as well as in the process of budget control and monitoring. To increase the clarity of the simulation procedure and results, a visualization of the TO BE model is presented in IDF0 notation (simulation language) on the Ramus platform.

It is noted that the effectiveness of the budgeting system based on the use of economic-mathematical modeling tools will allow to improve resource expenditure planning taking into account the opportunities, priorities, needs and limitations of a specific enterprise and its external business environment. The need to implement digitalization tools and economic-mathematical modeling in the budgeting system is substantiated.

The purpose of the article is to analyze the possibilities of forming an effective enterprise budgeting system based on the successful implementation of economic and mathematical modeling tools. The authors focus on the potential of using business analytics as a result of using economic and mathematical modeling tools to form an effective budgeting system.

The article argues for the possibility of effectively using modeling tools in the budgeting process, which allows enterprises to make high-quality management decisions based on forecasts, scenarios, optimization recommendations, visualization of current problem situations, etc.

The scientific novelty of this article lies in the fact that the recommendations and conclusions provided by the authors can be useful for domestic enterprises in the current conditions of severe restrictions on available resources, lack of free funds, existing and potential risks. In general, this article is useful for those who want to learn more about the possibilities of using economic-mathematical modeling tools in the budgeting system.

*Keywords:* budgeting, modeling toolkit, economic-mathematical modeling, modeling method, cost management.

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## ECONOMIC, FINANCIAL AND LEGAL ASSESSMENT OF CORPORATE INTEGRATION ASSOCIATION ACTIVITY

**Problem statement and its connection with import antiscientific and practical tasks.** In recent years, the problems of integration processes intensification in the corporate sector of the economy have caused increased attention from both scientists and practitioners, which is largely determined by the scale of globalization processes of the international economic relations system.

Integration of joint stock companies (JSC) is a complex and long process, the deployment of which takes place under the influence of numerous internal and external environmental factors. As a result of this process, a corporate association can be created, which should function more efficiently, stably and profitably than each of the JSCs forming the association separately. The key to achieving this kind of goal is the rational and reasonable selection of potential participants in the corporate integration association (CIA), the basis of which should be forecasting and evaluation of activities results.

### **Analysis of recent publications on the problem.**

Theoretical, methodological and methodological principles of planning and evaluation of corporate integration processes were considered in the works of many domestic and foreign scientists, in particular: I. Buleev [1], K. Finkelstein [10], M. Gruninger [12], O. Hutsaliuk [3-4; 13], N. Kyzym [5], A. Kozachenko [6], O. Lyashenko [7], V. Pastukhova [8], A. Pilipenko [9], N. Prokopenko [1], M. Sirover [12], A. Voronkova [2] and several others. Most often, currently proposed

methods for assessing the activities of CIAs are based on the use of those indicators used during the analysis of the activities of autonomously operating JSCs. However, the activity of the CIA has its own peculiarities, which must be taken into account during such an analysis.

The main differences characterizing the CIA, according to the author, are the complexity of organizational and economic relations of the participants in the association, as well as the presence of a synergistic effect within the corporate integration association, the assessment of which constitutes a scientific and practical task that requires additional study.

**Formulation of research objectives (problem statement).** The purpose of the research is to substantiate and develop theoretical and methodological approaches to the economic, financial and legal assessment of the corporate integration association activities.

**Materials and methods.** The theoretical and methodological basis of scientific research is the fundamental provisions of the general economic theory, management theory, the work of domestic and foreign scientists on the planning and evaluation of corporate integration processes.

**An outline of the main results and their justification.** During the operational management of corporate integration associations (CIAs), a number of management tasks arise, which are specific to corporate

integration processes. The emergence of such specific tasks is more characteristic of corporate integration associations that were formed without properly assessment of the necessity for such integration and the development of an effective organizational structure of the CIA. These features include the following:

1. Obtaining, analyzing and using the necessary information for management. Due to the large number of projects, as well as due to the presence of a rather complex organizational and economic structure of the corporate integration association (especially diversified), there is an excess of information that comes from all directions and levels in various measuring systems. It is often almost impossible to compare and reliably interpret the received information. As a result, it becomes necessary to maintain double, triple, or even more complicated, accounting, which creates difficulties in drawing up operational balances in the directions and, as a result, makes it very difficult to make tactical and strategic decisions.

2. Duplication of some management functions. Due to the multidisciplinary nature of CIA components, it becomes necessary to duplicate the accounting and control function in each CIA business unit. Such duplication increases the cost of maintaining administrative and managerial personnel, but as a rule, does not allow implementing most management functions with a satisfactory level of effectiveness.

3. Difficulties in assessment of the individual areas effectiveness. The occurrence of these difficulties is due to the fact that the corporate integration association activities can be quite profitable, even in the case of inefficient activities of CIA individual units (participants), due to the presence of financial flows complex system within the association. Consolidation of the results of various participants work (both profitable and unprofitable) makes it difficult to determine the sources of positive financial results formation of CIA

work, creates difficulties in the decision-making process to improve the efficiency of the association.

4. Centrifugal trends within the CIA. Quite common may be the situation when CIA individual units try to adhere only to their own (local) interests during operations - to the detriment of solving corporate tasks. The spread of such trends can lead to a decrease in the overall CIA efficiency as a whole.

5. Risks associated with the possible opportunistic behavior of employees of CIA individual units, due to management decentralization within the association or the possibility of obtaining (on a formal or informal basis) autonomous powers by these units heads. The complexity of end-to-end financial control and a large number of departments can create a favorable environment for the selfish treatment of personnel at all levels of the management hierarchy. This situation can lead to the emergence of internal risks of abuse, which, in turn, complicates both the improvement of economic results and, for example, the involvement of external investments in the CIA development.

Solving these problems is possible only on the basis of a comprehensive research of the corporate integration association activities and determining the mechanism for forming the work results. Therefore, a comprehensive analysis of the corporate integration association performance should consist of two blocks: a general analysis of the CIA performance; analysis of the synergistic effect generated within the CIA.

The overall analysis of CIA activities effectiveness is carried out using a scorecard, the composition of which is proposed to be determined based on the construction of basis research matrix. The matrix columns form the analysis components (structure, dynamics, volume, etc.), and the rows form the analysis directions (shareholder property, corporate property, products, market, sources of investment, areas of activity, efficiency, synergy, etc.). The CIA analysis matrix is presented in Table 1.

Table 1

CIA Analysis Matrix

		Analysis components		
		Structure analysis	Dynamics analysis	Volume analysis
Analysis directions	Shareholder property	Shareholders structure and composition; ownership structure and composition; ownership packages structure	Capital dynamics; property values dynamics; exchange rate forecast	Share capital amount; property market value
	Products	Products types and their share in the CIA product portfolio; cost structure by product types	Production volumes dynamics; shares dynamics in the product portfolio	Products production and sales; production costs
	Market	Market structure, market share; consumer structure	Realization dynamics; market shares dynamics; sales dynamics	Sales quantity; volume of transactions
	Finance	Receivables and payables structure; capital structure	Dynamics debt; financial indicators dynamics	Borrowing amount; assets volume; capital; investments volume

Source: authors' own developments.

Based on the data of such a matrix, further research can be carried out using factor analysis methods and others. Thus, the indicators system, the formation of which is carried out on the proposed basis, is able to allow not only monitoring, but also tracking the dynamics and structure of indicators. In addition, the scorecard thus formed allows also arbitrarily expanding the scorecard itself and adjusting it for use in various CIAs.

It should also be borne in mind that in modern economic conditions determined by the deepening of crisis phenomena in the national economy development, long-term forecasting of the corporate integration association activities can be carried out only on the basis of the use of indicators expanded system describing various aspects of its activities, goals and interests' variety of the participants in the association.

In the analysis of joint stock companies and CIAs efficiency, financial indicators are almost most often used, which significantly limits the managerial potential for regulating the association development. To solve the CIA strategic management tasks, it is necessary to evaluate a wider range of aspects of the association activities - both at local levels (within individual JSCs) and on a corporate scale. Therefore, it is necessary to analyze not only the result of the CIA activities, but also to determine the implementation effectiveness of the achieving this result method, that is, assessing and summarizing the results of JSCs strategy implementation. This assessment is possible only in the case of a clear definition of JSCs or CIAs strategy,

$$C_n = (D(PN)_n + D(PA)_n + (EE)_n) - (DI_n + DT_n + I_0), \quad (1)$$

where  $n$  – the calculation period;

$C_n$  – overall synergy effect;

$D(PN)_n$  – estimated additional profit from activities expansion;

$D(PA)_n$  – estimated additional profit from risk reduction due to CIA activities diversification;

$(EE)_n$  – saving current production costs;

$DI_n$  – additional investment for reconstruction and expansion;

$DT_n$  – tax payments increase (savings);

$I_0$  – investment at the takeover moment.

The calculating the synergistic effect method can be adjusted depending on the CIA type formed and the motives for its formation.

However, this calculation method has one significant drawback, which in some cases can interfere with its use or lead to incorrect conclusions by experts conducting calculations - this is a failure to account for a change in the money cost over time. This calculating the synergistic effect method can be used immediately after the integration and start of CIA operations. If it is necessary to analyze the synergistic effect after a certain period, it is indispensable to calculate the discount rate. In this case, the total synergistic effect will be calculated using the following formula (2):

$$Ct = \sum_{t=1}^T \frac{\Delta CF_t}{(1+r)^t}, \quad (2)$$

where  $\Delta CF_t$  – the difference up to time  $t$  between the cash flows of the consolidated CIA and the cash flows amount of each JSC separately;

$r$  – the expectation of the discount factor calculated taking into account the planned rate of return on the equity of the company that was not the initiator of the integration process.

The increase in can be calculated as follows (3):

$$\Delta CF_t = \Delta R_t - \Delta C_t - \Delta T_t - \Delta I_t, \quad (3)$$

where  $\Delta R_t$  – revenue increase from integration;

mission and goals, formalization of them in clearly defined terms.

When conducting a comprehensive analysis of corporate integration associations' effectiveness, it is necessary to take into account all the above aspects of the problem. But, it should be noted that the analysis issues of various aspects of joint-stock companies and corporate integration associations' activities are devoted to many works of domestic and foreign scientists [1; 2; 6; 9-11 and others]. However, it is extremely relevant to specify and optimize the analysis directions, since unreasonable growth of its volumes can lead to a significant increase in the time necessary for such an analysis. Limitations in its implementation, in turn, can cause complications or even complete inability to make adequate and effective decisions by the JSC (CIA) management based on such analysis. The most optimal, according to the author, is the list of analysis directions, which is given in Table 1.

Especially important is the issue of analyzing the synergistic effect formed inside the corporate integration association. The most complex structure and possibility of analysis is the diversified industrial and financial group synergistic effect. In this case, the CIA includes banking institutions and industrial enterprises of various profiles.

The synergy effect increases revenues and enhances the cash flows of the corporate integration association. In general, the synergistic effect amount formed within the CIA is as follows (1):



$\Delta C_t$  – costs increase,  
 $\Delta T_t$  – increase in tax deductions,  
 $\Delta I_t$  – increase of additional investments in working capital and fixed assets.

Based on this approach, it becomes possible to differentiate the synergy sources into four main categories: income increase, cost reduction, tax deduction reduction and additional investment reduction, and based on which, if necessary, a factor analysis is carried out to identify the degree of achievement of a certain strategy, integration goals and,

if possible, to identify reserves for increasing the synergy effect.

To analyze the CIA activities, it is necessary to analyze the various activities integration degree within the CIA. Such analysis is advisable to carry out in different directions of CIA participants' interaction: integration of participants' production potentials in the CIA; integration of financial and production potentials for various joint stock companies – CIA participants; integration of CIA participants' scientific potentials. The coefficients' general characteristics proposed for such analysis are given in Table 2.

Table 2

**Characterization of the indicators for assessing the depth of CIA participants' integration**

Scorecard Groups	Scorecard Name	Legend	Characteristics
Industrial potentials integration scorecard	Internal supply	$K_{sup}$	Shows the proportion of products produced for domestic consumption within the CIA
	Internal exchange	$K_{int.exch}$	Shows the share of CIA participants involved in the products production consumed within CIA
	Attracting production capacity	$K_{prod.cap}$	Indicates which part of the production capacity is used for domestic production
	Equity Participation	$K_{eq}$	Characterizes the participation degree in the capital of various participants in CIA, except for cross-ownership of shares
	Mutual equity participation	$K_{mut.eq}$	Characterizes the mutual penetration degree into each other's capitals of various CIA participants
Scientific potentials integration scorecard	Internal use of R&D	$K_{r\&d}$	Characterizes the degree of R&D implementation within CIA
	Amounts of R&D that have been mastered	$K_{mast.r\&d}$	Shows the production provision degree by internal R&D
	Participation in the Research Institute capital	$K_{cap}$	Characterizes the participation level of other CIA participants in the capital of participants conducting R&D
Industrial, financial potentials integration scorecard	Participation in financial capital	$K_{part.cap}$	Shows how many non-financial participants take part in the capital of financial participants
	Internal financing	$K_{int.fin}$	Characterizes the security degree of non-financial participants in CIA with the financial participants funds in CIA
	Participation of non-financial participants in financial capital	$K_{fin}^{f-n}$	Characterize the participation degree of financial and non-financial participants of CIA in each other's capital
	Participation of financial participants in non-financial capital	$K_{fin}^{n-f}$	
	Internal control	$K_{cont}$	Shows the control degree of non-financial CIA financial participants

Source: authors' own developments.

Calculation results analysis of the above-mentioned coefficients allows to assess the interaction of CIA individual activities. This analysis makes it possible to draw conclusions, both from the integration of capital of CIA activity various areas, and from the integration of processes of activity.

Thus, after conducting a general analysis of the CIA activities and calculating all the above-mentioned factors, it is possible to draw conclusions on the further existence of CIA, the need to adjust the CIA development strategy, change the general profile of the activities, etc.

**Conclusions and perspectives of further research.** A comprehensive analysis of the corporate integration association' activities should consist of two blocks: a general analysis of the effectiveness of the CIA activities; analysis of the synergistic effect generated within the CIA. It is recommended to carry out a general analysis of the effectiveness of CIA activities using a scorecard, the composition of which is proposed to be determined based on the construction of basis studies' matrix.

In order to analyze the activities of the already established CIA, it is necessary to analyze the

integration degree of various activities within CIA. Such analysis should be carried out in different directions of interaction between CIA participants (industrial potentials' integration, scientific potentials and integration of industrial and financial potentials of JSC) using the indicators' system proposed by the author. To illustrate and simplify the results' analysis of such an analysis, it is recommended to use the integration profile

of the JSC, which allows you to clearly assess the integration degree in different directions.

The direction of further research in this area are related to the methodological recommendations' development for modeling the optimal capital structure of a corporate integration association, which would ensure the financial results maximization of CIA activities.

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**Коцюрба О. Ю., Аблязова Н. Р., Захарченко О. В., Мотузка О. М. Економічна та фінансово-правова оцінка діяльності корпоративного інтеграційного об'єднання**

Розглянуто зміст процесу інтеграції акціонерних товариств (АТ). Узагальнено передумови здійснення раціонального і обґрунтованого відбору потенційних учасників корпоративного інтеграційного об'єднання (КІО) на основі прогнозування і оцінки результатів діяльності такого об'єднання. Встановлені особливості організації та управління корпоративними інтеграційними об'єднаннями (труднощі в одержанні, аналізі і використанні необхідної для управління інформації; дублювання окремих управлінських функцій; неоднозначність оцінки ефективності роботи окремих напрямків діяльності; відцентрові тенденції всередині КІО, ризики, пов'язані з децентралізацією управління об'єднаннями).

Доведено необхідність проведення дворівневої оцінки діяльності корпоративного інтеграційного об'єднання (на локальному рівні в межах окремих АТ, і в загальнокорпоративному масштабі) для вирішення завдань стратегічного управління КІО. Визначено напрями проведення комплексного аналізу ефективності діяльності корпоративного інтеграційного об'єднання, який повинен складатися з двох блоків: загальний аналіз ефективності діяльності КІО; аналіз синергетичного ефекту, який утворюється в межах КІО.

Обґрунтований склад системи показників оцінки діяльності корпоративного інтеграційного об'єднання на основі побудови матриці базисних досліджень. Доведено доцільність проведення диференціації джерел появи синергії КІО на чотири основні категорії: збільшення доходів, зменшення витрат, скорочення податкових відрахувань та зниження додаткових інвестицій, і на основі чого, при необхідності, проведення факторного аналізу для виявлення ступеня досягнення визначеної стратегії, цілей інтеграції та, у разі можливості, виявлення резервів збільшення синергетичного ефекту.

Визначено напрями проведення аналізу діяльності КІО на основі визначення ступеня інтеграції різних напрямів діяльності всередині КІО, таких як: інтеграція виробничих потенціалів учасників КІО; інтеграція фінансового і виробничих потенціалів різних акціонерних товариств – учасників корпоративного інтеграційного об'єднання; інтеграція наукових потенціалів учасників КІО. Обґрунтовано склад показників оцінки глибини інтеграції учасників корпоративного інтеграційного об'єднання. Запропоновано підхід до визначення ефекту синергії при утворенні корпоративного інтеграційного об'єднання до постійних змін в економічному середовищі.

*Ключові слова:* корпоративне управління, акціонерне товариство, корпоративна інтеграція, оцінка діяльності, корпоративне інтеграційне об'єднання, ефект синергії.

**Kotsiurba O., Abliazova N., Zakharchenko O., Motuzka O. Economic, Financial and Legal Assessment of Corporate Integration Association Activity**

The content of the integration process of joint stock companies (JSC) is considered. The prerequisites for rational and reasonable selection of potential participants in the corporate integration association (CIA) based on forecasting and evaluation of the results of such association's activities are summarized. Established peculiarities of organization and management of corporate integration associations (difficulties in obtaining, analyzing and using the information necessary for management; individual management functions duplication; ambiguity of the certain activities effectiveness assessment; centrifugal trends within the CIA, risks associated with association management decentralization).

The need for a two-level assessment of the corporate integration association activities (at the local level within individual JSCs, and on a corporate scale) to solve the tasks of the CIA strategic management has been proved. Complex analysis directions of corporate integration association activities efficiency are defined, which should consist of two blocks: general analysis of CIA activities efficiency; analysis of the synergistic effect that is formed within the CIA.

The indicators system composition of corporate integration association assessment based on construction of the basic studies matrix is substantiated. It is proved expediency of sources differentiation of CIA synergy occurrence into four main categories: increase of income, reduction of expenses, tax deductions reduction and additional investments reduction, and on the basis of which, if necessary, factor analysis is carried out to identify the achievement degree of a certain strategy, integration goals and, if possible, reserves detection of synergetic effect increase.

The analysis directions of the CIA activities are determined based on determining the integration degree of various activities within the CIA, such as: the production potentials integration of CIA participants; financial and production potentials integration of various joint stock companies – participants of the corporate integration association; scientific potentials integration of CIA participants. The indicators composition for assessing the depth of integration of the corporate integration association participants is substantiated. An approach to determining the synergy effect in the corporate integration association formation to constant changes in the economic environment is proposed.

*Keywords:* corporative management, joint stock company, corporate integration, activity evaluation, corporate integration association, synergy effect.



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## INNOVATIVE PROJECT CLUSTERS IN THE SYSTEM OF FORMING COMPETITIVENESS AND ECONOMIC DEVELOPMENT OF REGIONAL ART EDUCATIONAL INSTITUTIONS

**Formulation of the problem.** In the modern state of Ukraine, the conceptual foundations for the creation of a regional cluster policy have not yet been formulated, which are based on the establishment of the direction of measures of managerial influence on the prospects and possibilities of creating clusters, the definition of methods, levers and measures, the implementation of which contributed to ensuring the competitiveness of the regional economy and the formation of a smart economy [1-3]. In scientific research and the state mechanism of administrative management, it is necessary to outline scenarios for the formation of cluster policy in the region [4-7] and to propose an algorithm for scenario cluster policy in the region, the implementation of which will prevent future manifestations of a negative scenario of clustering of the regional economy and reduce its negative impact on the formation of a smart economy in Ukraine.

### **Analysis of recent research and publications.**

The Ukrainian school of regional studies separates into an independent direction the research of issues of regulation of the business environment, stimulation of cluster formation, support of small and medium-sized businesses, and development of business incubation tools. The study of the conceptual foundations of clustering and business incubation was carried out O. Amosha, M. Butko, Z. Varnalii, M. Voinarenko, M. Dolishnii, O. Zakharova, P. Hudz, D. Hulak, M. Kyzym, O. Kolomytseva, O. Kudrina, V. Liashenko, V. Omelianenko, I. Pidorycheva, L. Prodanova, S. Sokolenko, D. Solokha, O. Finahina, V. Khaustova, H. Shevtsova and others.

Obstacles to the development of innovation clusters in Ukraine were investigated V. Heiets, B. Danylyshyn, O. Zinchenko, L. Pankova, R. Mann, O. Chernyshov and others. At the same time, the issues of substantiation of the prerequisites and expediency of creating clusters in the region, the formation of a target cluster policy, the quantitative measurement of the impact of the functioning of innovative and educational forms of cluster development on the regional economy, the relationship between economic and cluster policy and its impact on the formation of a smart economy require a more in-depth study.

**The aim of the research.** The specified problematic issues led to the choice of the topic of the article. The goal of the research is regulatory economic policy in the field of creation of innovative and educational clusters in Ukraine, which will further ensure the systematic activation of entrepreneurial activity and the formation of a smart economy.

### **Presentation of the main research material.**

Regional and economic policies are active and in demand in the system of mechanisms of influence on regional development, as spheres of managerial (regulatory) interaction on processes, which is of primary importance in the strategic vision of the future, which is determined in the prospects of economic development, improvement of the social sphere, improvement of the ecological situation, activation integration processes and relations between territories and subjects of management at the regional level. In the scientific and practical plane of regional management, there are a certain number of varieties of regional policy,



the main of which should be recognized: state and regional; interregional; regional and branch; economic and social. Such structuring and complex meaningful filling of each type requires both active and passive changes in the reproductive processes of regional economic complexes.

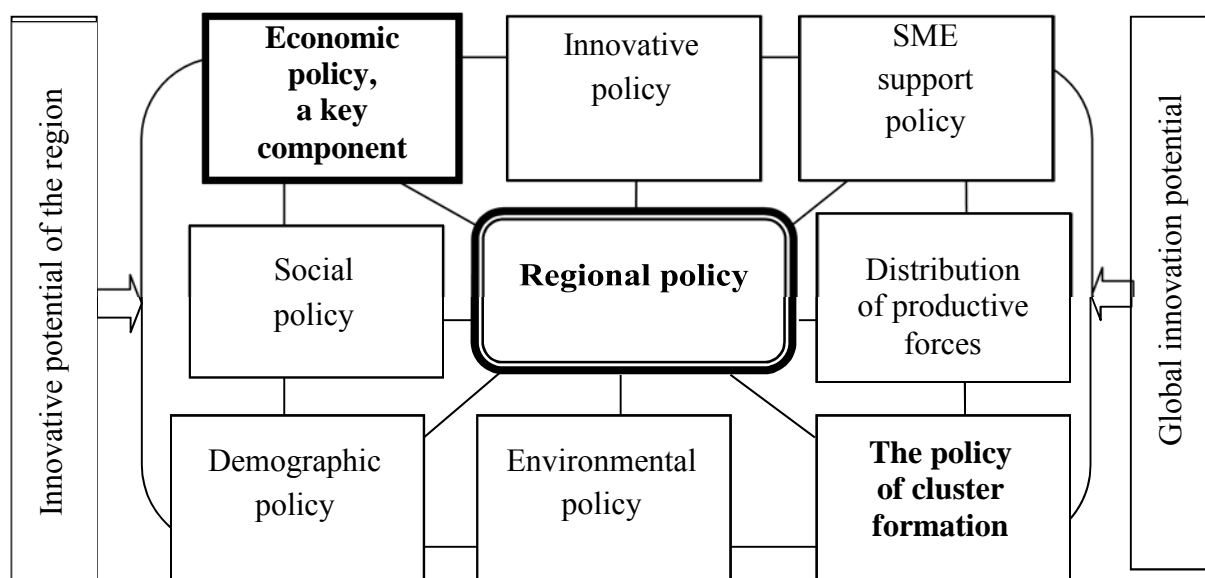
At the same time, firstly, the basic foundations of the implementation of such a policy should undergo changes – the ranges of regulatory influence and a clear delineation of the target value of those management tools that will be used by regional authorities in order to achieve the set goals. One of these tools is the innovative educational cluster (IEC), the implementation of which in the regional management system should create favourable conditions for the development of the business environment in the formation of the smart economy and ensure the balance of its needs with the capabilities of the educational system [8-12].

The expansion of the boundaries and components of regional socio-economic policy due to the latest processes is a positive phenomenon, which has managerial and technological innovations as guidelines, the synergistic involvement of innovative tools [13-15], institutions, effective legal support and organizational

support within regional management. In this context, special attention should be paid to expanding the boundaries of Ukrainian regional socio-economic policy through the development and implementation of cluster policy. However, the toolkit of Ukrainian regional management for developing and implementing the basics of cluster policy is still in the phase of its initial formation and accumulation of basic concepts and terms, due to which the elements of real implementation in the form of strategic plans, tasks, principles, and strategies are actually missing.

In a practical management sense, regional policy is the basis for the formation of a strategy and sequence of actions of authorities in matters of the economy and social sphere, as well as organizational support for all participants in the clustering process. Regional policy, by its very nature, consists of a certain number of components and undergoes certain stages of formation in accordance with current needs, economic and social interests, actual and scientifically justified changes.

A generalized vision of regional policy as a complex phenomenon within the regional economy is presented in Figure.



**Figure. Generalized vision of regional policy as a complex phenomenon**

Source: compiled by the authors.

Expanding the vision of the boundaries and components of regional policy is a progressive direction of movement in the knowledge system of regional management. Active transformations in the internal regional business environment, increased competition between the countries of the world, the lack of control of the processes of globalization and economic integration of world markets and transnational corporations form the obligation to adjust the components of regional policy, to prove their compliance with the progressive changes observed in

the system of theory and practice of management and regionalists. Clustering of the regional economy should be the most progressive tool for implementing such changes.

According to the level of regulation, clustering can be regulated by state administration bodies or by the market environment. The first form is typical for the implementation of the state regional development policy, and primarily involves the achievement of a general socio-economic effect at the level of the state as a whole. At the same time, the interests of individual

participants (enterprises and organizations) may not be taken into account, or their expediency may be unprofitable. The second form of clustering is characteristic of private capital. It takes into account the interests of all participants as much as possible and, in accordance with the laws of the market, optimizes the process of creating added value by combining them. Economically weak participants are eliminated and do not function for a long time. The second form of clustering, despite its higher economic expediency, can lead to regional development disparities, which endangers the achievement of social development goals [16].

Thus, various forms of economic clustering are expressed to one degree or another for all processes of cluster formation. At the same time, it is important to emphasize that the formation of clusters occurs in real life simultaneously in several forms. Each form highlights only certain features of the cluster formation process. Therefore, the multifaceted development of clusters determines the variety of forms of economic clustering [2; 16-17].

The global economy has accumulated experience in the formation and functioning of clusters, which should be taken into account when forming and implementing the cluster policy of the regions of Ukraine. World experience proves that the activity of the clustering process ensures sustainable economic growth of regions, expands business communications, improves culture and reduces social tension, and increases the competitiveness of enterprises. Harmonious and effective communications in the process of cluster formation form the further platform of knowledge management in business.

Analytics confirms that the highest level of development is achieved in those territories where the most favourable conditions for fruitful interaction between scientific, educational and business environments have been created, which has a positive effect on the functioning of the regional labour market. Undoubtedly, each structure has its own key interests, areas of planning, geography of activity, but the consolidation of their efforts around a common goal forms the prerequisites for the development of a competitive environment that functions according to the principles of self-regulation. International experience shows that there are no single rules by which to build an effective cluster policy. Here, everything depends on the peculiarities of the development of the business environment of the region: for one territory, a mono-profile model of clustering is suitable, for another, it is necessary to look for various options for sectoral diversification, which requires the support of regional and state authorities [18]. At the same time, there are established rules and principles, the implementation of which is mandatory to achieve the socio-economic effect expected from clustering.

In general, the goal of the regional cluster policy should be to eliminate disparities in the development of

business in the regions, stimulating regulation of the expanded reproduction of the economy and the creation of innovation-educational clusters at leading institutions of higher education (IHE). Such a goal is relevant for the regions of Ukraine in the form of an active movement towards the implementation of EU standards, it fully corresponds to the introduced reform of local self-government, and therefore must be carefully implemented in practice.

It is also appropriate to outline the tasks of cluster policy implementation, which are relevant and in demand under the current conditions of functioning of the regions of Ukraine:

- development of methodical support for clustering and especially IEC;

- justification, development and promotion of regulatory support for clustering;

- institutionalization of cluster culture;

- cooperation with international institutions implementing innovative projects and active work in the direction of obtaining national and international grants;

- formation of regional networks of business incubators, technology parks, technopolis and other infrastructural forms of support for small and medium-sized businesses [19-20] as components of innovative and educational cluster forms;

- development and promotion of targeted clustering projects – innovative, socio-cultural, educational, etc.

The general principles of the state regional policy are given in the State Strategy for Regional Development for 2021-2027, which was approved by Resolution No. 695 of the Cabinet of Ministers of Ukraine dated August 5, 2020. These principles include:

- legality – compliance with the Constitution and laws of Ukraine, international treaties, consent to the bindingness of which has been granted by the Verkhovna Rada of Ukraine;

- cooperation – coordination of goals, priorities, tasks, measures and actions of central and local executive authorities, local self-government bodies, ensuring cooperation between them during the formation and implementation of state regional policy;

- parity – ensuring the conditions of equal access of stakeholders to the possibilities of state and regional financing of programs of innovative development of the territory;

- openness – ensuring free access to information that defines state regional policy and is at the disposal of state authorities and local self-government bodies;

- subsidiarity – transfer of authority to the lowest level of management for the most effective implementation;

- coordination – interconnection and coherence of long-term development strategies, plans and programs at the state, regional and local levels;

- unitary – ensuring the integrity of Ukraine in terms of territory, political currents, socio-economic policy, etc.;

historical continuity – preservation, dissemination and orientation to the experience of previous stages of socio-economic development of the region;

compliance with the principles of sustainable development – the development of society to meet the needs of the current generation, taking into account the interests of future generations;

objectivity – development of all documents defining state regional policy based on real indicators that are likely to be achieved and that can be evaluated.

A thorough assessment of the listed principles will allow outlining the recommended principles for the development and implementation of cluster policy as a component of regional policy, namely: scientific content and connection with innovative scientific developments;

complexity in analysis, diagnosis of processes, decision-making; synergistic combination of knowledge (management, regional studies, entrepreneurship, innovative management and marketing, etc.); optimization of costs, time and resources; involvement of specialists with certain qualifications and relevant work experience; orientation to the world's leading experience accumulated in the field of clustering and implementation of cluster policy at the regional level.

The generalization of the basic principles of the research in relation to the leading foreign experience allows us to systematize the conditions for achieving the success of the cluster policy and to establish the basic limitations underlying its effectiveness (Table 1).

Table 1

**Systematization of leading experience in the field of creation innovative and educational cluster and substantiation of the basic limitations underlying the effectiveness of the cluster policy**

Conditions for successful functioning of the cluster	Meaningful interpretation of the cluster functioning conditions	Basic restrictions on the fulfilment of conditions for cluster functioning
A favourable legislative and tax environment for the functioning of an innovation-type cluster	Provides preferential conditions for starting a business that is based on innovation for development and modernization promising industries for the regional economy	Substantial state support is received only by those cluster initiatives for which the potential of economic growth and the prospects of innovative creativity in creating added value have been proven
High scientific and educational level of the institution of higher education, on the basis of which it is planned to create the IEC	The creation of the IEC on the basis of leading higher education institutions should become a guarantee of the future market success of the business entity through public trust in higher education institutions and a guarantee of providing it with highly professional specialists and innovative ideas	The selection of higher education institutions for the establishment of IECs should be carried out on a competitive basis, where the criteria are the availability of experienced specialists and resources, the effectiveness of the higher educational and scientific activities, the rating of higher education institutions in the national and international educational and scientific environment
Close relations between all participants of IEC (educational, scientific, business institutions and local authorities)	Prevention of obstacles and reduction of time for transmitting information, obtaining necessary data, responding to internal and external challenges and making effective management decisions should ensure the profitability and competitiveness of the cluster, the mutual appropriation of the latest knowledge by cluster participants	Preference should be given to those clusters in the activities of which participants not only use the latest technologies and innovations, and those that create new knowledge, capable of radically transforming the regional economy on the basis of achieving a synergistic effect
Development of business incubation processes at the initial stages of creating a cluster on the basis of one of its participants, usually in IHE with provision of service support	The purpose of creating a business incubator is the accumulation, stimulation and selection of viable and competitive ideas with their subsequent bringing to the level of practical implementation by providing advisory, mentoring, educational, scientific and organizational services according to the needs of a specific start-up	The business idea that is the basis of the start-up must meet following requirements: to be attractive to investors; have environmentally friendly production technology and final product; to be based on innovative and resource-saving approaches to conducting business and producing a finished product; continuous professional development of personnel involved in the practical implementation of a business idea

Source: compiled by the authors.

The regulatory and legal field of Ukraine regarding the regulation of the issues of creating clusters and regulating the activities of business incubators is not

sufficiently developed and powerful, but the beginning of its formation can be counted from 1999, when the Resolution of the Verkhovna Rada of Ukraine “On the

Concept of Scientific, Technological and Innovative Development” was adopted of Ukraine, which declared the expediency of the implementation of new educational programs and the development of a system of continuous education (upgrading the qualifications of personnel) in science, production, and the service sector, the formation of science-intensive production processes for the development of innovative structures, namely technology parks, incubators, centers, etc. This document also emphasizes the need to realize the exceptional role of science and innovative activity in the socio-economic revival of Ukraine.

At the same time, even in the absence of a perfect special legal framework in the field of cluster policy in Ukraine, it is possible to assess the existence of a regulatory basis for the creation of the IEC, provided that there are cross-cutting positions in the regulatory and legislative acts that regulate the basis of the joint activities of its main participants.

Any state intervention in the economy, and in our case – the application of various methods and tools for stimulating the processes of clustering of the innovative and educational space of the region, should take into account not only the possibilities (resources and potential) of the development of clusters in the

respective region, but also the expediency of stimulating these processes.

The analysis of world experience regarding the functions of the state (targeted regional policy) in the process of developing clusters allows us to talk about the performance of the following functions by the state:

regulatory – defining the rules of interaction of all cluster participants (the state itself, i.e. regional authorities, business, scientific and educational structures);

stabilizing – creation, preservation and development of favourable conditions for investments, innovations and connections between cluster participants;

entrepreneurial – the state, represented by regional authorities, acts as a direct participant of the cluster, and can also be the owner / co-owner of enterprises and organizations (educational, scientific, etc.).

At the same time, the main function of the government within the framework of the cluster policy should be stimulating, based on the creation of favourable conditions for the formation of innovative and educational cluster forms in the region. In order to determine the priorities of such stimulation, the author's conceptual vision of the goal, tasks and measures within the framework of the regional cluster policy of the region is proposed in the work (Table 2).

Table 2

**Conceptual vision of the regional policy of clustering on the basis of stimulation of the innovative and educational space of the region**

Component	Content
Goal	socio-economic development of the region based on innovative and educational forms of clustering; creation of conditions for formation, functioning and development of IEC
Tasks	increasing the level of competitiveness of the region; territorial socio-economic integration and spatial development; formation of a system of sustainable relationships between government, business, science and education; growth of business and innovative activity of business entities; improvement of the investment climate, investment attractiveness of regions, expansion of sources of development financing; business development, human development; development of systems of science and education, primarily higher education
Principles of formation	general principles of state regional policy: legality, cooperation, parity, openness, subsidiarity, coordination, unitarily, historical continuity, compliance with the principles of sustainable development, objectivity; principles that take into account the peculiarities of the operation of the IOC: innovativeness, competitive partnership, closeness of the technological and organizational cycle, readiness for cooperation, a common defined goal (synergistic effect)
Content of events	development and ratification of the legislative framework in the sphere of functioning of clusters; support for possible areas of integration of business, science and education; targeted funding and financial support for the creation and operation of clusters; justified tax regulation of activities of potential and actual participants of the cluster; primary stimulation of the functioning of clusters, which are among the most promising types of activities for the economy of the region; increasing the quality of the education system and professional training of specialists in the region; ensuring the availability of leading innovative knowledge and dissemination of information about the latest technologies created within the cluster; reduction of regulatory barriers to the creation of new innovative activities
Methods	administrative, economic, legal
Levers	crediting, financing, taxation, provision of benefits
Types of events	organizational, consulting, regulatory, resource, integration, support
Socio-economic effect	acceleration of regional development; increasing the profitability of business entities; increase in the level and quality of life of the population of the region

Source: compiled by the authors.



Depending on the specifics of the methods and tools, four main variants of the state's stimulating policy regarding clustering are used in global practice: functional state policy based on the creation of favourable conditions for the unification of interested parties in the creation of a cluster or business incubator; supporting policy, where the role of the state is to direct and support infrastructure investments; the regulatory policy of the state, which, along with comprehensive support for programs for the creation and operation of a business incubator, contains regulatory-type measures to change or expand the specialization of the region by types of activities; the policy of the state's responsibility for the promising and successful development of a cluster formation, which is manifested in the implementation of specific protective measures, such as subsidizing or reducing regulatory pressure [7; 21].

#### Conclusion and prospects for further research.

The main goal of the economic policy of clustering based on a systemic vision of the innovative and educational space of the region should be socio-economic development due to the introduction of

innovative and educational clusters, as well as the creation of conditions for the formation, functioning and development of a smart economy. The system of measures to stimulate smart economy clustering processes must comply with certain principles: firstly, general principles of state regional and vectorial economic policies, secondly, principles of creation, distribution and functioning of clusters, in particular IOC.

The policy of clustering the innovative and educational space of the region is a component of the general state regional policy and must be coordinated with other directions of regional policy, in particular with economic, structural, and branch policies. At the same time, the main instruments for the implementation of the cluster policy at the regional level must be clearly justified, the conditions for the implementation of the relevant instruments must be outlined, and the territories where it is economically expedient to implement innovative and educational clusters in the smart economy must be determined. This will become the direction of further scientific research.

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#### **Якушев О. В., Трушкіна Н. В. Інноваційно-проектні кластери в системі формування конкурентоспроможності та економічного розвитку регіональних мистецьких освітніх закладів**

Статтю присвячено актуальним питанням розробки та впровадження регуляторної економічної політики у сфері створення інноваційно-освітніх кластерів як інструменту формування смарт-економіки. Надано та обгрунтовано узагальнене бачення регіональної політики як комплексного явища. Доведено та системно аргументовано концептуальні основи формування кластерної політики регіону, що, на відміну від наявних, базуються на алгоритмі сценарування, розробленні цільових планів та проектів розвитку окремих регіонів, обгрунтуванні спрямованості заходів сприяння розвитку кластерів, визначенні методів, важелів та доцільних видів управлінського впливу, реалізація яких на рівні регіону дозволить досягти соціально-економічного ефекту для кожного учасника кластерної взаємодії.

Надано концептуальне бачення регіональної політики кластеризації на основі стимулювання інноваційно-освітнього простору регіону та визначено базові принципи, що повинні забезпечити успішну реалізацію управлінського регуляторного впливу – наукоємність та зв'язок з інноваційними науковими доробками; комплексність в аналізі, діагностуванні процесів, прийнятті рішень; синергетичне поєднання знань; оптимізація витрат, часу та ресурсів та інших.

*Ключові слова:* інноваційно-проектні кластери, економічна взаємодія, конкурентоспроможність, економічний розвиток, мистецькі освітні заклади, смарт-економіка.

#### **Yakushev O., Trushkina N. Innovative Project Clusters in the System of Forming Competitiveness and Economic Development of Regional Art Educational Institutions**

The article is devoted to pressing issues of development and implementation of regulatory economic policy in the field of creating innovative educational clusters as a tool for shaping a smart economy. Provided and reasonably generalized vision of regional policy as a complex phenomenon. The conceptual foundations of the formation of the cluster policy of the region are proved and systematically argued, which, unlike the existing ones, is based on the scenario, development of targeted plans and development projects for individual regions, substantiation of the direction of measures to promote the development of clusters, determination of methods, levers and appropriate types of managerial impact, implementation which at the regional level will achieve a socio-economic effect for each participant in cluster interaction. The conceptual vision of the regional policy of clustering is provided on the basis of stimulating the innovative and educational space of the region and the basic principles are determined that should ensure the successful implementation of managerial regulatory influence – the knowledge-intensiveness and the relationship with innovative scientific developments; complexity in analysis, diagnostics of processes, decision making; synergistic combination of knowledge; optimization of costs, time and resources and others.

*Keywords:* innovation project clusters, economic interaction, competitiveness, economic development, art educational institutions, smart economy.

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## STRENGTHENING THE ECONOMIC INTERACTION OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN THE INNOVATIVE DESIGN OF ACTIVITIES OF EXTRACURRICULAR EDUCATIONAL INSTITUTIONS USING ELECTRONIC EDUCATIONAL RESOURCES

**Introduction.** The problem statement. Modern education system in Ukraine must overcome essential digital alterations to relate to global tendencies of digital evolution to cater for realizing any personal potential.

The increase of demands for the staff professional competence in HEIs forces to quickly adapt to information environment, being competent in various practical situations for applying electronic means of teaching, therefore evolving digital competence is quite important in theory and practice of professional training.

Teacher's proficiency is absolutely decisive for teaching at HEIs. According to official standards of quality in teaching modern universities must secure the development of teaching staff professional competence applying transparency for the staff personal involvement [1, p. 190].

In the National economic strategy for the period till 2030, educational and scientific matters are given key positions in several directions of economic development, including direction 8 "Informative and Communication Technologies", mainly in its part on introducing computer techniques into social infrastructure units and on promoting digital skills for population, and also in direction 20, "Quality of Life", in part of raising living standards of the Ukrainians in general [2].

Introducing modern informational and communicative technologies (further ICT) that improve processes of education and upbringing, secure accessibility and efficiency of education was approved in 2013 National Strategy of Education Development as its prior task [3]. Besides, the Concept for promoting digital economy and Ukrainian community actualizes the tasks for digitalization of education, including creating educational resources and digital platforms supported by interactive and multimedia content in general access, and instruments of automated main processes in educational establishments, working out and introducing innovative computer, multimedia and computer oriented education means and equipment to create digital educational environment [4].

To fully execute proficient functions in staff competence complex, digital competence was singled

out as an essential element and a key competence for digitalizing educational activities.

The main problem of digitalizing the education is insufficient level of staff digital competence. Old fashioned teaching methods, lacking digital competence standards, the relative system of improving proficiency in digital education for teaching staff and also low accessibility to digital techniques for all agents of the processes resulted in low level of teaching staff competence in all factions of state educational system [5].

Digital competences include skills of applying, filtering, evaluating, creating, projecting and expanding digital educational resources [6, p. 211]. Hence acquiring digital competences is signified as a part of basic demands and needs education system must ensure their acquisition by the students and the staff as well as development of digital infrastructure, electronic services and electronic educational resources (further EER) at HEIs.

Digital competence is based on applying digital techniques, means of communication, management, integration, evaluation, creation and transmission the information ethically and lawfully for taking active part in informational and educational community. Digital competence contains skills of working in digital information and communication environment, perceiving and critical measuring of the digital and media content, efficient and safe application of digital means to solve various professional tasks.

This need is as well deepened by corona virus pandemic consequences that affected the problem of studying digital techniques by teaching staff at universities to manage teaching in distance and mingled learning and its resource support through necessary education means.

It is educational transformations that are under way in teaching community that demand related competences of teaching staff that may be arranged within improvement promoting syllabi.

Under the documentary instructions on promoting qualification improvement for teaching and scientific staff approved by the Cabinet of Ministers of Ukraine

the main tasks are signified to enforce earlier obtained and/or to obtain new competences in the professional sphere or training considering the demands of the related professional standard, obtaining the experience for doing optional tasks and taking optional duties in occupation and/or professional activity, and/or in job position, creating and evolving digital, managing, communicative, media, inclusive, speaking competences [7]. Therefore, these documents enable organizing qualification improvement for teaching staff and scientific employees at private and corporate educational institutions by the establishers or entitled foundation bodies.

Hence, there emerges a need for new approaches and organization patterns of the teaching staff qualification improvement including institutional open educational systems (further OES) for professional enforcement with which teachers are trained in job positions, in working surroundings when the re-preparation goes alongside with managing processes of introducing ICT at HEIs.

Solving tasks of the teaching process with EER is grounded through goals of digital education that officially is treated as “combination of various components and most updated technologies as a result of digital platforms application, new information and educational techniques, progressive forms of academic activity and pro-active teaching as well as quite up to date educational content” [4].

Problems of creating and applying models and choice making methods for ICT to create and making EER projects for OES at HEIs within qualification improvement syllabi aimed at digital competence for teaching staff in digitalization of educational processes, active application of techniques of mingled and distance schooling in quarantine periods at HEIs.

Creating EER is aimed at securing modern standards for teaching, managing accessibility for all participants of the academic process to get excellent ICT learning content, irrespective of their habitat and form of education [8].

**Theoretical framework.** Ukraine’s scholar outlet is represented in writings by V Bykov, M. Leschenko, Yu. Zhuk, N. Morze, O. Spivakovsky, M. Zhaldak, S. Lytvynova, R. Hurevich, A. Hurzhiy etc. who are broadly dealing with problems of ICT efficient application in academic learning, that regard evolving professional and digital competence, applying information techniques for learning, training teachers to professionally activate through digital techniques.

Ukrainian scholars, V. Bykov, M. Leshchenko, A. Yatsishin [9-12] are working out problems of open education, educational environment, means and methods of open education, open teaching systems, digital transformation in academic learning, introducing digital techniques.

Collective monographic edition [6] represents modern paradigms for working out teacher’s personal informational and digital competence, signifies the

model, factors and specific features of this competence in the system of teaching postgraduate training courses.

Therefore, universities should be transformed into Smart-universities that are conceptually based on informative and educational environment (IEE) which contains electronic content and interaction techniques of all participants of the academic process as it is regarded in publications by O. Buinytska and B. Hrytseliak [13].

In the article by S. Karplyuk [14] the notion of digitalization is regarded, the task and possibilities of digitalized education activity in modern HEIs are signified, with the system of digital competence including information resources, telecommunication and management.

Education system influenced by digital techniques and main notions for electronic teaching paradigm are regarded by V. Sedov considering that recent needs for the specialists are those in persons who are able to create educational routes and guide students along those routes, to work out on-line courses, education on-line platforms [15].

Yet foreign and Ukrainian scholars differently interpret competences connected with ICT, through applying various terms to signify similar skills and abilities like information and communicative competence, electronic competence, digital literacy, etc.

Foreign researchers regard digital competence as an ability to apply digital resources and information techniques, to perceive and critically evaluate digital resources and content, to exercise efficient communication [16], knowledge, skills, frameworks, necessary for the ICT and digital media to do tasks, problem solutions, information management, cooperation, communication, education [17].

Admitting digital competence as most upgraded concept to describe technological skills, Ukrainian scholars N. Morze, S. Vasylenko, M. Gladun define digital competence of a university lecturer (information literacy, communication and cooperation, creating digital content, safety and problem solution) [18].

O. Myroshnychenko gives definition to digital competence as an integrated ability to timely, critically and safely in professional area to choose, create and change digital resources, exercise their management, secure them and spread, apply them to teaching that increases possibilities for students and their digital competence. The author suggests the structure of digital competence: information and search competence, on-line communicative competence, safety and technical competence [19].

Improvement of teaching qualification in jobs, within framework of project for introducing mingled education, making EER projects for open systems in qualification enforcement are main matters in the article by O. Shcherbyna [20; 21].

Education environment at HEI in which learning and education management are realized is represented by EER that is ruled through skills and abilities of digital competence.



EER sense, content and typology are regarded in publications by V. Bykov, V. Lapinsky [22]. As the author states, EER or subject and information resources for education purposes are means for teaching in electronic models that are presented in teaching systems by electronic information sources [10, p. 417].

However, problems of making EER projects with ICT for qualification enforcement as a demand for the personnel employment in education programs require further research.

The research goal is to signify instruments and methods for ICT to create models in making projects, creating and applying EER in education that is solved within teaching staff enforcement programs.

**Methodology.** To obtain the settled goal, the method of system analysis was employed that enabled to single out the scholar investigation strategy. Therefore, structural and functional approach is applied within the method that is defined through decomposition of structure elements in open education environment as integrate and complex system and through presenting its components, and also the process approach to signify and describe EER processes preparation.

Modeling method is applied to build up a functional model in the processes of creating computer oriented environment in making EER projects. The method presupposes CASE technologies application based on application of instrumental means for structure analysis and modeling. According to the created project model and EER creation for the open education environment, the Rauf Ablyazov Eastern European University (Cherkasy, Ukraine) had worked out the integration project to introduce academic content delivered to be employed for teaching in the mingled and distance education techniques.

**Results.** One of prolific trends in reforming higher education is creating electronic courses in subject learning and introducing them into academic process. As electronic training system is presented at HEIs, students can be taught in decent hours and deliver their personal learning route.

E-learning (or electronic learning) is system of electronic education synonymous to such terms as electronic education, distance education, ICT training, network training, virtual ICT learning [23, p. 46].

E-learning can be classified according to means of obtaining learning content: synchronous (webinars, video conferences, document processing) and asynchronous learning (Email, file exchange, podcast, open on line courses). Within E-learning paradigm, trends and approaches were singled out, such as open learning resources (resource oriented education), education management system and mobile learning created to support distance learning that now is well applied in hybrid learning, community open on line courses, inverted class etc. [15, p. 75-76].

E-learning instruments include:

– student's personal room that is a personalized virtual working environment with all information and

access to resources and supplements employed in learning;

– depository of full text teaching content needed for keeping, searching and giving regular access to various learning instruments;

– interactive testing system that serves to monitor learning through testing;

– webinar service to exercise distance learning and consulting;

– repository of learning video content.

Hence, e-learning is a teaching paradigm based on open education resources, decentralized education activity and employed information technologies such as on line courses, digital resources, web-services, mobile applications.

Open education resources are digital education content for staff and students in the open environment that are spread with open license. For example, lecturing notes, video courses, scientific journals and publications [15, p. 76].

According to the degree of investigation area, to the form of teaching content, teaching methods, presence/absence of possibility of academic communication and ways of monitoring learning progress, open learning courses that are divided into two groups:

– separate digital learning and scholar resources in open access (manuals, textbooks, lecture notes, audio and video content, drills, tests, practical courses, scientific articles, monographic publications, databases);

– community open online courses (COOC) located on present online learning platforms (Universarium, Uniweb, Coursera, edX, Udacity).

Education programs, introduced in Ukrainian HEIs, demand appropriate methodology in learning that needs to be constantly revised, renewed and actualized. Usual time norms for self-preparatory learning imply 2/3 of class hours to promote quality learning as it is impossible to do without EER.

EER is normally defined as means of digital teaching or teaching instruments located in the information tele communication systems that are presented through electronic technical means and are applied in academic activity [8].

According to functional attributes, EER are divided into electronic editions (electronic version, copy, analogous edition) of printed book, e-book, e-practice tests, e-reading books, e-lecturing, e-manual, e-game resource); e-references (e-reference editions, e-encyclopedia, e-dictionary); e-practices (collection of virtual laboratory practices, e-recommendations in methods, e-workbooks) [8].

Most popular in the system of qualification enforcement is hybrid learning that is education model that combines digital and traditional modes of teaching. In this model students combine class learning and on-line studies.

Distance learning (DL) practiced in most Ukrainian universities and in the Rauf Ablyazov Eastern European University (Cherkasy, Ukraine) (further

RAEU) employed as a technology based on the open education principles widely applying computer programs of various aims and creates through modern tele communications information education environment for content learning and communication.

RAEU employs specialized software, system of distance learning (SDL) “Prometheus” that supports: obtaining and evaluating knowledge in the I-net environment, in corporate and local networks, sharing access to education resources and system management means; registering participants’ activities in the learning complex, dividing intercommunication among students, managing learning process. Electronic components of the syllabic complexes are located in single information and education environment of the RAEU on the SDL “Prometheus” basis. The system is presented through 2500 electronic education and methodology complexes, about 900 subjects that employ testing system, database constantly renovating [24].

Local normative documents regulating qualification enforcement at the RAEU should mention ways and types of EER that are initially chosen and later, appropriately introduced, and what preparations should be made, whereas next stage should be staff training in creating and employing the EER chosen. According to the results of the training, EER for subjects taught by the staff are created and located in the virtual environment.

Open system concept for staff qualification enforcement is based on main principles, models and methodical system of teaching that presuppose scaling of academic activities, collective work of teaching in small groups, teachers’ independent work with distance learning techniques [25]. OES that is SDL “Prometheus” at the RAEU, is presented as both the main studying object and means of staff teaching and monitoring the ICT in the University academic studies.

Methodology basis for creating and employing EER in teaching personal subjects should be the combination of two interconnected components: technological (teaching the staff to necessary ICT) and applied (applying ICT in teaching personal subjects) [25].

Tendencies to increasing importance of staff qualification improvement in OES, combination of various forms of learning through expanded employment of ICT resulted in emerging computer orientated environment for making EER projects that is a directed process for obtaining knowledge, skills and abilities in the integrated class and extra class activities of students and staff based on mutual complementation of technologies of traditional, electronic, distance and mobile learning.

Education process model should contain the stage of building up and adaptive supporting of the relevant academic course that can be regarded as a personal web environment for learning. In it, to promote the learning process electronic teaching and methodology content should be located, exactly: distance courses of the

teaching modules, e-books, electronic information content, test works.

Staff quality enforcement at the University can be also regarded as corporate education. Both corporative learning and progress management deal with knowledge exchange and founding communities for spreading knowledge. DL in the context of sustained learning and progress management (PM) are solving similar tasks: learning, ability to solve working tasks, to take efficient decisions and positively affect the surrounding community. PM is of dynamic nature, it supplies with actual knowledge, though with time, this knowledge appears to be not quite well shaped and cannot be applied for learning courses. Instead, DL is focused on verified and well structures knowledge through special syllabi that are often quite static. The drawback here is that such knowledge can lose its novelty characteristic for PM tasks. Hence, the architecture of classical SDLs cannot cater for the demands of progress management processes [26].

To realize sustained learning for the staff oriented on digital competence, the concept is appropriate to be applied: PM is regarded as a repository and learning process is the one to apply this repository. The latter secures safety and search of objects and also their being uploaded by the users.

The main sense and material for the SDL is digital learning content, any academic stuff represented through digital data or I-net references to such stuff. In connection with specific teaching tasks for DL on presenting education content, special classes of systems became popular that serve to manage learning content and teaching processes: CMS (courseware management systems), LMS (learning management systems), LCMS (learning content management systems), SDL – systems of distance learning, the term is appropriate for systems in Ukraine [26].

Results of comparing LMS and LCMS obtained by Brandon-Hall Research Group [27] testify that as environment to support combined learning LMS are better for application. Most popular LMS systems are Moodle, OPEN EDX, Blackboard, Claroline, Dokeos, ATutor, ILIAS, OLAT etc.

In the context of general project for introducing ICT in the University, in various types of EER ICT are considered as its separate stages. Such projects are quite complex in arrangement if consider their participants and complexity of tasks to be solved [25].

Among recent methods for making projects, CASE technologies are most efficient as those based on instrumental means of structure analysis and modeling. Irrespective of either the model exists, or is being under project there are some models of structure analysis that can fully describe the system. Most popular among them are SADT, models and related functional diagrams DFD, diagrams for ERD data streams, diagrams “sense-connection”. To solve the tasks of complex systems modeling, there was founded family of standards and methodology ICAM that consists of IDEF0, IDEF1-

IDEF14. In practice, SADT is structured with IDEFO notation suggested by Douglas Ross [28].

For functional modeling in processes of creating computer oriented environment while making EER projects for staff quality enforcement, IDEFO model is chosen. This methodology is noted for its focus on hierarchy of objects. IDEFO standard regards logical relations of stages but not their successive order and is represented as a set of modules connected with activity arrows (ICOM). Basic model description is presented in detail as much as the level needed through decomposition diagrams reproduced in notations IDEF0, IDEF3 or DFD [21]. Upper level diagram describes general process of creating and teaching academic course with EER applying. Special model for making EER project for open learning environment is given through functions of investigating the current state

of the environment, creating LMS programming modules, working out EER, as well as learning process proper and qualification improvement (see figure).

Process “Investigation of current situation in education environment” is described through functions of checking teachers’ competence level at ICT, analyzing university IT-infrastructure, investigating university network and network resources and also further dealing with proposals for improving education environment. Initially the model obtains information about teachers’ competence, education environment infrastructure, information system currently applied and experience of other education institutions. Finally, the model forms analytical report on HEI infrastructure, local network analysis results, staff ICT competence report and proposals on its improvement.

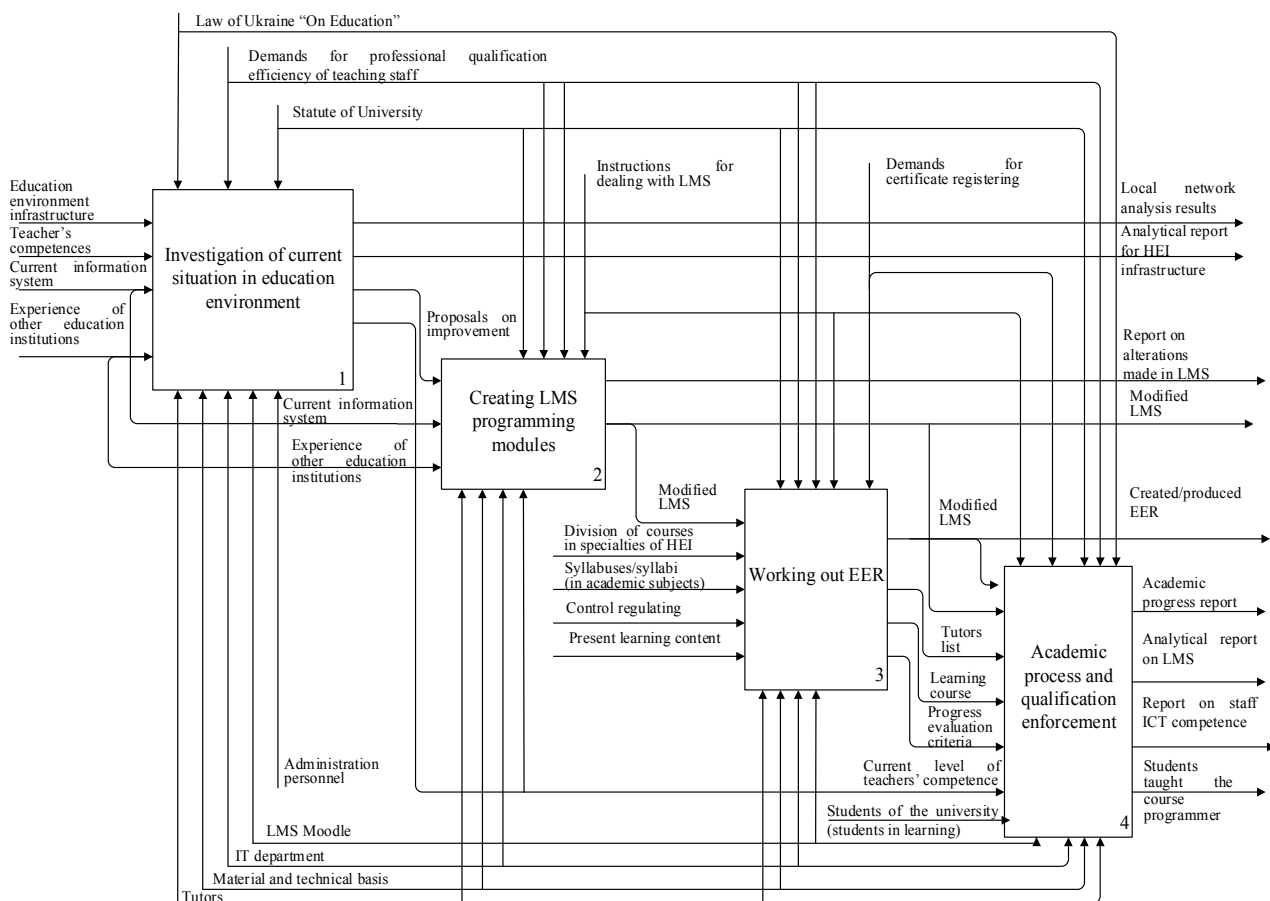


Figure. Decomposition diagram "Designing EER for open educational environment"

Function “Creating LMS programming modules” can be divided into sections: making projects for subsystems to identify the users, projects for subsystems of access to courses, fixing means of creating electronic learning resources and also means of monitoring and control. Initial positions show the model with the proposals for improvement that are formed in the previous functional block and with data for current information system and experience from other institutions.

Function of creating learning content by teaching staff of the institution can be divided into parts that are included as types of work into the diagram of decomposition “Working out EER”: teachers’ corrections of the learning platforms, preparing course discipline structure, creating learning content, control and test tasks. The initial stage for the model is modified LMS, syllabuses in academic subjects, present learning content, control regulating, division of courses in specialties of HEI. Final stages present tutors list, the list

of ready-made EER, progress evaluation criteria and completed electronic learning courses.

Functional block for academic process promotion and staff qualification enforcement contains the following elements: users' initial activity in the system, their progress at perceiving learning content, doing current testing tasks, final tests in course subjects and evaluation of competence level at ICT for tutors. This model starts with introduced academic course, tutors list, list of produced EER, progress evaluation criteria, current level of staff competence, student audience and modified LMS. The model final stage presents academic progress report, list of students taught to complete academic course, LMS analytical report and report on current level of teachers' ICT competence.

This suggested model allows realizing recommended approach to creating and applying EER in academic process for OES at HEI that promote staff digital competence.

From systematic point of view, EER projects can be regarded as artificial, direct managed system that promotes staff quality enforcement to project, create and apply EER, to manage process of introducing this system into schooling. Key elements of computer orientated environment at HEI are LMS projecting issues that really matter.

Introducing ICT at HEI can be directly connected with staff learning through involving learners to introducing a certain EER type [28].

In relation to the model there was created the project of integrating EER into the learning process at HEI including four main stages: 1) preparatory work (IT infrastructure analysis); 2) projects in computer orientated OES; 3) OES information content; 4) further LMS system employment by tutors at HEI.

To realize the project at the RAEU, the team was formed that includes project manager, course coordinator, analyst, system administrator, programming engineer, test manager, manager in audio and video projects, tutors.

The project is developed in PMBoK standards containing description of the project organization structure (outer and inner structure and project working team, working structure including WBS, CBS, CTR-dictionaries, matrices of responsibility). Project calendar and network planning is promoted. Its visual appearance is presented through Gant's diagram.

Main output of the project is LMS system integrated into learning process of the HEI (for example, Moodle / OPEN EDX) together with specially created modules and also EER made on its basis.

Projects in EER for OES at HEI include four principal stages: preparatory that implies IT infrastructure analysis for HEI, correction stages for computer orientated environment, its information content and LMS application (for example, Moodle/ OPEN EDX) by tutors.

Calculations were provided for economic profit of the project promotion and approximate price of its

operating by the team of various specialists during 352 working days. According to calculations, the project's price including wages for participants, amortizing expenses, social insurance fund payments and material expenses will make 327 500, 4 hrn. As LMS promotion will allow the university to improve competing positions and as a result attract more applicants, the term for the system to become profitable can be stated as that resulting from university's profit from additional fees compared with average fees obtained before. Optimal level makes 125 000 hrn a year, so the project can become profitable in 2 years and 8 months.

Transmission to education process based on active LMS employment and on staff quality enforcement based on ICT will allow HEI improve rating among other institutions and increase number of applicants at the expense of competing terms of schooling that is organized in electronic (distance) or hybrid format.

**Conclusion.** Task of promoting modern ICT into education process through university projects synchronous to programs of staff qualification enforcement in jobs is still important. Level of learning activity at the HEI depends on well-prepared workers ready to act professionally in hybrid and computer learning, so constantly acting system of qualification improvement is considered a means of their digital competence.

Digital competence should promote wide range of its elements: from media literacy to processing and critical evaluation of information data, safety and cooperation in the I-net to digital techniques and devices, ability of applying open resources and techniques for professional progress, for teaching students to use digital resources and services in studying and in private life, to solve various problems and tasks, to apply new technologies for evaluating their learning output and solving professional matters with digital technologies.

Complex attitude to solving ICT promotion problems can be exercised through creating open systems for staff qualification improvement.

ICT integration into learning process should be accompanied by proper preparation of staff and students to cooperate and interact in modernized information and education environment at HEI. Suggested model of creating EER for OES at HEI is regarded as modern tendency in digital infrastructures and can be related to prospective projects for digital transformations on local scale in education sphere in harmony with European and global education and scholar initiatives.

Staff qualification enforcement for OES, combination of different forms of teaching with broad application of ICT means create computer orientated environment for EER projects that may be substituted by LMS and LCMS.

Further research can be presented as creating and promoting automated management of business processes at HEI and training for digital transformation of education.



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### **Манькута Я. М. Посилення економічної взаємодії інформаційно-комунікаційних технологій в інноваційному проектуванні діяльності позашкільних освітніх закладів з використанням електронних навчальних ресурсів**

Стаття присвячена питанням формування цифрової компетентності педагогічних працівників освітніх закладів (ОЗ) у межах власної програми підвищення кваліфікації за місцем роботи. Зазначається, що питання проектування і розробки електронних освітніх ресурсів (ЕОР) з використанням сучасних інформаційно-комунікаційних технологій (ІКТ) актуалізуються в контексті цифровізації освіти, активізації використання технологій змішаного і дистанційного навчання в карантинних умовах роботи ОЗ.

У статті розглянуто основні підходи до визначення змісту цифрової компетентності викладачів; електронного навчання; основні види ЕОР, які формують відкрите освітнє середовище ОЗ. Визначено інструменти ІКТ і методику для побудови моделі проектування, створення і використання ЕОР. Підвищення кваліфікації викладачів у межах університету розглядається як корпоративне навчання, тому для його реалізації пропонується застосування концепції управління знаннями шляхом створення репозитарію цифрового навчального контенту. Серед сучасних методів проектування ЕОР найефективнішими вважаються CASE-технології, які базуються на використанні інструментальних засобів структурного аналізу та моделювання. Для функціонального моделювання процесів створення комп'ютерно-орієнтованого середовища проектування ЕОР обрано модель IDEFO.

Опис базової моделі «Проектування ЕОР для відкритого освітнього середовища» деталізується до необхідного рівня за допомогою діаграм декомпозиції. Специфіку моделі проектування ЕОР для відкритого освітнього середовища відображають функції дослідження поточного стану освітнього середовища, розробки програмних модулів системи управління знаннями, створення ЕОР, а також власне освітнього процесу та підвищення кваліфікації. Оскільки проект з упровадження ІКТ в ОЗ синхронізується з процесом підвищення кваліфікації викладачів через їх залучення до розробки і впровадження певного виду ЕОР, запропонована модель дозволяє подальше використання ЕОР в освітньому процесі.

У Східноєвропейському університеті імені Рауфа Аблязова (м. Черкаси) за стандартом РМВоК було розроблено проект, основним продуктом реалізації якого є інтегрована в освітній процес університету LMS-система разом із спеціально розробленими модулями, а також створені на її основі ЕОР.

**Ключові слова:** економічна взаємодія, інформаційно-комунікаційні технології, інноваційно-проектна діяльність, електронні навчальні ресурси, відкрите освітнє середовище, економічний розвиток, конкурентоспроможність, проектування електронних освітніх ресурсів, позашкільні освітні заклади.

### **Mankuta Ya. Strengthening the Economic Interaction of Information and Communication Technologies in The Innovative Design of Activities of Extracurricular Educational Institutions Using Electronic Educational Resources**

The article is devoted to the issues of forming the digital competence of pedagogical workers of educational institutions within the framework of their own professional development program at the place of work. It is noted that the issues of designing and

developing electronic educational resources (EER) using modern information and communication technologies (ICT) are actualized in the context of the digitalization of education, the activation of the use of mixed and distance learning technologies in the quarantine conditions of work of educational institutions.

The article considers the main approaches to determining the content of the digital competence of teachers; e-learning; the main types of EOR, which form the open educational environment of OZ. ICT tools and methods for building a model of design, creation and use of EOR are defined. Improving the qualifications of teachers within the university is considered as corporate training, therefore, for its implementation, it is proposed to apply the concept of knowledge management by creating a repository of digital educational content. Among the modern methods of EOR design, the CASE technologies, which are based on the use of structural analysis and modeling tools, are considered the most effective.

The IDEF0 model was chosen for the functional modeling of the processes of creating a computer-oriented EOR design environment. The description of the basic model "Designing EOR for an open educational environment" is detailed to the required level with the help of decomposition diagrams. The specificity of the EOR design model for an open educational environment is reflected by the functions of researching the current state of the educational environment, developing software modules of the knowledge management system, creating EOR, as well as the actual educational process and professional development. Since the project on the introduction of ICT in health care is synchronized with the process of improving the qualifications of teachers through their involvement in the development and implementation of a certain type of EOR, the proposed model allows the further use of EOR in the educational process.

At Rauf Ablyazov East European University (Cherkasy), a project was developed according to the PMBoK standard, the main product of which is an LMS system integrated into the educational process of the university along with specially developed modules, as well as EOR created on its basis.

*Keywords:* economic interaction, information and communication technologies, innovative project activity, electronic educational resources, open educational environment, economic development, competitiveness, designing of electronic educational resources, extracurricular educational institutions.

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## PLATFORM STRATEGIARCHY AS A TOOL FOR REDUCING INFORMATION ASYMMETRY, TAKING INTO ACCOUNT THE SCALE, CARDINALITY AND ORDER OF THE STRATEGY

### Formulation of the problem

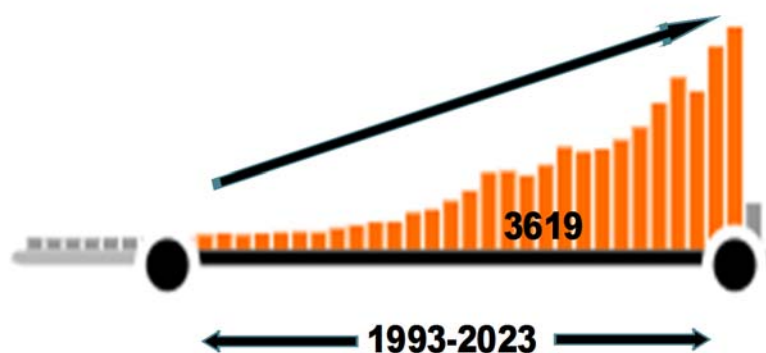
Information asymmetry is one of the key problems of modern economic theory and practice. Fourth industrial revolution does not solve this problem, but at the same time creates some opportunities to decrease it. The volume of information is constantly increasing at an accelerating rate. The possibilities for organizing this information without the use of artificial intelligence technologies for people and companies are exhausted.

Under these conditions, some people and companies cannot assess the intentions of others. As a result, activity is directed not at the coordinated construction of the desired future for all, but at the construction of one's own future through the futurocide of someone else's. For example, through deprivation of the last necessary development resources.

However, there is an opportunity to understand it much more broadly and deeply. The development of the platform economy creates both opportunities to overcome information asymmetry and its aggravation. This determines the relevance of studying this problem.

### Literature review

Problems associated with information asymmetry attract close attention of the scientific community around the world. For instance, over the past 10 years, the Scopus scientometric database alone contains more than three thousand publications related to this topic (Fig. 1) only in the three fields (Business, Management and Accounting – 2 183; Economics, Econometrics and Finance – 2 040; Social Sciences – 731).



**Fig. 1. Number of articles related to the study of information asymmetry in the Scopus database**

Scientific description of information asymmetry was done more than 50 years ago. “The foundations for this theory were established in the 1970s by three researchers: George Akerlof, Michael Spence and Joseph Stiglitz. They received the Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel, 2001, for their analyses of markets with asymmetric information” [1]. However, earlier (more than 200 years earlier) Emanuel Kant wrote “All actions relating to the rights of other men are wrong, if the maxims from which they follow are inconsistent with publicity.” [2, p. 185]. In fact, he emphasizes that there is an unacceptable

asymmetry of information in actions regarding other people if these actions cannot be public.

Now, in the age of the Fourth Industrial Revolution, we can see strong attention to asymmetric information in conditions of digitalization [3-7].

Mutascu and Sokic studied the asymmetric information in online social network. They came to the conclusions, that “many posted information wrongly passes the validation control, being profoundly altered from a qualitative point of view in reality. This suggests that the posted information without serious filters during the reading stage is a serious source of asymmetry” [3,



p. 14]. This indicates that digital platforms (for example, online social networks) create conditions for increasing information asymmetry. Which they try to reduce through improving the quality of user education or censorship.

Dong Quang Dang and others investigate information asymmetry on stock market. “Our findings confirm the two proposed hypotheses and are consistent with previous findings that earnings manipulations through accrual bases can distort the market and exacerbate the problem of information asymmetry. There are differences in outside investor’s abilities to process and analyse earnings-related information. So, low quality of earnings can divide investors into the informed and uninformed and exacerbate the information asymmetry in the stock market” [4, p. 15]. Position, that “information asymmetry has a positive effect on earnings management”, is supported by scientists from Indonesia [5, p. 84].

Some researchers show relationship between signaling theory and asymmetric information. They prove, that “signaling theory best explains the relationship between quality financial information and asymmetric information and thus, engaging in quality financial information can substantially reduce asymmetric information in capital markets and other economic dealings involving corporate firms and financial statements users” [6, p. 26]. As result “information asymmetry influences investors’ decisions greatly, causing fluctuations in the value of these companies in the financial market” [7, p. 15].

At the same time number of articles related to the study “strategy” in the Scopus database (1993-2023) is 2 486 322. But none of them is linked to “information asymmetry”.

The potential for reducing information asymmetry through the use of the general theory of strategizing [8] remains outside the focus of the scientific community. The practical implementation of the general theory of strategizing using a digital strategizing platform [9] forms the platform strategiarchy, a description of which will be presented below.

Consequently, the problem of reducing information asymmetry in various areas, both at the corporate and individual levels, remains unresolved.

### **Purpose of research**

Based on the review of the literature and unsolved research problem, the purpose of study is to substantiate the conceptual foundations of reducing information asymmetry using platform strategiarchy taking into account scale, cardinality and order of the strategy.

### **Presentation of main results**

The structure of the study assumes the following logic. At the first stage, it is described what strategiarchy means. At the second stage, the role of strategiarchy as a tool for reducing information asymmetry is substantiated. The third step describes a digital platform enabling strategiarchy (platform strategiarchy). The

fourth step proposes a metric to compare different strategies based on scale, cardinality and cardinality order of the strategy, which is going to be used as filter on digital platform.

### **Definition of strategiarchy**

Previous studies [8] have shown that strategy is a necessary and sufficient condition of subjectness. An object (for example, a hired worker) becomes a subject (master) as soon as it realizes (formalizes) its strategy. When a subject (for example, a capitalist) loses the ability to form and implement a strategy, he transforms in an object. For example, in the case of relations between owners and top managers, the strategy is created not so much in the interests of the owner as in the interests of top management. This is especially noticeable in relation to minority shareholders, who, being co-owners, are mostly removed from the management of the company. The actions of objects are always reactive, and the actions of subjects are always proactive. The presence of a strategy guarantees the presence of reflected goals in an individual [8, p. 122].

Strategy is a mutually agreed upon mission, vision, values, goals, plans and risks. The presence of a strategy provides not only an understanding of the direction in which an individual or organization plans to move, but also the space of this movement, including the rules (laws, patterns) operating in this space. This structure has universal character and it is relevant for different level from individual to state or multinational companies. So that we can see basis for implementation of fractal logic, when the structure characteristic of a lower level is reproduced at a higher level [9, p. 171].

There exist only two options: (1) person or organization has own mission (key element of the strategy) or (2) person or organization does not have own mission therefore stays in position "submission" (in relation to person or organization who has mission).

In a broad sense, strategiarchy is a model of social structure aimed at increasing subjectivity in society and minimizing information asymmetry through the institutionalization of strategizing.

Key characteristics of strategiarchy:

1. Every capable individual and legal entity has a public strategy.

2. Every capable individual and legal entity has the ability and opportunity to evaluate any strategy (of the other capable individual and legal entity).

In a narrow sense, strategiarchy is a system for coordinating strategies at various levels of governance and management. In other words, strategiarchy is the result of ascent from the abstract (general theory of strategizing) to the concrete (digital platform for strategy consolidation [10]).

As will be shown below, the system of coordinating public strategies leads to a reduction in information asymmetry.

Elements of the logic described in the concept of strategiarchy has already been implemented on the stock

exchange (during listing, when companies indicate the priorities of their activities), in state and municipal administration (when forming strategies and monitoring their implementation), in TNCs (when coordinating the general strategies of parent and subsidiary companies). These examples provide reasonable assurance that it can be deployed at other levels as well.

### **Role of strategiarchy as a tool for reducing information asymmetry**

Information asymmetry is a natural characteristic of any communication. The origins of asymmetry are explained by people having different goals and images of the future. Party A always knows more about its future actions than party B and vice versa. However, it is possible to significantly reduce the unpredictability of other Party's actions.

There are two main causes of asymmetry – (1) hidden properties and (2) hidden actions. The asymmetry caused by hidden actions relates primarily to the secrecy of strategic aspirations. Asymmetry may also relate to the properties of the product, which is generally described in the organization's mission.

The way to overcome information asymmetry caused by hidden actions is signaling [11-12]. For example, in what has become a classic paper, Michael Spence showed that having completed academic degree is a powerful signal from applicants to employer that typically leads to higher earn compared to applicants who have the same number of education years but no official diploma [11].

A public strategy gives signals about its planned actions for all stakeholders. Consequently, strategiarchy is a signaling way of overcoming total information asymmetry.

### **Digital platform for implementation of strategiarchy**

The digital era creates opportunities to bring the concept of "strategiarchy" to life through the use of digital platform capabilities. As it has been shown in work "Digital platformization of the process of strategizing the development of the national economy" [9, p. 347-348] such digital platform must use blockchain technology.

The development of decentralized digital platforms based on blockchain technology allows the use of strategic management at the individual and collective levels in all aspects of its manifestation. The digital blockchain platform combines authenticity, privacy and publicity. Therefore, not only national or regional (local) strategies, but even individual strategies can be publicly posted, made visible only in necessary cases or to some extent, but without the possibility of being destroyed or deleted from the data storage.

Thus, the presence of a digital blockchain platform containing the strategies of all collective (bodies of state power, local self-government, state enterprises, political parties, public organizations, etc.) and individual (officials, civil servants, politicians, heads of structural

divisions of state enterprises ) users allows you to compare the goals, values, etc., declared in the strategy with the real activity of individuals and organizations, which is recorded through an indestructible digital profile and the digital footprint they leave. When comparing digital footprints and strategic goals with each other, an opportunity is created for:

- formation of a general and universal culture of strategizing;
- aggregation of goals from individual to higher levels;
- increasing the level of trust between counterparties and, as a result, reducing transaction costs;
- the transition to a digital society with dominant subjectivity;
- transformation of the economic model of management.

Consequently, the implementation of strategiarchy using a digital platform is called platform strategiarchy.

Of the currently existing international organizations, the UN has the most suitable organizational, economic and political capabilities. Digital platform of strategizing, that would operate in the UN, will henceforth be called multinational digital platform of strategizing (MDPS). And the basic strategy for placement on this platform could be the "Sustainable Development Goals" to create opportunities for further coordination of the strategies of other collective and individual entities. This would be an interesting example of top-down movement.

However, there are no restrictions for the simultaneous coordination of strategies at the lower level of a large community or small enterprise.

### **General features of strategy: scale, cardinality and cardinality order**

Main feature of each platform working with big data is filter. In the target state MDPS would contain more than one billion of members (individuals and legal entities) and their strategies. And every user of MDPS would face with a problem of how to prioritize existing strategies, compare your strategy and strategies of others.

As tools for solving this problem, you can use scale of strategy and cardinality of strategy, which will be discussed below.

The scale of a strategy reflects the location of the strategy in the resource- impact coordinate system. The quantitative assessment of the "resource" is determined through the number of employees of the organization. The quantitative assessment of the "impact" is determined through the number of clients or stakeholders.

Based on the characteristics of the strategy scale, it is proposed to evaluate the integral indicator "cardinality of strategy", defined as the square root of the product of the strategy resource and the impact of the strategy. Cardinality order is determined by the order of the number characterizing the cardinality of strategy.

We will now formalize the above definitions.

Let

A – individual or organization (group of individuals);

St(A) – strategy A;

R(St(A)) – resource strategy A;

r – order of R(St(A));

I(St(A)) – impact strategy A;

i – order of I(St(A));

Sc(St(A)) – scale of strategy A;

N(St(A)) – cardinality of strategy A;

v – cardinality (strategy A) order.

Then

$$R(\text{St}(A)) = 10^r \quad (1)$$

$$I(\text{St}(A)) = 10^i \quad (2)$$

$$\text{Sc}(\text{St}(A)) = R(\text{St}(A)) * I(\text{St}(A)) = 10^{(r+i)} \quad (3)$$

$$N(\text{St}(A)) = (\text{Sc}(\text{St}(A)))^{(1/2)} = 10^{((r+i)/2)} \quad (4)$$

$$v = (r+i)/2. \quad (5)$$

As we can see unit of measurement for Sc(St(A)) is people squared, that suggests the advisability of introducing a category representing its square root. This category is cardinality of strategy (N(St(A))).

The cardinality order is calculated as the arithmetic mean between the resource order and the impact order or decimal logarithm of cardinality of strategy.

To deepen understanding of these concepts, it is necessary to consider specific examples. To do this, let us take various individuals and organizations: 1) United Nations, 2) USA, 3) Facebook, 4) Kiev, 5) Elon Musk, 6) Felix Arvid Ulf Kjellberg, 7) Robinson Crusoe.

In cases where there is no formalized strategy or group of strategic documents, it is assumed that the current assessment of impact and resources corresponds with the target.

1) United Nations is the most powerful intergovernmental organization, which tries to speak on behalf of whole human race and have influence on all world. Wherein, United Nations Secretariat staff is over 36 000 people<sup>1</sup>. So that, using formulas (1) – (5), if R(St(UN)) – direct current resource of United Nations and I(St(UN)) – influence of United Nations strategy whole human population:

$$R(\text{St}(\text{UN})) = 36\,000 = 3.6 * 10^4 \approx 10^{4.56}$$

$$r(\text{St}(\text{UN})) = 4.56$$

$$I(\text{St}(\text{UN})) = 8 * 10^9 \approx 10^{9.9}$$

$$i(\text{St}(\text{UN})) = 9.9$$

$$\text{Sc}(\text{St}(\text{UN})) = R(\text{St}(\text{UN})) * I(\text{St}(\text{UN})) = 10^{15.46}$$

$$N(\text{St}(\text{UN})) = (\text{Sc}(\text{St}(\text{UN})))^{(1/2)} = 10^{7.23}$$

$$v(\text{St}(\text{UN})) = 7.23$$

2) For USA as country, resource R(St(US))=R(US) equals population (about 330 million) and impact (I(US)) – global world (8 billion). In this case, evaluation of resource has extremely broad character. In reality US “strategy” includes corpus of strategic documents such as National security strategy (October 2022<sup>2</sup>) or National Cybersecurity Strategy (March 2023<sup>3</sup>) and so on. This situation is typical for any government entities.

We count all population. So that

$$R(\text{St}(\text{US})) = 300 * 10^6 \approx 10^{8.48}$$

$$r(\text{St}(\text{US})) = 8.48$$

$$I(\text{St}(\text{US})) = 8 * 10^9 \approx 10^{9.9}$$

$$i(\text{St}(\text{US})) = 9.9$$

$$\text{Sc}(\text{St}(\text{US})) = R(\text{St}(\text{US})) * I(\text{St}(\text{US})) = 10^{18.38}$$

$$N(\text{St}(\text{US})) = (\text{Sc}(\text{St}(\text{US})))^{(1/2)} = 10^{9.19}$$

$$v(\text{St}(\text{US})) = 9.19$$

3) For company Meta (Facebook), resource (R(FB))<sup>4</sup> is calculated based on the number of employees and impact (I(FB)) – as a number of Facebook users (3,05 users<sup>5</sup>). So that

$$R(\text{St}(\text{FB})) \approx 67 * 10^3 \approx 10^{4.83}$$

$$r(\text{St}(\text{FB})) = 4.83$$

$$I(\text{St}(\text{FB})) = 3.05 * 10^9 \approx 10^{9.48}$$

$$i(\text{St}(\text{FB})) = 9.48$$

$$\text{Sc}(\text{St}(\text{FB})) = R(\text{St}(\text{FB})) * I(\text{St}(\text{FB})) = 10^{14.31}$$

$$N(\text{St}(\text{FB})) = (\text{Sc}(\text{St}(\text{FB})))^{(1/2)} = 10^{7.15}$$

$$v(\text{St}(\text{FB})) = 7.15$$

For city Kiev, resource (R(K)) is calculated based on the number of employees at administrations (city + districts, as of 2019 about 4 000<sup>6</sup>) and impact (I(K)) – as a number of citizens in Kiev about 3 million people. Of course, this approach to estimate resource is very conservative, by its low limit. In any case, as example, we have:

$$R(\text{St}(\text{K})) \approx 4 * 10^3 \approx 10^{3.6}$$

$$r(\text{St}(\text{K})) = 3.6$$

$$I(\text{St}(\text{K})) = 3 * 10^6 \approx 10^{6.48}$$

$$i(\text{St}(\text{K})) = 6.48$$

$$\text{Sc}(\text{St}(\text{K})) = R(\text{St}(\text{K})) * I(\text{St}(\text{K})) = 10^{10.08}$$

$$N(\text{St}(\text{K})) = (\text{Sc}(\text{St}(\text{K})))^{(1/2)} = 10^{5.04}$$

$$v(\text{St}(\text{K})) = 5.04$$

Next group of samples shows scale and cardinality of strategies on individual level.

<sup>1</sup> United Nations (2023). Report of the Secretary-General on the Work of the Organization (A/78/1, seventy-eighth session). URL: [https://www.un.org/sites/un2.un.org/files/sg\\_annual\\_report\\_2023\\_en\\_0.pdf](https://www.un.org/sites/un2.un.org/files/sg_annual_report_2023_en_0.pdf) (p. 15).

<sup>2</sup> URL: <https://www.whitehouse.gov/wp-content/uploads/2022/10/Biden-Harris-Administrations-National-Security-Strategy-10.2022.pdf>.

<sup>3</sup> URL: <https://www.whitehouse.gov/wp-content/uploads/2023/03/National-Cybersecurity-Strategy-2023.pdf>.

<sup>4</sup> By the end of 2023, Facebook reported 67,317 employees. URL: [https://fourweekmba.com/facebook-employees-number/#:~:text=By%20September%202022%2C%20Facebook's%20\(Meta,bringing%20the%20headcount%20to%2075%2C964](https://fourweekmba.com/facebook-employees-number/#:~:text=By%20September%202022%2C%20Facebook's%20(Meta,bringing%20the%20headcount%20to%2075%2C964).

<sup>5</sup> Number of monthly active Facebook users worldwide as of 3rd quarter 2023(in millions). URL: <https://www.statista.com/statistics/264810/number-of-monthly-active-facebook-users-worldwide/>.

<sup>6</sup> URL: <https://kievlast.com.ua/mind/kilkist-chinovnikiv-u-kiivradi-kmda-ta-rda-bezperervno-roste-navishho>.

5) Elon Musk strategy must be coherent with companies' strategies, which he owns or manages (main actives are SpaceX: 13 000 employees<sup>1</sup> and 1.3 million customers in the US<sup>2</sup>; Tesla: 127,855 employees worldwide<sup>3</sup> and 1.8 million delivered vehicles<sup>4</sup>, Twitter/X: 1300 employees<sup>5</sup> and 550 million users<sup>6</sup>). So that resource is about 133 155 (13 000 + 127,855 + 1300) and impact is 553.1 million (1.3 + 1.8 + 550).

$$\begin{aligned} R(\text{St(IM)}) &\approx 133\,155 \approx 10^5 \cdot 1.2 \\ r(\text{St(IM)}) &= 5.12 \\ I(\text{St(IM)}) &\approx 553.1 \cdot 10^6 \approx 10^8 \cdot 8.74 \\ i(\text{St(IM)}) &= 8.74 \\ \text{Sc}(\text{St(IM)}) &= R(\text{St(IM)}) \cdot I(\text{St(IM)}) = 10^{13.86} \\ N(\text{St(IM)}) &= (\text{Sc}(\text{St(IM)}))^{1/2} = 10^{6.93} \\ v(\text{St(IM)}) &= 6.93 \end{aligned}$$

6) Felix Arvid Ulf Kjellberg doesn't have clear public strategy, but we have some information for interpretation and understanding of his strategy.  $I(\text{St(PDP)}) = I(\text{PDP})$  and equals to subscribers number in the YouTube (111 million<sup>7</sup>). Of course, this most popular YouTube blogger has accounts in other social networks such as Instagram, TikTok, Twitch. But YouTube is the most popular of them. As a result:

$$\begin{aligned} R(\text{St(PDP)}) &= 1 = 10^0 \\ r(\text{St(PDP)}) &= 0 \\ I(\text{St(PDP)}) &= 111 \cdot 10^6 \approx 10^8 \cdot 8.45 \\ i(\text{St(PDP)}) &= 8.45 \\ \text{Sc}(\text{St(PDP)}) &= R(\text{St(PDP)}) \cdot I(\text{St(PDP)}) = 10^{8.45} \\ N(\text{St(K)}) &= (\text{Sc}(\text{St(K)}))^{1/2} = 10^{4.23} \\ v(\text{St(K)}) &= 4.23 \end{aligned}$$

7) The final example is Robinson Crusoe, who personifies the one-man economy. In case of Robinson Crusoe we can see next characteristics of strategy:

$$\begin{aligned} R(\text{St(RS)}) &= 1 = 10^0 \\ r(\text{St(RS)}) &= 0 \\ I(\text{St(RS)}) &= 1 = 10^0 \\ i(\text{St(RS)}) &= 0 \\ \text{Sc}(\text{St(RS)}) &= R(\text{St(RS)}) \cdot I(\text{St(RS)}) = 10^0 \\ N(\text{St(RS)}) &= (\text{Sc}(\text{St(RS)}))^{1/2} = 10^0 \\ v(\text{St(RS)}) &= 0 \end{aligned}$$

Robinson Crusoe has shown minimum order cardinality ( $v=0$ ). Maximum order cardinality is achieved if  $R=I=8 \cdot 10^9$  ( $r=I \approx 9.9$ ) and  $v=9.9$ , which corresponds to the situation of full involvement of the entire population of the Earth as both a resource and a stakeholder.

Aggregation of the results obtained above is presented in Fig. 2. This figure shows the map of scale of strategies.

By comparing the order of the strategies considered as examples, we can build a series according to their significance:

$$\begin{aligned} v(\text{St(RS)}) &= 0 < v(\text{St(PDP)}) = 4.23 < v(\text{St(K)}) = \\ &= 5.04 < v(\text{St(IM)}) = 6.93 < v(\text{St(FB)}) = \\ &= 7.15 < v(\text{St(UN)}) = 7.23 < v(\text{St(US)}) = 9.19. \end{aligned}$$

By transferring this information to the MDPS, or a group of platforms that is collectively equivalent to the MDPS, strategies can be compared and prioritized to determine the most important strategies.

Also, MDPS allows you to form a one-to-one match between each strategy and the individuals and companies that act as resources or stakeholders. As a result, individuals receive an information about what focus of attention they are in. Consequently, digitalization and coordination of strategies makes it possible for the subject of strategy implementation to wisely choose the focus of his attention on the strategies of other actors when forming and implementing his own strategy.

### Discussions

The proposed indicators for assessing resources and impact are not exhaustive. As measure of resources, we can use other parameters than a number of people. For instance, gross revenue for commercial companies, budget for countries or cities. As measure of impact, we can use other parameters than a number of clients. For instance, contractors and suppliers can also be considered as people influenced by the company.

### Conclusions

1. The problem of information asymmetry in the context of digitalization of economy is influenced by two multidirectional factors. On the one hand, an increase in the volume of information leads to an increase in asymmetry, and on the other, digital technologies create conditions for its reduction. One of the possible tools for reducing information asymmetry is a model of society called strategairchy.

2. Ultimately, strategiararchy presupposes the presence of public strategies among all individuals and legal entities. However, the presence of such strategies without the possibility of systematizing and comparing them creates little added value for society. A partial solution to this problem can be obtained by introducing the concepts scale, cardinality and order of strategy cardinality.

<sup>1</sup> URL: <https://storage.courtlistener.com/recap/gov.uscourts.txsd.1934705/gov.uscourts.txsd.1934705.1.0.pdf> (p. 4).

<sup>2</sup> URL: <https://www.pcmag.com/news/spacex-starlink-now-has-13-million-customers-in-the-us>.

<sup>3</sup> URL: [https://ir.tesla.com/\\_flysystem/s3/sec/000095017023001409/tsla-20221231-gen.pdf](https://ir.tesla.com/_flysystem/s3/sec/000095017023001409/tsla-20221231-gen.pdf).

<sup>4</sup> URL: <https://www.cnbc.com/2024/01/02/tesla-tsla-q4-2023-vehicle-delivery-and-production-numbers.html>.

<sup>5</sup> URL: <https://www.cnbc.com/2023/01/20/twitter-is-down-to-fewer-than-550-full-time-engineers.html>.

<sup>6</sup> URL: <https://www.cnn.com/2023/09/18/musk-says-twitter-now-x-is-moving-to-monthly-subscriptions.html>.

<sup>7</sup> PewDiePie (2023). URL: <https://www.youtube.com/@PewDiePie>.



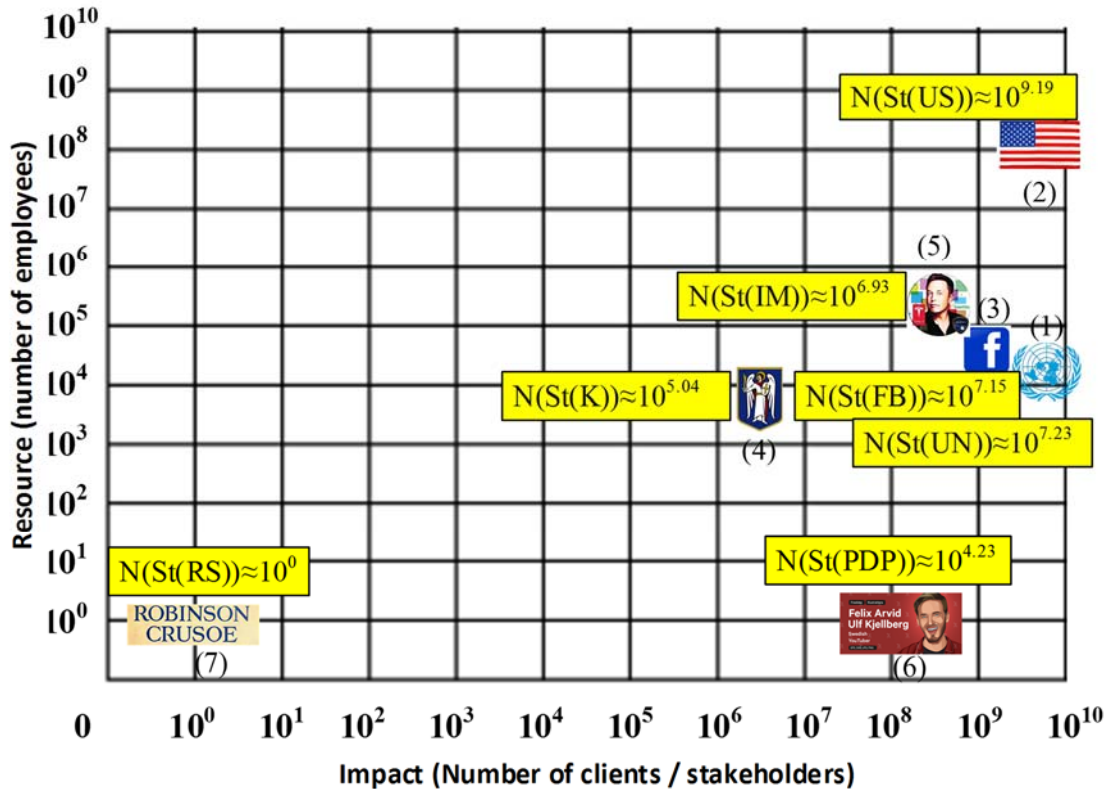


Fig. 2. Scale of strategy (examples)

3. The scale of the strategy is equal to the product of influence and resource of the subject of strategy implementation. The quantitative assessment of the "resource" is determined by the number of employees of the organization. "Impact" is quantified through the number of customers or stakeholders. The cardinality of a strategy is defined as the square root of the scale of the strategy. The order of strategy cardinality is determined

by the order of the number characterizing the cardinality of the strategy, i.e. the decimal logarithm of the power.

4. Order of strategy impact allows to classify the strategies. If  $I(St(A))$  – strategy impact of company A,  $i$  – order of  $I(St(A))$ ,  $i(St(A))_{t=0}$  – order of the impact on the start of the strategy,  $k$  – strategy implementation period, that is systematized in Table.

Table

Name and description of the strategy depending on the order of its impact

Changing the order of strategy impact	Name and description of the strategy
$(i(St(A))_{t=0} - i(St(A))_{t=k}) \leq -1$	<i>Exit/retreat strategy</i> : (1) termination of current activities; (2) failure to meet the needs of existing customers
$-1 < (i(St(A))_{t=0} - i(St(A))_{t=k}) < 0$	<i>Survival strategy</i> : (1) reduction in the number of clients; (2) maintaining hopes of returning to previous positions
$(i(St(A))_{t=0} - i(St(A))_{t=k}) = 0$	<i>Position retention strategy</i> : (1) maintaining the current number of clients
$1 > (i(St(A))_{t=0} - i(St(A))_{t=k}) > 0$	<i>Development strategy</i> : (1) increase in the number of clients
$(i(St(A))_{t=0} - i(St(A))_{t=k}) \geq 1$	<i>Accelerated development strategy</i> : (1) a sharp increase in the number of clients; (2) very risky for realization

5. Based on the proposed definition of the scale and power of strategy, the power of humanity’s potential strategy is approximately  $10^{10}$  ( $8 \cdot 10^9$ ). Consequently, increasing the scale, power and order of the strategy of "humanity as a whole" presupposes a constant increase in population. This is in conflict with the environmental capacity of the planet. Resolution of this contradiction is possible through human’s exploration of space.

Based on this, space exploration can be considered a tool for increasing subjectivity in society based on the construction of a strategariarchy.

6. The *scientific novelty* obtained as a result of the research lies in the description of new scientific concepts: strategariarchy, scale, cardinality and order of strategy. The introduction of which allows us to form a scientific and theoretical basis for the further institutionalization of strategizing, which in turn creates

conditions for reducing information asymmetry when moving from the abstract-theoretical to the concrete-applied level.

### Directions for further research.

Based on the findings, promising directions for further research are the formation and updating of strategies, taking into account their intersections in resources and clients.

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**Вишневський О. С. Платформна стратегіархія як інструмент зменшення інформаційної асиметрії з урахуванням масштабу, потужності та порядку стратегії**

Метою дослідження є обґрунтування концептуальних основ зменшення інформаційної асиметрії за допомогою платформної стратегіархії з урахуванням масштабу, потужності та порядку стратегії.

Наукова новизна дослідження полягає в описі нових понять: стратегіархія, платформна стратегіархія, загальні характеристики стратегії (масштаб, потужність і порядок стратегії). Використання цих понять дозволяє сформулювати теоретичну основу для подальшої інституціоналізації стратегування, яке створює умови для зменшення інформаційної асиметрії у умовах розвитку цифрової економіки.

У широкому сенсі стратегіархія – це модель соціального устрою, спрямована на підвищення суб'єктності в суспільстві та мінімізацію інформаційної асиметрії через інституціоналізацію стратегування.

Основні характеристики стратегіархії: (1) кожна дієздатна фізична та юридична особа має публічну стратегію; (2) кожна дієздатна фізична та юридична особа має здатність і можливість оцінити будь-яку стратегію (іншої дієздатної фізичної або юридичної особа).

У вузькому розумінні стратегіархії – це система координації стратегій на різних рівнях управління. Одночасно, стратегіархії являє собою результат сходження від абстрактного (загальна теорія стратегування) до конкретного (цифрова платформа для консолідації стратегій).

Імплементация стратегіархії на цифровій блокчейн платформі називається платформною стратегіархією. Введення понять масштаб, потужність та порядок стратегії дозволяє упорядкувати та співставляти стратегії в тому числі на відповідній цифровій платформі.

*Масштаб стратегії* дорівнює добутку впливу та ресурсу суб'єкту реалізації стратегії. Кількісна оцінка «ресурсу» визначається через чисельність працівників організації. Кількісна оцінка «впливу» визначається через кількість клієнтів або зацікавлених сторін. *Потужність стратегії* визначається як квадратний корінь масштабу стратегії. *Порядок потужності стратегії* визначається порядком числа, що характеризує потужність стратегії тобто десятковий логарифм потужності. На конкретних прикладах (ООН, США, Facebook, місто Київ, Ілон Маск, Фелікс Арвід Ульф Чельберг, Робінзон Крузо) продемонстровано розрахунок цих характеристик.

У підсумку розміщення стратегій на цифрових платформах дозволяє знизити асиметрію інформації при різних комунікації між компаніями, урядом та індивідами.

*Ключові слова:* стратегіархія, платформна стратегіархія, інформаційна асиметрія, масштаб стратегії, потужність стратегії, порядок потужності стратегії, цифрова платформа, цифрова економіка.

**Vyshnevskiy O. Platform Strategiararchy as a Tool for Reducing Information Asymmetry, Taking into Account the Scale, Cardinality and Order of the Strategy**

The purpose of study is to substantiate the conceptual foundations of reducing information asymmetry using platform strategiararchy taking into account scale, cardinality and order of the strategy.

The *scientific novelty* obtained as a result of the research lies in the description of new scientific concepts: strategiararchy, platform strategiararchy, information asymmetry, scale of strategy, cardinality of strategy, order of strategy scale. The introduction of which allows us to form a scientific and theoretical basis for the further institutionalization of strategizing, which creates conditions for reducing information asymmetry in the process of developing the digital economy.

In a broad sense, strategiararchy is a model of social structure aimed at increasing subjectivity in society and minimizing information asymmetry through the institutionalization of strategizing.

Key characteristics of strategiararchy:

1. Every capable individual and legal entity has a public strategy.
2. Every capable individual and legal entity has the ability and opportunity to evaluate any strategy (of the other capable individual and legal entity).

In a narrow sense, strategiararchy is a system for coordinating strategies at various levels of governance and management. In other words, strategiararchy is the result of ascent from the abstract (general theory of strategizing) to the concrete (digital platform for strategy consolidation).

The implementation of strategiararchy using a digital platform is called platform strategiararchy. The introduction of the concepts "scale of strategy", "cardinality of strategy", "order of strategy scale" allows you to organize and compare strategies, including on the appropriate digital platform.

*The scale of strategy* is equal to the product of influence and resource of the subject of strategy implementation. The quantitative assessment of the "resource" is determined by the number of employees of the organization. "Impact" is quantified through the number of customers or stakeholders. The cardinality of a strategy is defined as the square root of the scale of the strategy. The order of strategy cardinality is determined by the order of the number characterizing the cardinality of the strategy, i.e. the decimal logarithm of the power. The calculation of these characteristics is demonstrated on specific examples (United Nations, USA, Facebook, Kiev, Ilon Musk, Felix Arvid Ulf Kjellberg, Robinson Crusoe).

As a result, placing strategies on digital platforms allows to reduce information asymmetry in various communications between companies, government and individuals.

*Keywords:* strategiararchy, platform strategiararchy, information asymmetry, scale of strategy, cardinality of strategy, order of strategy scale, digital platform, digital economy.



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## THE ECONOMIC IMPACT OF CLOUD TECHNOLOGIES ON THE INDUSTRY 4.0 DEVELOPMENT

### Introduction

Industry 4.0 represents the fourth industrial revolution, characterized by the integration of digital technologies such as the Internet of Things (IoT), big data, artificial intelligence (AI), and automation into manufacturing and other industrial processes [1; 2]. This revolution is driving a new era of productivity, efficiency, and innovation, allowing businesses to optimize operations, enhance product quality, and create new business models. The importance of Industry 4.0 lies in its potential to transform industries, making them more responsive to market changes and customer demands. Historically, adopting advanced IT infrastructure for Industry 4.0 required significant capital expenditures (CAPEX). Companies had to invest heavily in hardware, software, and skilled personnel to build and maintain complex IT systems. These substantial upfront costs were a barrier for many organizations, particularly small and medium-sized enterprises (SMEs), limiting their ability to leverage Industry 4.0 technologies. Cloud computing has emerged as a game-changer in this context, offering a more flexible and cost-effective alternative to traditional IT infrastructure. By shifting from CAPEX to operational expenditure (OPEX), cloud computing allows businesses to pay for IT resources on a subscription basis, scaling up or down as needed without large upfront investments. This model not only reduces financial risk but also provides access to cutting-edge technologies and services that were previously out of reach for many companies. Thesis statement: Cloud technologies significantly reduce initial capital expenditure, improve ROI, and make Industry 4.0 accessible to smaller enterprises. This shift from CAPEX to OPEX, coupled with the scalability and flexibility of cloud solutions, democratizes access to Industry 4.0 innovations, enabling even small businesses to participate in the digital transformation and reap its economic benefits.

### Literature review

A study by Ramesh Kumar Ayyasamy et al. explores the effects of cloud computing, big data analytics, and the Internet of Things (IoT) on the innovation performance of manufacturing firms. It identifies dynamic and innovation capabilities as mediating factors, suggesting that firms can enhance their innovation performance by effectively leveraging

these digital technologies [1]. Amuthalakshmi Periasamy and Krishnan Umachandran discuss the incorporation of Industry 4.0 technologies such as augmented reality, virtual reality, and AI in the educational sector. They emphasize that the pandemic has accelerated the adoption of these technologies, facilitating a more immersive and effective learning environment. A work [4] identifies the critical factors influencing cloud computing adoption in Industry 4.0-based advanced manufacturing systems. It highlights the importance of considering these factors to ensure effective implementation and improved manufacturing productivity. Minakshi Sharma et al. examine the role of cloud resource management in enabling Industry 4.0. They discuss various resource provisioning techniques, their challenges, advantages, and performance parameters, emphasizing the importance of efficient resource management for Industry 4.0 success [5]. The economic impact of cloud computing on Industry 4.0 is significant, transforming cost structures and fostering innovation across various sectors. Federico Etro's work emphasizes that cloud computing allows firms to rent computing power and storage on-demand, converting fixed costs into variable ones and enhancing the incentives for new business creation, which drives investments, macroeconomic growth, job creation, and job reallocation in the ICT sector [6; 7]. Another study by Promise Mvelase and colleagues reviews multiple pricing models in cloud computing, highlighting cost savings, efficiency boosts, and the profound impact on market structures and competition [8]. In healthcare, Gillala Rekha and Jasti Yashaswini explore how Industry 4.0 and cloud technologies revolutionize eHealth by integrating IoT, fog computing, and big data, thus enhancing the accessibility and usability of health data [9]. Ediz Daykol focuses on the IT industry's shift towards cloud computing, which allows firms to adapt quickly to changing demands, minimizing costs associated with over-provisioning and enabling them to focus on core business objectives [10]. The reviewed literature highlights several key insights into the economic impact of cloud technologies on Industry 4.0 by driving cost reduction and operational efficiency through scalability, flexibility, and reduced maintenance costs. They enable improved collaboration and support accelerated development cycles, fostering innovation and faster market adaptation. However, there are notable



gaps that future research can address to provide a more comprehensive understanding. While there is a significant focus on the immediate benefits of cloud technologies, such as cost savings and operational efficiency, there is a lack of detailed analysis on the long-term economic impacts. Future studies should investigate the sustained economic benefits and potential drawbacks of cloud adoption over extended periods. Many studies discuss the general advantages of cloud technologies but fall short of providing a comparative analysis of the leading cloud service providers (AWS, GCP, and Microsoft Azure), which is one of the key strategic choices for any organization which plans to implement Industry 4.0 concepts. This choice would define multiyear direction of organizational development, that is why understanding differences, pros and cons of cloud providers is a crucial for proper decision making. Future research should offer detailed comparisons of these providers, focusing on their specific offerings for Industry 4.0 and the economic advantages they bring. There is a need for more case studies that illustrate successful implementations of Industry 4.0 initiatives leveraging cloud technologies, particularly in small and medium enterprises (SMEs). Detailed case studies can provide valuable insights into best practices, challenges faced, and economic outcomes. While some sectors, like manufacturing and healthcare, are discussed, there is limited coverage of other industries that can benefit from Industry 4.0 and cloud technologies. Future research should explore the economic impact of these technologies across a wider range of sectors. The goal of the article to show how cloud technologies could enable to the development of Industry 4.0. Provide a practical guidance for the organization in making the right choice among cloud providers and show economic value of using such technologies in scope of transaction to Industry 4.0 concepts.

### **Main Part**

Since the introduction of the Industry 4.0 concept, the key blocker for its implementation was high cost. Organizations needed to be ready to invest in hardware, software, and changes to some of their processes and operations, which posed a high risk and caused significant capital expenditure. With the advent of cloud computing and increased interest from key cloud providers in Industry 4.0, organizations gained the opportunity to use multiple instruments right out of the box without creating them from scratch. This shift from to operational expenditure enabled various organizations, from small businesses to large enterprises, to start implementing Industry 4.0 in their production processes without large initial investments.

Capital Expenditure (CAPEX) refers to the funds used by a company to acquire, upgrade, and maintain physical assets such as property, industrial buildings, or equipment. This type of spending is aimed at creating future benefits and typically involves significant upfront

investment. Examples of CAPEX include purchasing new machinery, upgrading existing facilities, or investing in new technology infrastructure. On the other hand, Operational Expenditure (OPEX) refers to the ongoing costs for running a product, business, or system. OPEX is typically shorter-term in nature and includes expenses like rent, utilities, salaries, and maintenance costs. These expenses are necessary for the day-to-day functioning of a business and are often more predictable and manageable on a regular basis. Cloud computing fundamentally shifts IT investments from a CAPEX model to an OPEX model. Traditionally, businesses had to make significant CAPEX investments to purchase hardware, software, and other IT infrastructure components. These upfront costs were often a barrier, especially for small and medium-sized enterprises (SMEs), limiting their ability to adopt advanced technologies. With cloud computing, businesses can access computing resources over the internet on a pay-as-you-go basis. This model allows companies to avoid large initial investments in IT infrastructure. Instead, they pay for the cloud services they use, transforming these costs into OPEX. This shift means that businesses can scale their IT resources up or down based on demand, ensuring they only pay for the capacity they need at any given time. The transition from CAPEX to OPEX offers several financial benefits for businesses:

1. Reduced initial costs by avoiding significant upfront investments in IT infrastructure, companies can preserve their capital for other strategic investments or operational needs. This is particularly beneficial for SMEs, which may have limited access to large capital reserves.

2. Cloud services allow businesses to scale their IT resources according to their needs. This flexibility ensures that companies can quickly respond to market changes without the risk of over-investment or under-utilization of resources.

3. With the pay-as-you-go model, businesses can better predict and manage their IT expenses. This predictability helps in budgeting and financial planning, as companies are not subject to the fluctuations that come with maintaining and upgrading physical infrastructure.

4. Shifting IT expenses to OPEX improves cash flow by spreading costs over time. This can be particularly advantageous for businesses with seasonal or fluctuating demand, as they can align their IT spending with revenue generation periods.

5. Cloud providers continuously update their services with the latest technologies and security measures. Businesses can benefit from these advancements without having to invest in new hardware or software, ensuring they remain competitive and secure.

The transformation of IT investments from CAPEX to OPEX through cloud computing not only lowers barriers to adopting advanced technologies but

also offers significant financial and operational benefits. This shift enables businesses of all sizes to innovate, scale efficiently, and manage costs more effectively, driving overall growth and competitiveness in the digital age. The adoption of cloud technologies in Industry 4.0 has significantly enhanced the Return on Investment (ROI) for businesses. This improvement is primarily due to the reduction in initial costs and the scalability of cloud solutions. Traditional IT infrastructure required substantial upfront capital expenditure (CAPEX) for purchasing hardware and software, which posed a significant barrier for many companies, especially small and medium-sized enterprises (SMEs). Cloud computing, however, shifts these expenses from CAPEX to operational expenditure (OPEX). Companies can now subscribe to cloud services on a pay-as-you-go basis, avoiding large initial investments. This model not only reduces financial risk but also offers the flexibility to scale resources up or down based on demand. This adaptability ensures that businesses can optimize their IT spending, leading to a more efficient allocation of resources and higher ROI. Additionally, cloud technologies enable rapid deployment and scaling of Industry 4.0 solutions. This speed to market allows companies to quickly leverage new technologies, enhancing their competitive edge and revenue potential. The reduced initial costs and scalable nature of cloud services contribute to substantial ROI improvements by enabling businesses to achieve more with less financial risk. To understand better the business case of such implementations it was review several public case studies.

### **Examples of Successful Industry 4.0 Implementations Leveraging Cloud Technologies**

**1. Siemens MindSphere:** Siemens developed MindSphere, an industrial IoT as a service (IaaS) platform that uses cloud technology to connect machines and infrastructure to the digital world. This platform helps companies collect and analyze data from connected devices, optimizing operations and driving innovation. By leveraging AWS, Siemens has enabled its customers to implement IoT solutions with lower upfront costs and scalable options, significantly improving ROI [11].

**2. General Electric's Predix Platform:** General Electric (GE) developed Predix, a cloud-based Industrial Internet of Things (IIoT) platform that provides advanced analytics and machine learning capabilities. This platform helps industrial companies optimize their operations by leveraging real-time data. By using cloud infrastructure, GE allows its customers to deploy advanced technologies without substantial CAPEX, ensuring a scalable and efficient solution that improves ROI [12].

**3. BMW's Smart Manufacturing:** BMW has integrated cloud computing into its smart manufacturing processes, enabling real-time data collection and analysis across its production lines. This integration has

led to significant improvements in efficiency and productivity. By leveraging AWS, BMW quickly scales its data processing capabilities and deploys advanced analytics, resulting in optimized production processes and reduced operational costs [13].

**4. ABB Ability™:** ABB's cloud-based suite of solutions, ABB Ability™, enhances operational performance and productivity. By using the cloud, ABB provides scalable analytics and real-time insights, allowing companies to make data-driven decisions and optimize their industrial processes. The reduced upfront investment and scalable nature of cloud services have led to substantial ROI improvements for ABB's customers [14].

These case studies illustrate how the adoption of cloud technologies in Industry 4.0 not only lowers initial costs but also provides the scalability and flexibility needed to achieve higher ROI. By leveraging cloud solutions, businesses can implement advanced technologies more efficiently, drive innovation, and manage costs effectively, leading to overall growth and competitiveness.

### **Historical Challenges for SMEs in Adopting Industry 4.0 Technologies:**

Traditionally, implementing Industry 4.0 technologies required substantial capital investment in advanced machinery, IoT devices, and IT infrastructure. These high upfront costs posed a significant barrier for SMEs, which often operate with limited financial resources. SMEs frequently face a shortage of skilled personnel who can manage and implement advanced digital technologies. This skill gap hinders their ability to adopt and fully leverage Industry 4.0 solutions. Many traditional Industry 4.0 solutions were designed with large-scale operations in mind, making it difficult for SMEs to adapt these technologies to their smaller, more variable production environments. Integrating new Industry 4.0 technologies with existing systems and processes can be complex and disruptive, posing a risk for SMEs that cannot afford significant downtime or operational disturbances.

### **How Cloud Technologies Lower the Barriers to Entry:**

Cloud computing shifts IT spending from capital expenditure (CAPEX) to operational expenditure (OPEX). This pay-as-you-go model allows SMEs to access advanced technologies without large initial investments, making it easier to adopt Industry 4.0 solutions. Cloud platforms offer a range of Industry 4.0 tools such as IoT management, big data analytics, and AI services that SMEs can utilize without needing in-house expertise. These tools are often user-friendly and come with support services that help bridge the skill gap. Cloud services are inherently scalable, allowing SMEs to start small and expand their use of Industry 4.0 technologies as their needs grow. This flexibility ensures that SMEs can tailor their technology

investments to their specific requirements and business conditions. Many cloud-based Industry 4.0 solutions are designed to integrate seamlessly with existing systems. This reduces the complexity and risk associated with implementation, allowing SMEs to adopt new technologies with minimal disruption.

As reviewed previously in the article, cloud technologies help to reduce barriers to implementing Industry 4.0 concepts by making it cheaper and transferring CAPEX to OPEX. However, it is crucial for organizations to wisely choose their cloud providers, as each provider has its own pros and cons.

### Overview of Major Cloud Providers and Their Offerings for Industry 4.0:

#### Overview of AWS Services Relevant to Industry 4.0:

- **AWS IoT Core:** This service allows devices to connect to AWS services and other devices securely. It enables data collection, processing, and analysis in real-time, which is crucial for industrial applications.

- **AWS Greengrass:** This service extends AWS to edge devices so they can act locally on the data they generate while still using the cloud for management, analytics, and durable storage.

- **AWS Machine Learning:** AWS offers a suite of machine learning services including Amazon SageMaker, which helps in building, training, and deploying machine learning models at scale.

- **AWS Lambda:** This serverless compute service runs code in response to events and automatically manages the compute resources required by that code, which is useful for real-time data processing in manufacturing.

- **AWS Data Lakes and Analytics:** AWS provides comprehensive data lake solutions and analytics services such as Amazon Redshift, AWS Glue, and Amazon Athena, enabling large-scale data processing and insights.

#### Economic Benefits of AWS for Industry 4.0 Initiatives:

AWS's pay-as-you-go pricing model reduces upfront costs and enables SMEs to adopt advanced technologies without significant capital investment. AWS services can scale up or down based on the business needs, allowing companies to manage their resources efficiently. With a broad range of services, AWS supports innovation and flexibility in implementing Industry 4.0 solutions.

#### Overview of GCP Services Relevant to Industry 4.0:

- **Google Cloud IoT:** This fully managed service allows for secure connection, management, and data ingestion from globally distributed devices.

- **BigQuery:** Google's serverless, highly scalable, and cost-effective multi-cloud data warehouse designed for business agility.

- **Google Cloud AI and Machine Learning:** Services such as AutoML, TensorFlow, and AI Platform that provide powerful tools for building and deploying machine learning models.

- **Google Kubernetes Engine (GKE):** Managed Kubernetes service for running containerized applications, which can be useful for scalable deployment of industrial applications.

- **Cloud Functions:** A serverless execution environment for building and connecting cloud services, ideal for real-time processing needs in Industry 4.0.

#### Economic Advantages of GCP for Businesses:

GCP offers competitive pricing and flexible contracts, which can be beneficial for cost management in SMEs. With powerful analytics tools like BigQuery, companies can gain deep insights from their data to optimize operations. GCP's strong support for open source technologies ensures easy integration with existing systems and flexibility in application development.

#### Overview of Microsoft Azure Services Relevant to Industry 4.0:

- **Azure IoT Hub:** A managed service that acts as a central message hub for bi-directional communication between IoT applications and the devices it manages.

- **Azure Machine Learning:** This service provides tools for building, training, and deploying machine learning models quickly and easily.

- **Azure Digital Twins:** This service enables the creation of comprehensive digital models of physical environments to monitor, diagnose, and optimize industrial operations.

- **Azure Functions:** Serverless compute service that allows you to run event-triggered code without managing servers, ideal for real-time industrial applications.

- **Azure Data Lake and Analytics:** Azure provides scalable data storage and analytics services that allow for large-scale data processing and insights.

#### Economic Impact of Using Azure for Industry 4.0 Projects:

Azure offers a highly integrated ecosystem of services that streamline the deployment of Industry 4.0 applications. With advanced security features and compliance certifications, Azure ensures that industrial applications meet stringent regulatory requirements. Azure supports hybrid deployments, allowing companies to leverage both on-premises and cloud resources effectively.

The major cloud providers – AWS, Google Cloud Platform, and Microsoft Azure – offer a comprehensive range of services (table 1) that enable businesses to implement Industry 4.0 solutions efficiently and cost-effectively. Their offerings help reduce initial investment barriers, provide scalability, and enhance innovation, making advanced industrial technologies accessible to enterprises of all sizes.

Table 1

## Service Offerings Comparison

Feature / Service	Amazon Web Services (AWS)	Google Cloud Platform (GCP)	Microsoft Azure
<b>IoT Services</b>	AWS IoT Core, AWS IoT Greengrass	Google Cloud IoT Core, Google IoT Edge	Azure IoT Hub, Azure IoT Edge
<b>Machine Learning</b>	Amazon SageMaker, AWS Lambda	Google Cloud AI Platform, TensorFlow	Azure Machine Learning, Azure Functions
<b>Data Storage &amp; Analytics</b>	Amazon S3, Amazon Redshift, AWS Glue, Amazon Athena	Google Cloud Storage, BigQuery, Google Cloud Dataflow	Azure Blob Storage, Azure Data Lake, Azure Synapse Analytics
<b>Edge Computing</b>	AWS Greengrass	Google IoT Edge	Azure IoT Edge
<b>Digital Twins</b>	AWS IoT TwinMaker	Google Cloud IoT	Azure Digital Twins
<b>Integration &amp; APIs</b>	AWS API Gateway, AWS AppSync	Google Cloud Endpoints	Azure API Management
<b>Security</b>	AWS Shield, AWS IAM	Google Cloud IAM, Cloud Security Command Center	Azure Security Center, Azure Active Directory

Source: Created by author.

One of the key factors for making the right choice is to assess the cost of the services as the model of pricing is different and it might be more or less relevant for different cases.

**Cost Analysis**

A direct cost comparison (Table 2) is complex due to the variable nature of cloud pricing models, which depend on specific use cases, resource usage, and service configurations. However, here is a high-level overview of cost considerations for similar services:

Table 2

## Cloud Services Cost Comparison

Service	AWS	GCP	Azure
<b>Compute (On-Demand Instances)</b>	Amazon EC2: \$0.0464 per hour (t3.medium)	Google Compute Engine: \$0.0475 per hour (n1-standard-1)	Azure VMs: \$0.048 per hour (B1s)
<b>Storage (Object Storage)</b>	Amazon S3: \$0.023 per GB	Google Cloud Storage: \$0.020 per GB	Azure Blob Storage: \$0.018 per GB
<b>Data Transfer (Outbound)</b>	\$0.09 per GB (first 10 TB)	\$0.12 per GB (first 10 TB)	\$0.087 per GB (first 10 TB)
<b>Machine Learning</b>	SageMaker: \$0.10 per hour (ml.t2.medium)	AI Platform: \$0.09 per hour (n1-standard-4)	Azure ML: \$0.08 per hour (Standard_DS11_v2)

Source: Created by author based on the [15-16].

Prices can vary based on the region and specific configurations. For accurate pricing it is recommended to use each provider's cost calculator. Each of the major cloud providers—AWS, Google Cloud Platform, and Microsoft Azure—offers robust and comprehensive services tailored to Industry 4.0 applications. AWS excels in its extensive IoT and machine learning services, GCP is noted for its advanced data analytics capabilities, and Azure stands out for its integration with Microsoft's enterprise services and strong support for hybrid cloud environments. The choice of provider will depend on specific business needs, existing technology stack, and long-term strategic goals of the organizations.

**Conclusion**

The adoption of cloud technologies is transforming the landscape of Industry 4.0, bringing significant economic advantages and increased operational efficiencies to businesses of all sizes. By shifting IT investments from capital expenditure (CAPEX) to operational expenditure (OPEX), cloud computing has made advanced technologies more accessible, particularly for small and medium-sized enterprises (SMEs). This shift enables companies to reduce initial costs, scale resources dynamically, and improve the return on investment (ROI) for their Industry 4.0 initiatives. Major cloud providers – Amazon Web Services (AWS), Google Cloud Platform (GCP), and



Microsoft Azure – offer comprehensive solutions that support the implementation of Industry 4.0 technologies. Each provider brings unique strengths: AWS excels in IoT and machine learning services, GCP offers powerful data analytics capabilities, and Azure provides robust integration with enterprise services and hybrid cloud environments. The comparative analysis of these providers highlights the versatility and depth of services available, enabling businesses to choose the most suitable platform for their specific needs. Despite the benefits, there are challenges and considerations to address. Security and compliance remain critical concerns, requiring ongoing vigilance and adherence to regulatory standards. The risk of vendor lock-in necessitates strategic planning, such as adopting multi-cloud strategies and using interoperable solutions. Effective cost management is essential to maximize the economic benefits of cloud adoption, with best practices including continuous monitoring, auto-scaling, and purchasing reserved instances for predictable workloads. Case studies from industry leaders such as Siemens, General Electric, BMW, and ABB illustrate the practical benefits of cloud-based Industry 4.0

solutions, focusing on how cloud technologies can enhance operational efficiency, reduce costs, and drive innovation across various sectors. By leveraging cloud platforms, businesses can implement sophisticated IoT, machine learning, and data analytics solutions, gaining a competitive edge in the digital economy. In conclusion, cloud technologies are pivotal in enabling the widespread adoption of Industry 4.0, transforming how businesses operate and compete. By addressing security, compliance, vendor dependence, and cost management, companies can effectively harness the power of the cloud to drive growth, efficiency, and innovation in the industrial sector. A prominent direction of future research will be an analysis of the economic effects of integrating cloud-based Internet of Things (IoT) solutions in Industry 4.0, focusing on cost reductions, efficiency gains, and new business opportunities. Also, a topic for future deep dive investigations will be an analysis of the economic advantages of using cloud technologies for predictive maintenance in Industry 4.0 environments, including cost savings and improved equipment lifespan.

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#### **Резніков Р. Б. Економічний вплив хмарних технологій на розвиток Індустрії 4.0**

Ця стаття досліджує значний економічний вплив хмарних технологій на Індустрію 4.0, зосереджуючи увагу на тому, як ці технології революціонізують промисловий сектор. Розглядається трансформація ІТ-інвестицій з капітальних витрат (CAPEX) на операційні витрати (OPEX) завдяки хмарним обчисленням. Цей зсув робить передові цифрові технології більш доступними та вигідними, особливо для малих та середніх підприємств (МСП). Зменшуючи потребу у значних початкових інвестиціях і надаючи масштабовані, платні за використання рішення, хмарні обчислення значно підвищують повернення на інвестиції (ROI) для ініціатив Індустрії 4.0. Порівняльний аналіз основних провайдерів хмарних послуг — Amazon Web Services (AWS), Google Cloud Platform (GCP) і Microsoft Azure — показує різноманітність послуг та економічних переваг, які вони пропонують для застосувань Індустрії 4.0. AWS лідирує з комплексними послугами IoT та машинного навчання, GCP відзначається можливостями аналітики даних та штучного інтелекту, а Microsoft Azure забезпечує міцну інтеграцію з підприємствами та гібридними хмарними рішеннями. У статті також розглядаються критичні виклики, такі як безпека, відповідність і ризики, пов'язані з залежністю від провайдерів. Вона пропонує стратегічні інсайти щодо практик управління витратами, які можуть максимізувати економічні переваги впровадження хмарних технологій, такі як використання багатохмарних стратегій і авто-масштабування та зарезервованих екземплярів. Крім того, стаття включає кейс-стадії провідних промислових компаній, таких як Siemens, General Electric, BMW та ABB. Ці приклади ілюструють, як хмарні рішення Індустрії 4.0 підвищують операційну ефективність, знижують витрати та сприяють інноваціям. Наприклад, Siemens використовує AWS для масштабованих рішень IoT, GE використовує Azure для отримання аналітичних даних на основі даних, а BMW використовує GCP для покращення виробничих процесів завдяки передовій аналітиці даних. На завершення, хмарні технології є важливими драйверами Індустрії 4.0, пропонуючи значні економічні переваги та сприяючи інноваціям та ефективності. Переборюючи історичні бар'єри для входу, особливо для МСП, та надаючи гнучкі, масштабовані рішення, хмарні обчислення трансформують промисловий ландшафт, стимулюючи зростання та сприяючи широкому впровадженню передових виробничих технологій.

*Ключові слова:* хмарні технології, Індустрія 4.0, трансформація з CAPEX на OPEX, економічний вплив, малі та середні підприємства, ROI, провайдери хмарних послуг, цифрова трансформація.

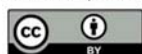
#### **Reznikov R. The Economic Impact of Cloud Technologies on the Industry 4.0 Development**

This article explores the profound economic impact of cloud technologies on Industry 4.0, focusing on how these technologies are revolutionizing the industrial sector. It delves into the transformation of IT investments from capital expenditure (CAPEX) to operational expenditure (OPEX) due to cloud computing. This shift is making advanced digital technologies more accessible and

affordable, particularly for small and medium-sized enterprises (SMEs). By reducing the need for significant upfront investments and providing scalable, pay-as-you-go solutions, cloud computing significantly enhances the return on investment (ROI) for Industry 4.0 initiatives. A comparative analysis of major cloud service providers—Amazon Web Services (AWS), Google Cloud Platform (GCP), and Microsoft Azure—reveals the diverse range of services and economic benefits they offer for Industry 4.0 applications. AWS leads with comprehensive IoT and machine learning services, GCP excels in data analytics and AI capabilities, and Microsoft Azure provides robust enterprise integrations and hybrid cloud solutions. The article also addresses critical challenges such as security, compliance, and the risks associated with cloud provider lock-in. It offers strategic insights into cost management practices that can maximize the economic benefits of cloud adoption, such as leveraging multi-cloud strategies and utilizing auto-scaling and reserved instances. Furthermore, the article includes case studies from leading industrial companies like Siemens, General Electric, BMW, and ABB. These examples illustrate how cloud-based Industry 4.0 solutions enhance operational efficiency, reduce costs, and drive innovation. For instance, Siemens leverages AWS for scalable IoT solutions, GE utilizes Azure for data-driven industrial insights, and BMW employs GCP for advanced data analytics to improve manufacturing processes. In conclusion, cloud technologies are essential enablers of Industry 4.0, offering significant economic advantages and fostering innovation and efficiency. By overcoming historical barriers to entry, especially for SMEs, and providing flexible, scalable solutions, cloud computing is transforming the industrial landscape, driving growth, and facilitating the widespread adoption of advanced manufacturing technologies.

*Keywords:* cloud technologies, Industry 4.0, CAPEX to OPEX transformation, economic impact, small and medium-sized enterprises, return on investment, cloud service providers, digital transformation.

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## PROBLEMS OF POST-WAR RESTORATION AND DEVELOPMENT OF INFRASTRUCTURE IN UKRAINE

### 1. The Role of Infrastructure under Current Conditions

The damage Ukraine sustained because of the military activities amount to catastrophic sums. It refers to residential domain, transport, trade, industry, energy and extractive industries, agriculture, education, tourism and culture objects, water supply and sewage, health-care, environment and forestry, telecommunications and IT. The large ratio of this damage is made by infrastructure. Therefore, the future programme of overcoming war outcomes and recovery of Ukrainian national economy in the post-war period, and thus renovation of economic and social sphere, development of defense industry sufficient to provide national security must be closely connected with infrastructure, along with the other components.

On the other hand, the high level of infrastructure development in the country, comparable to the European one, is one of the most important precursors of Ukraine's economy successful entering European economic space and the entrance to EU.

Meanwhile, the views of programmes on overcoming war outcomes and post-war development creators [1], including the domain of Ukraine economy, e.g. [2-4] tend to vary greatly. However, they lack key formula that would lead Ukrainian society to effectively achieve the necessary ultimate result. For instance, very few remember the details of State Commission of Russia Electrification Plan (GOELRO) that was adopted in 1920, still the formula "...plus electrification of the whole country" remains in the memory of generations.

Besides, it is logical to consider that ultimate solutions as per relevant issues of normal situation recovery are to be made after overall and detailed analysis of approaches, action of all main factors and mechanisms of implementation, and evaluation of non-implementation results, while the programmes quintes-

sence must be grounded and clearly directed to the future, as "generals are often prepared to fight the last war"<sup>1</sup>. This quotation by Winston Churchill may be proven not only theoretically [5], but also by real historical examples. Thus, during the time of USSR collapse instead of choosing the way of Donbass alternative development with utmost restructuring of coal mining, ineffective in complicated subsurface conditions, it was decided to leave the situation without any essential change in the branch. Inconsistency that resulted from contemplations on that the issue of Donbass resolving must be transferred to a more convenient time [6], influenced the further unrolling of events in this industry and the region as a whole and brought even more tragic outcomes.

It's a paradox that even the United Nations experts do not require the definition of key strategic formula main components. The must for them is the long-term planning (up to 50 years with parcellating into five-ten years cycles), thinking by the categories of "great strategies and great undertakings", defining bifurcation point as its condition promotes raising one step higher even though with a high risk of downward slide [7]. The probability of civil catastrophes in bifurcation point grounds the relevance and need to tackle them by compensatory measures. It is exactly this position that we need to evaluate the recent and, by and large, constructive scientific work of the scientists from academic and higher educational establishments.

Thus, e.g., "...building up strategic goals in recovery and defining its branch vectors are of top importance for Ukraine even today. One could include to branch vectors of recovery the transformation of economics structure by means of innovation renewal of industrial capabilities using organisational and economic factors implementation based on new information technologies in such branches as machine

<sup>1</sup> Generals are always fighting the last war. Winston Churchill.



building and defense industry, steel, food, chemical, pharmaceutical and timber industries, as well as in new spheres of activities like bio- and nanotechnologies. In order to move along these vectors efficiently, state policy activities must be planned and implemented to create the rational structure of new industrial complexes in the regions, including also their relocation, renewal and development of new logistic schemes and to build enterprises able to substitute the production-sales chains destroyed by Russian aggression, along with the holistic strategic planning scheme" [2]. Otherwise, "...comprehensive solution of social and labour issues requires, with no exaggeration, global, or, to be more exact, neoglobal goal setting and mega views on how to achieve these goals. We have no doubt that the best social labour policy is the leveraged, highly professional and innovation oriented economic policy with such basic subsystems as socio-demographic, socio-labour, investment, technical and technological, innovation, financial and institutional, which could ideally become the components of Ukrainian "Marshall plan" [3]. Moreover, «...forming a new economic model as the basis of economy recovery must follow the way of new industrialization characterised by transition to principally new technics and technology. The inner interrelation between technical renewal of industry and economic development must become an immanent feature of post-war Ukraine market economy... New industrialization must begin with installation of such enterprises that could continue technological chain of raw materials production and easily substitute import. Added value in industrial branches is always sufficiently higher than in the ones of raw materials. This envisages new high technology jobs creation that will produce higher added value and provide the increase to population real income" [4].

This being well said; however, we would like to continue discussing recovery issue from point of view we have expressed above. Consequently, post-war recovery of Ukraine must be linked not with infrastructure per se, but in its wider definition, which formulates the goal of current work, i.e. to prove that it is infrastructure development that must be an important component of the formula to further state economy restoration strategy and its social sphere.

We consider viable the following frame to vividly demonstrate the role of infrastructure in the modern world: there's a huge number of electrical appliances in the world and all of them, whatever purpose they might be used for, require electricity to operate – this could be either electric cord, or battery or accumulator, but it is inevitably necessary. The same applies to infrastructure as it is inevitably necessary for every sphere of life, be it transport, industry, social sphere, healthcare or education... everything needs its own infrastructure.

The category of infrastructure in the meaning of roads, bridges, canals, ports, airports, and communication systems was introduced at the end of the 1930s,

while in the 1950s the stage of infrastructure development was used as the third, along with labour and capital, factor of macrolevel production function [8]. Today economic infrastructure is a complex of branches and activities that serve production and a state as a whole. While social infrastructure, in its turn, is the complex of branches and enterprises that provide normal functioning of population, including ones in industry, healthcare, pre-school, school, secondary and professional education. Also, the various types of infrastructure are differentiated, i.e. informational, military, innovation, market, space, touristic, etc.

In some countries economics infrastructure is divided into production and social (non-production) spheres, that is, refer science to infrastructure. In general, national economy infrastructure is the complex of branches and activities creating the basis of national economy and simplify and make more efficient the goods and services flow. Therefore, any event in post-war development of Ukraine and preparation to entering the EU is at the end of the day the development of exact infrastructure types and, consequently, the further action strategy will result from prospective "infrastructural" development.

The definition of infrastructure is so refined that it is not always possible to differentiate infrastructural component per se. «If the world were ruled by logics, – as had stated "The New York Times" just two days before the first Moon expedition, - one of honorary places on Cape Kennedy during Apollo-11 launch would be taken by Mykyta Khrushchov, USSR ex-President, and the former first secretary of soviet communist party" [9]. This passage was explained by the fact that the then USSR defense industry to a certain extent became the infrastructure for the USA space industry development, the launch of the first soviet artificial satellite caused psychological condition in the USA that was called "sputnik moment", "sputnik crisis". John Kennedy who followed Dwight Eisenhower as the US President, who was not the supporter of space race, increased the grade of opposition to the military one on the wave of "sputnik", which provided Werner von Braun, at that time American constructor, with the outstanding investment and mobilization opportunities.

Another example, if to address soviet realia: historians still argue if the development of virgin soil in Kazakhstan was the individual strategic campaign or the cover operation to build cosmodrome, that is the element of space infrastructure.

It makes sense to subdivide infrastructure by two directions from strategizing point of view: those its types that give economics the opportunity to earn funds, and those where it is viable (necessary) to invest funds into. Still, in both cases infrastructure needs funds for its development as well as while modernization is required. For instance, according to one of the versions the center of Europe is located near the Ukrainian village of Dilove near the town of Rakhov, Zakarpatskyi region<sup>1</sup>. Such

<sup>1</sup> Geographic centre of Europe Dilove. URL: [https://ua.igotoworld.com/ua/poi\\_object/13831\\_geographical-centre-of-europe.htm](https://ua.igotoworld.com/ua/poi_object/13831_geographical-centre-of-europe.htm).

geopolitical status provides Ukraine according to first direction the component of infrastructure required to convert the national state into powerful logistic and energy operator (transitioner). Gas transportation specialization of Ukraine is well known, however, at the times of the USSR the domestic fuel and energy complex was also of significant importance for the continental energy industry. There are three energy synchronous zones on the Eurasian continent. Union of the Coordination of Transmission of Electricity (UCTE) includes energy systems of 23 continental Europe countries that are part of UCTE. Since July 2003 till February 2022 the Western Energy System of Ukraine (the so called "Burshtynska thermal plant island") was working in a synchronized manner with UCTE. The Eastern synchronous zone, OCTE, includes the countries of CIS (Commonwealth of Independent States) (excluding Turkmenistan and Armenia, energy systems of which function in parallel with Iranian one) and Baltic countries (Lithuania, Latvia, Estonia). The Northern system (NORDEL) joins the energy systems of Northern Europe countries, i.e. Sweden, Norway, Finland and the western part of Denmark.

These unions were developing independently from one another, though the links were being grown with time. The conference "The perspectives of unification "East-West"" in 2009 proved that there are no unsolvable technical and institutionally legal obstacles to create pan-European energy markets with the possibility to create the largest energy space in the whole world «with indicated power over 860 GW, which includes 12 time zones, 37 countries and about 900 million energy users. The united European space is the opportunity to increase the energy provision reliability throughout the territory along with the expanding of energy market borders and possibilities. However, it is exactly Ukrainian high tension electricity transmission ETL-750 and ETL-400, which are not active now, were to act as integrators of united Euro-Asian network and to be its transit corridor, and Poland, which is peripheric now, should have turn into the capital of common energy zone [10].

The use of non-working mines capacities could also be a prospective for energy accumulation, the creation of international energy hubs in the mining regions of Ukraine and Poland. Nevertheless, military and political situation in Ukraine and Europe makes implementation of pan-European energy space impossible for long term. Nevertheless, the synchronizing of Ukrainian and European energy networks took place, with the prospective creation of competitive and transparent electric energy market according to the requirements of European legislation and market practices [11].

According to Elon Musk version, 5 out of 11 branches of the fastest transport landlines Hyperloop could go through the territory of Ukraine, three of which cross Kyiv: the first one joins China, Europe and Canada, the second one joins Asia, Middle East, Europe

and Northern Africa, while the third one is between Spain and China. It will be possible to get to India from Kryvyi Rih or Dnipro or to America from Kharkiv, Donetsk or Odessa.

Ukraine can also be prominent as the participant of a New Silk Road project, in order to do this, an effective and transparent mechanism of customs clearance as well as high quality system of railways and automobile highways is required – the scale of Chinese investment in this strategy implementation could amount to several trillions of dollars [12].

It's significant that now discussions are being held on creation of new high-capacity portals with conveyor belts lines in the area of Ukraine-EU border crossing between Rava Russka in Lviv region and Polish town of Tomaszow-Lubelskie, which are 32 km from one another [13].

Notwithstanding the importance of transition infrastructure to Ukraine, it's worth not failing to properly evaluate the role of innovative infrastructure. According to Ukrainian Law, innovation infrastructure is a complex of enterprises, organisations, institutions and their unities, associations of any form of property that give services in the provision of innovative activities (financial, consulting, marketing, information and communication, legal, educational, etc)<sup>1</sup>. Besides, innovation ecosystems are created and developed in localization space where material, production, information and labour resources are concentrated and that allow develop and use innovative solutions, and every economy branch has specific traits of economic activities performing and innovative activity types [14].

Although, under the environment of current industrial revolution this needs more detailed description. Old industrial regions of Ukraine (Dnipropetrovsk, Donetsk, Luhansk and Zaporizhia regions) are still not using the research potential to the full range. On the background of almost 82% of low marginal steel export, the ratio of investments into highly and medium technological branches of Donetsk oblast makes only 5,4% against 9,7% in Ukraine in general [15]. If one considers startup as a sign and the fastest factor of innovation development, then the distribution of projects through the regions is significantly non-homogeneous: the largest number of them is registered in Kyivska region (almost 58% or 154 units), there's only one startup in Donetsk region (Wattagio) [16], with also two in Dnipropetrovsk and one in Zaporizhia and Kirovohrad regions each. Even though, according to the data of Startup Ranking service, Ukraine takes 42<sup>nd</sup> place among 192 world countries as for the number of startups (266 units) [17]. The most progressive Ukrainian startup sector is technological one - in 2019 p. The record breaking 544 million USD of venture investments were mobilized to this sector, the sum total of investments into Ukrainian technological companies within the period of 2014-2019 makes 1400 million USD [18], which makes Ukraine one of the most attractive countries in Eastern and Central Europe for investment.

<sup>1</sup> On innovation activity. The Law of Ukraine. URL: <https://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=40-15#Text>.

This limited number of startups in old industrial regions makes surprised those people, for example, who have very long driving experience and still remember the traditions of old Soviet "garage culture" that compensated the poor access to brand automobile service stations by the work of handy people. These craftsmen who sprang from the school extracurricular activities of technical creativity or engineering construction groups at Pioneer Clubs or military and sports preparation associations did magic of creativity and wisdom. Based on this, the knowledge about the so-called Maker Movement in the USA gives the idea of a modern examples of innovation: tech-shops have already appeared in California, Michigan and North Carolina, the movement of personal production FabLab has also increased. Tech-shop is a workshop, a shop and a club at the same time [19]. The owners of these establishment offer to their subscribers the access to various new generation industrial equipment with the overall cost of several million USD, including automatically programmed mills and tools, laser knives, etc for a decent monthly payment. There's a movement of industrial labs called Hacklab where people produce not only for themselves but also according to the other companies' orders. In other words, a new class of industrial freelancers is emerging. Within the scale of global state 3D-entrepreneurship is able to make such a giant leap of economic effectiveness based on additive production and owing to reducing of material quantity, good energy capacity, and energy and logistics spending and elimination, which was impossible to imagine even at the times of previous industrial revolutions [20]. WhatsApp messenger that is now used by over one billion of people all over the world and was sold to Facebook for 22 billion USD in 2014 was created by Mr. Ian Borysovych Kum who was born in Ukraine (now American citizen).

The world is loaded with funds during the epoch of industrial revolutions. The owners take funds from old branches and are trying to use capital in a more profitable way. Innovation infrastructure, like transport and energy ones, should become a way to use this financial flow to invest it in industry development infrastructure and through it into society as a whole, to increase labour efficiency, its intellectual level creation of decent conditions and security and by this increasing the life quality of people at enterprises, environment protection and rational use of natural and secondary resources. It will have a significant social effect apart from sufficient economic results. Thus, this has to be defined as separate and important infrastructure branches.

## 2. Social infrastructure development directions

Social infrastructure should include those its types that allow to achieve notable social results. In this way, the improvement of demographic situation in Ukraine should have its own infrastructure. The ideas to create such specific types of infrastructure are inspired by the thoughts expressed by the specialists of the Institute of Demography and Life Quality named after M. V. Ptukha, National Academy of Science of Ukraine.

For example, the complex approach to achieving financial self-sustainability of families with children needs the services uniting employment and parenting (affordable and high quality system of pre-school institutions, individual childcare services). The growth of orphans number requires establishment of institutions that will bring up orphans in families or in environment close to family, implementation of the mechanisms to define (and search) children who lost their parents as a result of military activities, lost children, or families in hardship, etc, it's important to adjust support mechanisms for all forms of upbringing children with no parents – foster families, patronage families, family type orphanages, guardians families or national fostering.

The special type of infrastructure should be ageing people support with promotion of active longevity, which envisages efforts to increase ability of keeping good health condition and social integration for elderly people. What sets a good example is the everyday life of people as it is organized internationally in elderly people homes that allows their keeping themselves busy. At the same time, public awareness would be of importance, based on the example of an active part of those institutions that care about sticking to healthy lifestyle since childhood, as well as awareness of negative results of unhealthy lifestyle, the vivid examples of difference in health condition between people with who cared about it since childhood and contrary ones.

Even the need to quickly increase life expectancy, especially among men requires its infrastructural support, e.g. in high quality treatment and nutrition at workplace (with employers' involvement to provide one), labour conditions control, support to working flexitime, etc. One should not forget about high quality and sufficient nutrition of people as an important component of the state food security.

The decrease of immigration expenses is also impossible without relevant infrastructure that must keep contacts with compatriots abroad (labour, educational, cultural, financial, legal), support and develop their feelings of being Ukrainians, their love to their Motherland and nuclear, "small" Motherland. Principal impossibility to ban migration causes the necessity to create mechanisms off preventing migration being one-way with no return by using potential positive effect, e.g. increase of Ukraine labour potential by using new skills and knowledge of returning migrants, as well as involving migrants' funds not only to keep their families but also for investments into economy.

Now the infrastructure is required to create workplaces for internally displaced population (IDPs) and integrate them to its maximum within the territories of their temporary residence, to create civil bodies for their uniting so that they could have the channel of self-representation and share positive experience of work and residence integration at a new place.

The lack of qualified workforce which Ukraine economy will definitely face in post-war period will require infrastructure of foreign workforce involvement based on the principles of substitutional migration. It could be rational, for example, to establish the service



of foreign students' recruitment during their studies or after they successfully graduate educational establishments in Ukraine to maximally integrate them as long-term migrants into Ukrainian society.

There's a reason to have a new and more astute approach to professional education of vocational jobs workers based on existing technical higher educational and vocational establishments, including would-be students, to stimulate their choosing engineering professions. Besides, practical training is required to educate people to get professional positions they are going to obtain after higher educational establishment graduation. To do this, universities must have closer contacts with enterprises and production businesses that are virtually the ones searching for young specialists. The experience of some technical universities as for apprenticeship of their students in production is also worth attention.

It is logical, with the aim of ordering and professions effectiveness improvement, to differentiate awarding qualifications and academic degrees for scientists, education professionals and the ones employed in production and management according to their place of work, i.e. for scientific institutions (scientific degrees should remain), educational establishments (PhD, or PhD in education with obtaining their degree in higher educational establishment with the emphasis upon scientific economic and organisational

issues of educational process, using scientific results in education and, if wish be – scientific degrees), in business and production (management, MBA, with degrees obtaining in scientific or educational establishments).

### 3. Conclusions and recommendations

The analysis of publications and practical situation gave the chance to realise that strategic studies of post-war Ukraine recovery lack to a certain degree an important formula constituent that would give more impression not only about essence but also about the ultimate result of the programme product. This insufficient awareness of [Ukrainian society as per the choice of strategic development way leads to a certain unclearness of priorities. However, everything aforementioned about the infrastructure under current conditions give all the grounds to considering in to be one of the basic constituents for the formula of further state national economy and its social sphere development.

Therefore, infrastructure's nomenclature is worth preparation and development followed by continuous monitoring of every direction activities, correlation of achievement with world practices, actions to achieve results, relevant investment, including international projects with taking into consideration their sequence and terms of implementation. So, consequently, one of strategic slogan for post-war recovery of our state must be "Future Ukraine is at the first-place infrastructure of social life and production at the European level".

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**Амоса О. І., Амоса О. О. Проблеми повоєнного відновлення та розбудови інфраструктури України**

У статті звертається увага на відсутність ключової формули у стратегічному плануванні для розробки програм відновлення. Тому розглянуто можливість інфраструктурної трансформації як ключової складової формули відбудови економіки. Проаналізована роль інфраструктури в умовах війни та після неї. Наголошується на важливості інфраструктури для відновлення економіки, соціальної сфери та національної безпеки з урахуванням великих втрат у різних сферах, таких як житло, транспорт, промисловість, освіта, охорона здоров'я та інші. Показано, що розробка ефективних програм відновлення, з акцентом на інфраструктуру, має вирішальне значення. Остаточні рішення слід ґрунтувати на ретельному аналізі, оцінці впливу та чіткому стратегічному плануванні з урахуванням історичного досвіду.

*Ключові слова:* інфраструктура, національна економіка, виробнича та соціальна сфери, повоєнне відновлення, енергетика.

**Amosha O., Amosha O. Problems of Post-War Restoration and Development of Infrastructure in Ukraine**

The article draws attention to the lack of a key formula in strategic planning for the development of recovery programs. Therefore, the possibility of infrastructure transformation as a key component of the formula for economic recovery is considered. The role of infrastructure in the conditions of war and after it is analyzed. The importance of infrastructure for economic recovery, social sphere and national security is emphasized, taking into account large losses in various areas, such as housing, transport, industry, education, health and others. Developing effective recovery programs with a focus on infrastructure has been shown to be crucial. Final decisions should be based on careful analysis, impact assessment, and clear strategic planning based on historical experience.

*Keywords:* infrastructure, national economy, industrial and social spheres, post-war reconstruction, energy.



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## ECONOMIC POTENTIAL OF THE RAILWAY ENGINEERING INDUSTRY OF UKRAINE IN THE CONTEXT OF POST-WAR RECOVERY AND EUROPEAN INTEGRATION

**Target setting.** The critical socio-economic situation in Ukraine caused by the Russian-Ukrainian war with intensified hostilities in a large part of the country, a dramatic change in the trends of global economic policy, and the institutional environment pose a number of complex problems for the state. In particular, the problem of finding new forms of international cooperation that would make it possible to realize Ukraine's potentially high competitive position (primarily in the European division of labor). The post-war development of Ukraine largely depends on the formation of an effective transport and logistics system within the countries of Central and Eastern Europe (CEE) on its initiative, which actualizes the need not only for revitalization but also for innovative development of its infrastructure, especially the rolling stock fleet.

Currently, the Ukrainian railway engineering industry is in a state of decline due to a number of systemic problems, such as backward technology, insufficient investment, corruption, and the loss of traditional markets. As Ukraine moves toward European integration, the question arises as to how to restore the economic potential of this previously important sector in the context of postwar reconstruction. In this regard, there is a need for production cooperation with promising rolling stock manufacturers, searching for optimal models of integration of Ukrainian companies into the global commodity and financial markets.

International alliances, in particular the Lublin Triangle, a platform for cooperation between Poland, Lithuania, and Ukraine, can become an effective form of long-term development. However, despite the declared intentions of broad cooperation between the founding members of this alliance in all sectors of the economy, the organization's real activities are carried out only in the context of political consultations and military cooperation. However, this does not reveal the potential of this organization. In addition, Ukraine would benefit from the expansion of the Lublin Triangle by adding a number of other CEE countries, such as the

Czech Republic, Romania, Moldova, Bulgaria (and quite possibly Slovakia, Georgia, and Azerbaijan). We should also anticipate the formation of other new alliances. All of them will objectively include transport logistics issues as one of the determining factors.

Thus, there is a complex institutional, economic, technical, and technological problem of extending such interaction to the economic sphere of cooperation, which in turn raises the issue of identifying potential opportunities and priority areas for the development of Ukraine's international partnership in the field of transport engineering.

**Scientific research of the problem under study and its unresolved aspects.** Even though this topic has been repeatedly considered and analyzed by international experts and analysts [1], there are still a number of unexplored issues, in particular, in the field of international economic cooperation. It is worth noting that such international alliances are the basis for the development of the economy of both a weaker country and wealthy partners, both by "pulling" the weaker country to their level and by activating a number of representatives of various sectors of the economy of stronger countries. Examples include Germany's cooperation with the Czech Republic and Slovenia, the triumvirate of the Baltic countries, and other successful examples of economic globalization [2, p. 12; 3, p. 34].

A noteworthy analysis of the prospects for international cooperation arising from geographical location, communication links, similar economic features at certain stages of development and history is presented in the informative analytical report "State and Prospects of Strategic Partnership between Poland and Ukraine" [4]. In particular, this document emphasizes the benefits of developing transport communications [4, p. 154]. A fundamental analysis of the integration of Ukraine's railway system into the European transport system is presented in a monograph by the former Minister of Transport of Ukraine, General Director of Ukrzaliznytsia, H. Kirpa [5]. The analytical work of Jacob Bornio is also worth noting, as he has made

interesting conclusions about the impact of the Lublin Triangle on the economies of the participating countries, pointing out that their task now is not only to strengthen the dialogue but also to develop economically [6, p. 7]. In addition, this paper indirectly considers the prospects of communications, without which the comprehensive development of the alliance is impossible. The issues of transport and logistics interaction in the country have become the subject of systematic institutional developments in the works of scientists of the Institute of Industrial Economics of the National Academy of Sciences of Ukraine [7-8].

The general theoretical and epistemological component of the study of the totality of aspects of the transport and logistics sphere of Ukraine in the postwar period can be considered in a number of articles in CEE scientific journals on the feasibility, problems, and prospects of creating a new expanded alliance on the basis of the Lublin Triangle, which can become a significant factor in shaping peace and stability on the European continent [9 – 11].

It should be noted that although all researchers emphasize the need to develop economic infrastructure as part of Ukraine's integration into international organizations, the issues of economic, technical, and technological support for improving transport and logistics connectivity remain out of sight.

Instead, the authors of the article for the first time raise the issue and substantiate specific proposals for the creation of an appropriate transport and logistics cluster with a network of transport and logistics clusters within the Lublin Triangle [12-14]. The issues of actualization of the design and technological potential of railway engineering enterprises of Ukraine in the context of opportunities for the development of cooperation between the countries of the Lublin Triangle are studied in the works [15-18].

**The aim of the article** is to conduct a comprehensive study of the current state and prospects of development of the Ukrainian railway engineering industry in the context of post-war reconstruction of Ukraine and European integration, which involves, first of all, determining effective strategies and recommendations to ensure sustainable competitive development of the domestic railway engineering industry in the face of modern challenges.

**The informational and analytical basis of the study** was formed by the authors' research work "National Business Cultures of Poland and Ukraine: Improving the Scientific and Practical Foundations of Cooperation in the European and World Markets" (state registration number 0120U103807) within the framework of the Ukrainian-Polish project of the Ministry of Education and Science of Ukraine and the National Agency for Academic Exchange of Poland NAWA (2020 – 2021) and the topic „Trójkąt Lubelski: podstawy rozwoju gospodarczego powojennej odbudowy Europy w XXI wieku”, carried out under the Project of the Ministry of Higher Education of Poland «Inicjatywa Doskonałości – Uczelnia Badawcza» (2022-2023).

**The statement of basic materials.** By their nature, international organizations-alliances such as the Visegrad Group, the Three Seas Initiative, the Lublin Triangle, etc. are aimed at supporting and strengthening the competitive advantages of certain regions of Europe. In particular, the strategic development of certain sectors of the economy will help strengthen the positions of their member countries on the world stage [4, p. 26].

An objective analysis shows that in the context of justifying the prospects of the most realistic and beneficial alliance for Ukraine in the context of post-war recovery and implementation of the European integration course, we should consider the Lublin Triangle with the prospect of joining the Czech Republic, Romania, Moldova, Bulgaria (possibly also Slovakia, Georgia, and Azerbaijan) [11]. It should be noted that the idea of establishing this kind of international organization has a long history and solid theoretical, methodological, scientific, and practical foundations. It naturally assimilates the following determinants.

First: key provisions of the concept of "Intermarium" put forward by J. Piłsudski [19].

Second: the conceptual approach of the Marshall Plan – the US law "Economic Cooperation Act of 1948" [20], which was used to restore Europe after the Second World War (the main provisions and specific organizational and administrative mechanisms for implementing the "Economic Cooperation Act of 1948" were also used in the post-war restoration of Japan, Taiwan, South Korea, etc.).

Third: Z. Brzezinski's concept of "The Grand Chessboard" with the definition of a particularly significant role of Ukraine as one of the five axes of Eurasia (under certain conditions, Brzezinski also predicted the strengthening of the role of Poland and the Baltic states) [21].

The special dynamics of changes in modern geopolitics (which will increase even more in the mid-term) for Ukraine in the context of the possible establishment of new international alliances opens another historical perspective. It arose as a result of D. Tusk's political force coming to power after the recent elections to the Sejm in Poland. This gives grounds to predict with high probability the activation of another alliance – the Weimar Triangle, founded by Germany, France, and Poland. Moreover, under certain conditions, due to the strengthening of the Ukrainian trend in modern geopolitics, we should not exclude even the invitation of Ukraine to the Weimar Triangle: Germany, France, and Poland may be interested in this based on their particular interests.

However, this kind of versatility can focus on Ukraine (and the Weimar Triangle is likely to transform, for example, into a Pan-European Square). Generalization of the current and projected trends in the development of the transport and logistics sector and the relevant engineering industries of the Weimar Triangle countries also shows that they will keep these issues projected to Ukraine.

But it is Ukraine that should be the initiator and lobbyist of such processes.

To summarize, in the context of solving both tactical and strategic institutional, economic, scientific, and technical problems, it is expedient and necessary for Ukraine to consider the aspects of substantiating the prospects for the development of its transport and logistics sector and relevant subsectors of mechanical engineering with a projection on cooperation, first of all, with the following countries: Poland, the Baltic States, the Czech Republic, Germany, France.

The basis of the EU's transport and logistics activities is the Trans-European Transport Network (TEN-T), which in turn is part of a wider system of trans-European networks. The Pan-European Transport Network TEN-T is a large-scale EU infrastructure project that provides for the coordinated improvement of major roads, railways, inland waterways, airports, seaports, inland ports, and traffic management systems, providing integrated and intermodal intercity high-speed routes. The EU is working to promote networks through a combination of leadership, coordination, issuing guidelines, and financing the development aspects. On June 21, 2016, the Ministers of Transport of the European Union, the Eastern Partnership, and the European Commission decided to extend the indicative maps of the European Transport Network TEN-T to the EU's neighboring countries, including Ukraine.

The strengthening of the Ukrainian trend in the current and predictable transformational processes of geopolitics will be embodied in the following likely (and expected) decision of the European Union: even in the conditions of war, transport corridors to the territory of Ukraine will be extended. This, again, emphasizes the importance of cooperation between Ukrainian manufacturers and those in this group of countries.

The creation of an effective economic mechanism for Ukraine's integration into the pan-European transport network, the actualization of infrastructure projects in the context of the implementation of the powerful transit potential of our country requires a transition to the concept of "transport logistics hubs" (TLH), which also stem from the essence of the Single European Regional Policy as contributing to the balanced development of territories.

In the future, given the geographical features of the territory, rail transport will retain the leading role in Ukraine's transportation system, with the undoubted need for the simultaneous development of river and sea routes. For comparison, 82% of freight and 36% of passenger transportation in the country is carried out by JSK "Ukrzaliznytsia". However, today the railroad industry has a number of long-standing unresolved issues, including, first of all, the inconsistency of the existing economic structure and management system, and especially the state of the infrastructure and rolling stock fleet with the strategy for further development of the transport industry [5, p. 31-32]. As a result, there is an urgent need to modernize the infrastructure of transport corridors, improve transportation technology,

and accelerate the replacement of vehicles that have reached the end of their service life.

In our opinion, the problem of renewal of the rolling stock fleet of the Ukrainian railways should be carried out taking into account the need for maximum localization of production of high value-added products, creation of jobs, updating the design and technological potential of domestic science while adapting international experience and obtaining investments. There are grounds to say that the implementation of the TLH network within the expanded Lublin Triangle will activate the production potential of domestic machine-building enterprises, expand their investment opportunities, and especially reorient supply chains and markets. Hence, there is a need to search for potential models of cooperation of domestic manufacturers of railway rolling stock within the selected group of countries.

**Locomotives and rolling stock.** Since the percentage of deterioration of electric locomotives, diesel, and electric locomotives of JSK "Ukrzaliznytsia" increased from 82% to over 90% between 2001 and 2023, there is an urgent need to renew the fleet of the domestic railway monopoly [15, p. 103; 17, p. 39]. For the last 10 years, the management of JSK "Ukrzaliznytsia" has been making constant attempts to attract foreign manufacturers of rolling stock to resolve this issue. However, it is worth reminding that for a long time, a number of alternative attempts to implement trilateral agreements with JSK "Ukrzaliznytsia" on localization of locomotive production with the participation of foreign companies have failed. First of all, it should be noted that the locomotive industry in Ukraine has suffered significant damage since the leading company, PJSK "Luhanskteplovoz", has been not only formally owned by a Russian investor but also under actual occupation since 2014. Hence, its prospects remain uncertain both in the field of locomotive construction and the production of rolling stock.

Back in June 2013, a memorandum was signed between the State Agency for Investment and National Projects of Ukraine and the Polish company PESA Bydgoszcz SA on the prospects for the production of dual-system electric locomotives of the new innovative Gama platform rolling stock within the framework of a joint venture created at the production facilities of the SE RPC "Elektrovozobuduvannia". However, already in September 2013, "Ukrzaliznytsia" together with Skoda Transportation agreed on the organization of production of 3 types of electric locomotives (including innovative dual-system electric locomotives Skoda 109E, which were to be designated DS-25) at the facilities of Zaporizhzhia Electric Locomotive Plant with a gradual increase in the share of components produced by Ukrainian industry to 90% [16, p. 125]. In the end, due to the uncertainty of the prospects for orders by Ukrzaliznytsia, PESA denied the possibility of cooperation with the RPC "Elektrovozobuduvannia". Instead, the Ukrainian-Czech plant Zaporizhzhia Electric Locomotive LLC didn't start production of passenger electric locomotives either [16, p. 125]. In



November 2018, Škoda Transportation opened an official representative office in Dnipro to develop railway transport design projects and integrate into the Ukrainian market [16, p. 127].

Initially, JSK “Ukrzaliznytsia” planned to hold another tender for the purchase of rolling stock. The following companies were among the bidders: Alstom (France), Siemens (Germany), CRRC (China), Škoda (Czech Republic), and PJSK “KRCBW” (Ukraine). In this context, it is worth noting the intentions of some railway car building and repair plants to master the production of locomotives [22-23]. However, this scenario is unlikely, since with the existing production capacities of these enterprises, it can only be a matter of finalizing samples under external contracts of JSK “Ukrzaliznytsia” produced abroad, and not creating a product with high added value. On May 13, 2021, representatives of the Governments of France and Ukraine signed a framework agreement on the implementation of the project to renew the fleet of electric freight locomotives of JSK “Ukrzaliznytsia”. In case of winning the tender, the management of PJSK “KRCBW” planned to establish its production of electric locomotives, the cost of which, according to representatives of the Ukrainian manufacturer, could be 15-20% lower than the price of Alstom locomotives [24].

Today, PJSK “Kryukiv Railway Car Building Works”, having its own powerful design and technological basis and production facilities, has taken a monopoly position as a supplier of motor-car rolling stock for JSK “Ukrzaliznytsia” among Ukrainian manufacturers of rail equipment.

Since 2012, PJSK “KRCBW” on its initiative began designing a new family of suburban, regional, and interregional locomotive trains of a new generation, including diesel trains, and electric trains of different current systems with bodies of similar design. In early 2012, PJSK “KRCBW” built and tested the first 2 samples of the experimental electric train EKr1, which was named “Tarpan” [25, p. 290 – 291]. As a result of the victory of PJSK “KRCBW” in the tender announced by Kazakhstan Railways, the development of the diesel train DPKr2 began, taking into account the regulatory technical requirements in force in Ukraine. In the summer of 2014, a prototype diesel train DPKr2-001 was built, which was named “Obriy” with a construction speed of 154 km/h. In 2014, PJSK “KRCBW” also developed technical specifications for suburban electric trains of AC EKr3 and DC EKr4 [18, p. 357 – 358].

In the spring of 2017, JSK “Ukrzaliznytsia” announced another tender for the supply of three-car diesel trains for regional traffic, in which PJSK “KRCBW”, Polish company PESA Bydgoszcz SA and Kharkiv Railway Car Building Plant LLC took part. However, JSK “Ukrzaliznytsia” soon canceled the tender, rejecting all submitted bids due to non-compliance with the tender documentation. As a result of winning another tender, PJSK “KRCBW” developed and manufactured a regional three-car diesel train DPKr3 with a maximum speed of 140 km/h. Despite the

successful construction of the first four samples of the DPKr3 diesel train under the tender and the possibility of producing electric trains by PJSK “KRCBW”, JSK “Ukrzaliznytsia” is persistently trying to hold a tender with the involvement of the Swiss company Stadler Rail AG for the supply of 80 electric trains with localized production in Ukraine for the amount of UAH 31,462,000,000 [18, p. 358]. However, with the outbreak of hostilities on the territory of Ukraine on February 24, 2022, the prospects for this cooperation remain uncertain.

**Wagons.** In the late 1980s, half of the production capacity of the USSR railway car industry was concentrated in Ukraine, including 100% of the production of tank cars, up to 50% of freight cars, and heavy-duty transporters [26, p. 5, 27]. For a long time, the leading manufacturer of tank cars in Ukraine was the Azovmash Plant, which was virtually destroyed during the hostilities in Mariupol. The fate of the Stakhanov Railway Car Building Plant, which has been in the occupied territory for a long time, remains uncertain. Today, Ukrainian railway car manufacturers include PJSK “KRCBW”, PJSK “Dneprovagonmash”, RMF “Karpaty”, LLC “Kharkiv Railway Car Building Plant”, and a number of certified car repair plants.

The number of new wagons on European railways is constantly growing. In 2022, private companies alone increased their freight car fleet by almost 11,000 units. According to the International Union of Wagon Keepers, their investment in the purchase of new wagons is about €400 – 500 million per year [28]. Currently, the EU market is key to the survival of the Ukrainian railway car industry, as the markets of the CIS countries that use a wide gauge (1520 mm) are virtually blocked for Ukraine. The EU market used to be inaccessible to Ukrainian railway car building companies due to the complex certification procedure, and especially the need to switch to European railway car production technologies.

Back in the early 2000s, JSK “KRCBW” gained practical experience in creating subway wagons, innovative freight wagons, as well as locomotive-powered passenger wagons with a speed of 160 km/h [25, p. 58]. The company was able to stabilize its financial position by expanding its product range, upgrading its fixed assets with the latest equipment, and preserving its design and technological potential by mastering the industrial production of new types of rolling stock [29, p. 187]. In the end, today, despite the formal presence of 2 competitors in the form of JSK “Dniprovgonrembud” (Dnipro) and OJSK “KhRCBP” (Kharkiv), it is PJSK “KRCBW” that is the exclusive monopolist in the production of passenger railway cars in Ukraine. In particular, in 2022, JSK “Ukrzaliznytsia” purchased 100 passenger railway cars from PJSK “KRCBW” with the help of the state budget and plans further purchases under the rolling stock renewal program until 2026 [30].

Nowadays, the possibility of PJSK “KRCBW” entering the EU passenger railway car market arose as a result of the interest in the Company's products by a

private Czech railway operator RegioJet. Given the significant growth in rail transportation in the EU, which has created a significant demand for the products of local railway car manufacturers, Ukrainian rolling stock manufacturers have a unique chance to enter the European market, provided they master international quality standards. RegioJet's management expressed readiness to order 1,000 passenger railway cars from PJSK "KRCBW" if they are adapted to EU standards and cost no more than EUR 1 million per unit. For comparison, in European countries, the cost of one passenger railway car is on average 2 million euros per unit [31].

In the fall of 2023, PJSK "KRCBW" for the first time in Ukraine received the right to manufacture freight cars for the European gauge – 1435 mm. The company's specialists designed an intermodal platform railway cars of the Sgrss 80' type for the transportation of containers. The prototypes of these railcars have already been tested at European testing grounds and have proven their compliance with the requirements of the technical specifications for interoperability (TSI) in force in the EU [32].

However, the most promising candidate for entering the EU markets is PJSK "Dniprovgonmash", as its parent group "TAS" has already acquired 40% of the shares of the Austrian company TransAnt GmbH, a manufacturer of innovative module railcars. TransAnt module railway cars, developed together with the company's Austrian minority shareholders, the Voestalpine AG metallurgical group, and the state-owned OBB Rail Cargo Group, will be sold to European rail operators. This is a new type of freight car that can be quickly transformed from one type to another. Within 2 years, the company plans to produce about 1500 railway cars annually. In 2021, OBB Rail Cargo Group announced plans to purchase 1400 module wagons from TransAnt GmbH for €130 million [28]. Since February 2022, PJSK "Dniprovgonmash", having received the appropriate international certification, has been producing the main components for the module-type TransAnt railway cars [28].

In the fall of 2023, PJSK "Dniprovgonmash" shipped the first lightweight modular freight cars (MultiBOX) designed for operation on EU railways. The project is implemented in cooperation with Austrian partners. Now MultiBOX is undergoing the necessary tests for compliance with European standards, and PJSK "Dniprovgonmash" is already working on additional orders, not only for module structures, but also for railway cars, and is preparing to explore new opportunities in the European market [33]. The net income of PJSK "Dniprovgonmash" for 2022 increased by 77.3% to UAH 1 billion 108.7 million, and net profit amounted to UAH 48.64 million against a loss of UAH 111.3 million a year earlier. At the same time, sales of railway cars increased by 35% to 623 units, and production increased by 21% to 577 units [34]. It became known that the TAS Group, which includes PJSK "Dniprovgonmash", received permission from the Antimonopoly Committee of Ukraine to increase its

stake to more than 50% of the shares in the Austrian TransAnt GmbH [35]. However, despite the broad prospects for European industrial integration, the relative proximity to the territory of hostilities remains among the main risks of PJSK "Dniprovgonmash".

**Special equipment.** Unfortunately, mass production of special rail equipment in Ukraine is not widespread. The exception is the hand car manufactured by RPE "DEVZ" (Dnipropetrovsk) [36, p. 57], as well as track machines manufactured in cooperation with the Austrian company Plasser & Theurer GmbH and PJSK "Starokramatorsk Machine-Building Plant" (Kramatorsk) [37, p. 178 – 180]. Instead, a sample of the railcar for track and power grid repair AD-01 developed by PJSK RPE "Dniprospetsmashina" was presented in the spring of 2013 [38] has not been mass-produced, which, in our opinion, makes it all the more impossible for it to be certified in the EU, not to mention its competitiveness in local markets.

**Conclusions and prospects for further research of the issue under study.** Therefore, an important element of Ukraine's post-war recovery and European integration should be its effective participation in Eastern European international organizations, among which the most realistic may be participation in the expanded format of the Lublin Triangle (or Weimar Triangle). The organizational and managerial mechanism of this cooperation is proposed to be implemented through the creation of a network of transport and logistics hubs, for which it is important not only to comply with the principle of combining the flows of different types of transport but also to optimize the location of hubs within the member countries of the alliance since transport and logistics flows intersect in large industrial centers with an existing human and resource base.

The railway transport network will traditionally remain the key logistical element in ensuring such logistics. However, the market for wide-gauge railway equipment (1520 mm) is virtually closed to Ukrainian manufacturers of rail rolling stock. In this regard, there is an urgent need to find alternative formats of manufacturing cooperation in order to prevent the industry from going bankrupt in Ukraine. In our opinion, a possible solution to this problem is the realization of full cooperation between Ukraine and certain Central and Eastern European countries.

The economic potential of this cooperation can be realized in two ways: by the leading Ukrainian manufacturers of railway equipment (PJSC "KRCBW", PJSC "Dniprovgonmash", etc.) entering the EU market, and by attracting potential manufacturers to create joint ventures based on the privatization of state property in Ukraine. In our opinion, this format of cooperation, with the prospect of creating special economic zones in Ukraine, has great potential for the domestic machine-building industry, given its need to reorient supply chains and markets in the international arena.

That is, the creation of a network of diverse special economic zones should be considered an appropriate

regulatory regime for implementing Ukraine's post-war restoration policy (including in the context of establishing the proposed cooperation of domestic railway transport enterprises).

Due to the ineffective management system, the railway engineering enterprises that are still in state ownership have outdated design and technological developments and are unable to ensure competitiveness. The presented analysis confirms that the Ukrainian industry is capable of being present in the EU markets in the field of railway car building; instead, the outdated locomotive facilities and the creation of innovative rolling stock require attention.

The development of the competitive environment for locomotive and rolling stock manufacturers in Ukraine will involve the development of a long-term

strategy taking into account the specific needs of the railway operators' market and the actualization of design and technological cooperation, in particular with manufacturers PESA Bydgoszcz SA, Newag SA (Poland), Škoda Transportation (Czech Republic), which have long practical experience in the production of mainline equipment and innovative design and technological solutions.

In general, systematic manufacturing, commercial, scientific, and technical cooperation with CEE companies will allow Ukrainian enterprises not only to master new technological standards but also to compete with the world's leading manufacturers in this industry (which is a natural and logical phenomenon of the modern global economy).

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**Рубан М. Ю., Чеботарьов С. В. Економічний потенціал залізничного машинобудування України в умовах повоєнного відновлення та європейської інтеграції**

Опрацювання сукупності проблем повоєнного відновлення України і похідних питань провадження євроінтеграційного курсу держави передбачає, перш за все, обґрунтування оптимальних стратегічних напрямів відповідної відновлювальної політики. Узагальнення світового досвіду розробки і реалізації політики повоєнного відновлення виступає ґносеологічним і науково-практичним підґрунтям у числі визначальних стратегічних напрямів відновлення України виокремити створення транспортно-логістичного кластеру на базі розширення міжнародного альянсу – платформи співробітництва «Люблінський трикутник». Розширення «Люблінського трикутника», за умов проведення Україною необхідної відповідної діяльності, є цілком реальним шляхом доєднання до Польщі, Литви та України Чехії, Румунії, Молдови, Болгарії (дещо пізніше, можливо, також – Словаччини, Грузії та Азербайджану).

В статті автори поглиблюють висунуту ними й обґрунтовану в українській і зарубіжній науковій літературі пропозицію створення зазначеного транспортно-логістичного кластеру з використанням мережі транспортно-логістичних хабів в контексті пропонованого розширення «Люблінського трикутника». Ще одним новим історичним шансом для України за даним напрямом (й у більш ширшому інституціональному й економічному розумінні) може бути прогнозоване запрошення доєднатися до Німеччини, Франції та Польщі в межах альянсу «Веймарський трикутник».

На основі аналізу економічного і науково-технічного стану вітчизняних підприємств залізничного машинобудування розглядаються проблеми та перспективи їхньої широкої кооперативної співпраці з підприємствами Польщі, країн Балтії, Чехії, Німеччини та Франції в підгалузях виробництва локомотивів і моторвагонного рухомого складу, вагонів та спеціальної техніки. Відповідним регуляторним режимом, який в змозі забезпечити практичне запровадження пропонованої співпраці (як й у широкому контексті практичного провадження політики повоєнного відновлення України), слід визначити створення мережі спеціальних економічних зон.

*Ключові слова:* повоєнне відновлення України, регуляторні режими, «Люблінський трикутник», транс'європейська транспортна мережа, транспортно-логістичний кластер, залізничний транспорт, локомотиви та моторвагонний рухомий склад, вагони, спеціальна техніка.

**Ruban M., Chebotarov Ie. Economic Potential of the Railway Engineering Industry of Ukraine in the Context of Post-War Recovery and European Integration**

The study of the set of problems of Ukraine's post-war restoration and derivative issues of the state's European integration course involves, first of all, substantiation of the optimal strategic directions of the relevant restoration policy. Generalization of the world experience in the development and implementation of post-war restoration policy serves as an epistemological and scientific-practical basis for the following strategic directions of Ukraine's restoration: the creation of a transport and logistics cluster based on the expansion of the international alliance –

the Lublin Triangle cooperation platform. Expansion of the Lublin Triangle provided that Ukraine takes the necessary measures, is quite realistic by adding to Poland, Lithuania, and Ukraine the Czech Republic, Romania, Moldova, Bulgaria (later, perhaps, also Slovakia, Georgia, and Azerbaijan).

In the article, the authors elaborate on their idea, which is substantiated in the Ukrainian and foreign scientific literature, to create the mentioned transport and logistics cluster using a network of transport logistics hubs in the context of the proposed expansion of the Lublin Triangle. Another new historic chance for Ukraine in this area (and in a broader institutional and economic sense) may be the expected invitation to join Germany, France, and Poland in the Weimar Triangle alliance.

Based on the analysis of the economic, scientific, and technical state of domestic railway engineering enterprises, the problems and prospects of their wide cooperation with enterprises of Poland, the Baltic States, the Czech Republic, Germany, and France in the sub-sectors of production of locomotives and rolling stock, wagons and special equipment are considered. The appropriate regulatory regime that can ensure the practical implementation of the proposed cooperation (as well as in the broader context of the practical implementation of Ukraine's post-war restoration policy) should be the creation of a network of special economic zones.

*Keywords:* post-war restoration of Ukraine, regulatory regimes, Lublin Triangle, trans-European transport network, transport and logistics cluster, rail transport, locomotives and rolling stock, railway cars, special equipment.



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## FISCAL DECENTRALISATION AND LOCAL GOVERNMENT REFORM: ADAPTATION IN UKRAINE EXPERIENCE OF POLAND AND LITHUANIA

**Introduction.** The need to create an effective system of local government necessitates a thorough study of foreign practice, primarily the analysis of the implementation of local government reform in the European Union (EU). Military operations in Ukraine have only exacerbated this need, given the urgent need to reformat local self-government to the conditions and objectives of martial law and the post-war period. In this context, it is useful to study the positive experience of neighbouring countries, in particular Poland and Lithuania, which have implemented effective reform the local self-government practices that have had positive consequences for their economies. Lithuania's experience is particularly important, as it was in the process of joining the EU that radical changes were made to the entire public administration system.

Ukraine's European integration vector requires the actual implementation of reforms based on the principles of deconcentration, decentralisation, and subsidiarity in relations between the central government and the regions. However, regional imbalances in the development of territories, the inability to implement the reform on the ground, shortcomings in public finance management, problems of fiscal decentralisation, financial insolvency of the subregional level, and the spread of corruption schemes are all consequences of current problems of the local self-government that require radical changes [1, 2].

The experience of such unitary countries as Denmark, Norway, Sweden, Poland, Lithuania, Czech Republic, Estonia, France shows that the transfer of significant powers of state authorities to the local level has strengthened the local self-government, eliminated artificial obstacles (excessive permits, documents, control from the centre) for business and entrepreneurship, and provided a positive solution to the problems that are extremely important for the post-war development of Ukraine, namely

- creation of a transparent investment climate
- the ability of communities with sufficient budgets, human and natural resources to effectively address the issues of local residents and the development of their territories.

### **Analysis of recent research and publications.**

The topic of the formation of effective local government, the ability of local self-government to

achieve its goals, its functioning in crisis conditions and necessary reforms constantly attracts the interest of researchers in various fields of social sciences. In our opinion, fundamental studies in this regard are: the publication by T. Horvat (the section on Lithuania, prepared by A. Beksta, A. Petkevicius) [3] and the publication by researchers from Kazakhstan, with a detailed analysis of foreign experience in reforming the public administration system [4].

J. Reguluski was one of the first to trace the process of reforming the local self-government system in Poland in the 1990s [5]. Together with him, the methods and techniques of decentralisation in Eastern Europe, in particular Poland, were studied by W. Przybylski and A. Wojciuk [6], the processes of reforming local self-government in Poland by S. Michałowski, A. Pawłowska [7], H. Izdebski [8]. Researcher A. Skorupska [9] presents the results and prospects of international cross-border cooperation, the role of the CU in this process in the context of the decentralisation reform.

The experience of the Polish government and local self-government in organising local finances is presented in the study by Adam Sauer [10]. The Baltic experience of reforming local self-government in the context of European integration was the focus of a group of researchers led by J. G. King [11]; I. Brauks [12] analysed the impact of political factors on administrative reforms and financial issues of the functioning of the CBC in the transition period to understand the prospects for the development of municipalities and territorial communities as a result of the reforms; the experience of A. Draudi [13] on the experience of administrative and territorial reforms is extremely interesting.

Domestic scholars S. Seriogin and L. Prokopenko analysed in detail the experience of the self-government reform in Lithuania, focusing on the organisation of self-government control and audit, issues of representation of communities of settlements, etc. O. Baimuratov, T. Batanov and A. Golikova [15-17] focused on the problems of the legal status of territorial communities and also considered territorial communities as carriers of corporate interests. Also, a significant contribution to the study of local self-government as a specific form of public authority and the peculiarities of decentralisation was made by

scientists of the Institute of Industrial Economics of the National Academy of Sciences of Ukraine (O. Amosha, Y. Zaloznova, S. Ivanov, V. Lyashenko, I. Pidoricheva, etc).

Identification of previously unresolved parts of the overall problem. Objective. At the same time, despite the large amount of information and significant scientific work in this area, various aspects of understanding the legal nature and ways of implementing the local self-government reform remain relevant for consideration, taking into account the experience of neighbouring EU member states. The current situation of martial law only exacerbates this need and makes it relevant for the national practice of state-building, which requires additional comprehensive

analysis based on domestic and foreign experience. The purpose of the study is to analyse the experience of reforming local self-government in Ukraine's neighbouring countries, namely Poland and Lithuania, which are EU members, and the possibility of using it in reforming the territorial organisation of power in Ukraine in the current conditions of state-building, complicated by martial law and with a view to post-war development.

Summary. Describing the richness of institutional forms of local self-government in Europe according to certain criteria (Table 1), Polish researchers divide them into three main groups: "Anglo-Saxon", "French", "North and Central European" (Table 1).

Table 1

### Main institutional forms of local self-government in Europe

Group	Relation-ship of local government with central government	Range of tasks	Financial autonomy	Model features	Systemic position	Countries where implemented
Anglo-Saxon	Strong programmatic and operational autonomy	Relatively broad	Very limited	Centralised, top-down, focusing on economic performance and quality of public services	No constitutional provision	UK and Ireland
French	Strongly limited autonomy	Relatively small	Very limited	Strengthening local democracy	Constitutionally regulated	France, Italy, Belgium, Spain, Portugal, Greece
North and Central Europe	Extensive autonomy	Very extensive	Significant	Increase in economic efficiency, strengthening of local democracy	Constitutionally provided	Constitutionally provided Norway, Sweden, Denmark, Baltic countries, Austria, Switzerland, Germany, the Netherlands, Poland

Source: compiled by the author

It is worth noting that the Baltic States and Poland belong to the same group. Thus, local authorities in Europe vary greatly in size, functions, organisation and forms of financing. Despite this diversity, there are a number of common rules for the functioning of local authorities:

1. It is assumed to be the main form of territorial organisation of local communities.

2. The effectiveness of the financial mechanisms assigned to the LS should correspond to the scope of its tasks, so that it can perform them efficiently, effectively and qualitatively.

3. Local governments should have a level of financial and organisational autonomy and management that allows them to perform their tasks in a manner that meets the expectations of their citizens, in a manner that meets the expectations of citizens.

4. There should be effective mechanisms to ensure accountability and responsibility of local authorities to members of local communities.

In this sense, namely, in the practice of fiscal decentralisation and the creation of an effective system

of work of local self-government bodies with the use of innovative tools and measures, it is useful to study the experience of Poland and Lithuania.

Historically, the evolution of the formation and development of local self-government bodies in Poland, Lithuania and Ukraine over a long historical period has been significantly influenced by the affiliation of parts of these countries to certain state entities (the Polish-Lithuanian Commonwealth, the Austro-Hungarian Empire, the Kingdom of Romania, Sweden, the EU), which, on the one hand, determines significant common features, in particular, territorial, mental and social, and, on the other hand, leads to significant socio-economic differences, which have only increased since the 1990s. In terms of self-government, all of these states became independent at different times, gaining their own statehood and immediately laying the foundations for self-government at the constitutional level.

The processes of reforming the territorial authorities in both Poland and Lithuania went through several organisational stages, which were marked by institutional, regulatory and fiscal changes.



### Poland

As noted in article [19], the experience of European countries, in particular Poland, proves that in the continental system of local self-government (which is implemented, including in Ukraine), the three-tier system is effective. It was Poland that, at the first stage, eliminated the level of the county and replaced the three-tier system with a two-tier system, but at the next stage of the reform, in 1999, returned to the previous organisation of territorial power, such as region-district-

community. The need for Ukraine to take into account the European approach to territorial division and the Nomenclature of Territorial Units for the purposes of NUTS statistics has been repeatedly emphasised by Ukrainian scientists from the Institute of Industrial Economics of the National Academy of Sciences [20]. The correspondence between the levels of NUTS in the European Union and the required level in Ukraine is shown in Table 2

Table 2

**Administrative correlation of NUTS levels in Poland and Ukraine**

Level in accordance with the nomenclature NUTS	Population size	Administrative division of Poland	Analogue of Ukraine
NUTS-1	3-7 million people	Macroregions	Economic district
NUTS-2	800 thousand-3 million people	Voivodeships (województwo)	Area
NUTS-3	150 thousand - 800 thousand people	Poviats (powiat), including cities with the status of urban powiat	Sub-regional level (rural and urban areas)
LAU (NUTS 4-5)	up to 150 thousand people	Commune (gmina)	communities

Source: compiled by the author.

The correlative identity with the Polish territorial administrative-territorial structure gives Ukraine the opportunity to take into account the positive effects based on foreign experience. Given that Poland and Ukraine have almost identical starting points and similar territorial divisions, it is necessary to take into account the experience of fiscal reform.

In Poland, the process of restoring local self-government started the fastest, in the early 1980s. Thanks to the active conceptual development and practical activities of the democratic political opposition, a new generation of Polish politicians addressed the role of self-government (community as a form of organisation of residents, providers of administrative services, institution responsible for the development of a particular region, etc.)

The success of the administrative-territorial reform in Poland is the result of the fact that it was carried out on the basis of an effective combination of its own tradition with the European experience and practice of the local self-government. However, in addition to its successes, the local self-government reform in Poland was not without certain mistakes, which should be taken into account when studying the Polish experience in Ukraine:

- 1) ambiguous wording of legal provisions;
- 2) financial insolvency of the sub-regional level (counties);
- 3) ineffectiveness of local referendums due to low turnout;
- 4) insufficient cooperation of municipalities;
- 5) uneven distribution of tasks and costs at the local level;

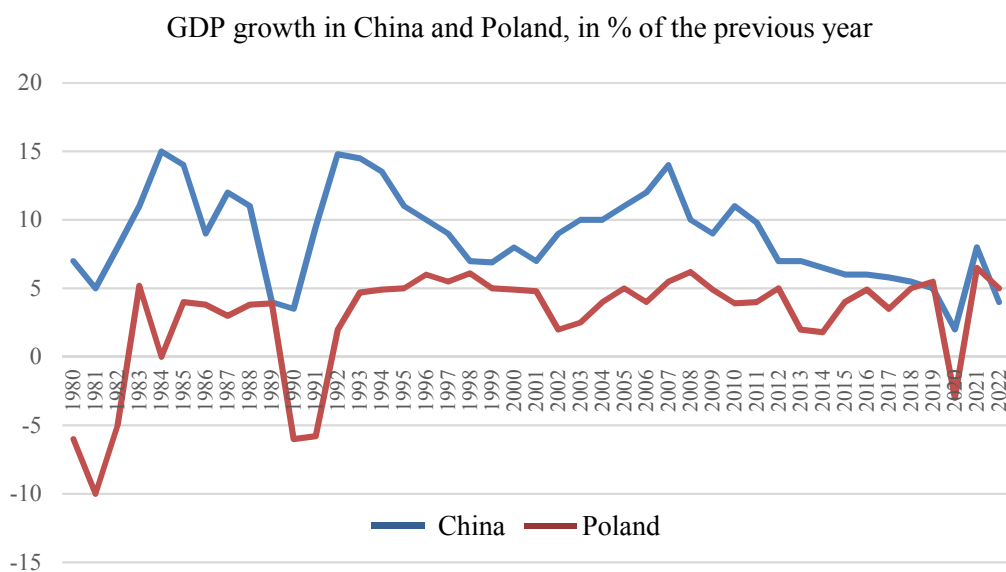
6) insufficient cooperation between local governments and the private sector in the framework of public-private partnerships;

7) multiple terms of office of gmina heads and mayors.

In recent years, Poland and many EU countries have seen an increase in the dynamics of reform activities aimed at modernising public administration, including its key component – local self-government. Their initiators, looking for inspiration, turn to different paradigms of public administration and at the same time are guided by the values of the administrative culture dominant in their country.

Over the past two years, the military actions in Ukraine have given a significant impetus to the intensification of economic processes in European countries. Ukraine's neighbouring countries have benefited from the mass migration of Ukrainian refugees: despite the loss of economic growth due to the rising cost of imported energy, all of Ukraine's neighbours, except Moldova, have experienced GDP growth rates of 2-6%.

Poland's GDP growth due to the influx of refugees was 2.1% in 2022 [22]. According to Credit Agricole economists, the value of additional demand created by Ukrainian migrants in 2022 ranged from 13.4 to 17.6 billion zlotys. Data from the Central Statistical Office of Poland (GUS) show that the country's GDP is growing, mainly due to an increase in consumer spending, especially among basic goods, which is driven by the influx of migrants from Ukraine. The *Bankier.pl* portal notes that, according to official data, for the first time in more than 40 years, Poland's GDP grew more than China's (Fig. 1) [23].



**Fig. 1. GDP dynamics in Poland and China in 1990-2022, % [22]**

The flow of human capital from Ukraine to European countries also had a significant impact on the EU's macroeconomic indicators. Thus, the inflow of migrants from Ukraine, according to Deloitte, led to an increase in the EU labour force by 0.8% in 2022 [23].

In order to increase the investment attractiveness of Polish companies, the government decided to introduce the Estonian corporate income tax (CIT) in Poland, a taxation model that has been successfully operating in Estonia for 20 years. According to the Paying Taxes ranking of tax systems around the world, Estonia and Latvia have been ranked first and second, respectively, in terms of competitiveness among tax systems around the world for several years (Fig. 2-3).

The introduction of the exit capital tax in Poland at the first stage was marked by tax advantages. At the same time, the first stage of the introduction of the Exit Capital Tax in Poland resulted in a new special tax regime that complicated the corporate tax landscape. Namely, the initial conditions of the 2021 fiscal reform in Poland contained a list of problems and shortcomings:

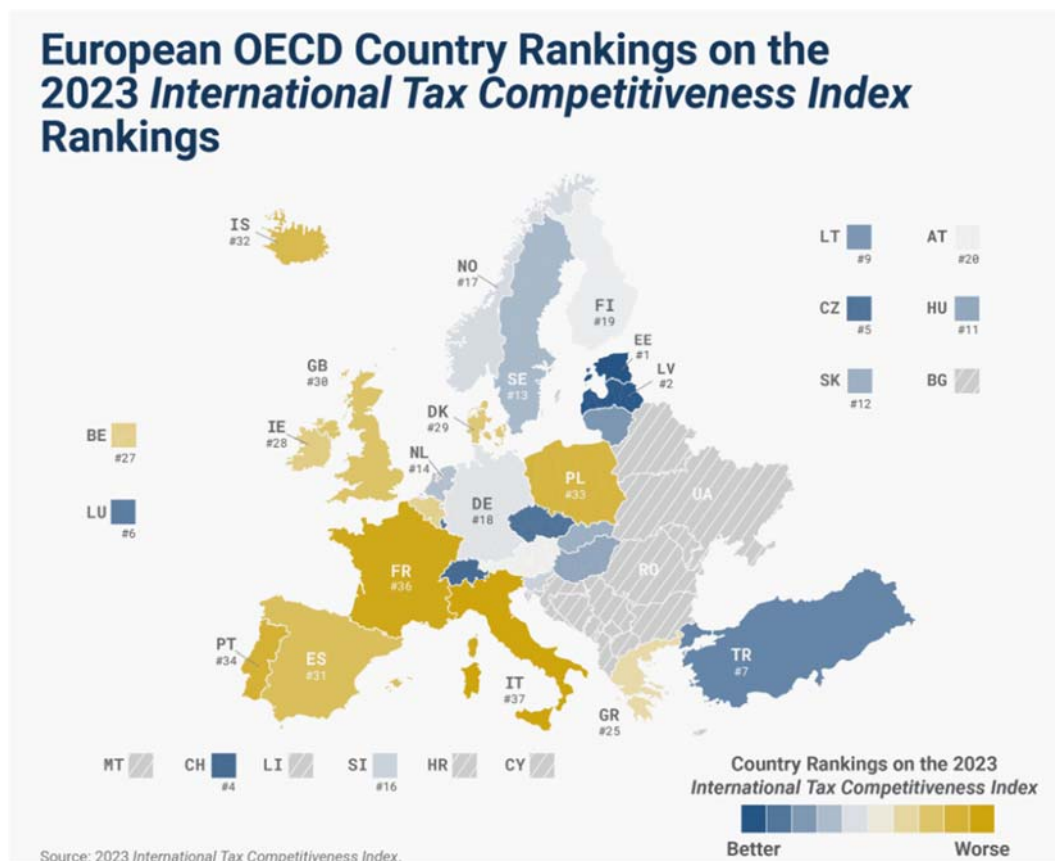
- The Estonian CIT was intended only for limited liability companies and joint stock companies. Other entrepreneurs operating, for example, as a limited partnership, joint-stock company, individual entrepreneur, cooperative, are not eligible to use it.

**2023 International Tax Competitiveness Index Rankings**

Country	Overall Rank	Overall Score	Corporate Tax Rank	Individual Taxes Rank	Consumption Taxes Rank	Property Taxes Rank	Cross-Border Tax Rules Rank
Estonia	1	100.0	2	1	15	1	11
Latvia	2	88.5	1	3	27	5	9
New Zealand	3	86.1	29	5	1	8	19
Switzerland	4	84.7	10	9	3	36	1
Czech Republic	5	81.2	6	4	25	6	10
Luxembourg	6	78.9	23	21	7	14	5
Turkey	7	78.6	11	7	13	22	7
Israel	8	78.3	13	23	11	11	8
Lithuania	9	76.6	3	10	30	7	22
Australia	10	75.9	32	14	9	4	21
Hungary	11	75.0	4	6	38	23	3
Slovak Republic	12	74.3	18	2	29	3	30
Sweden	13	73.3	8	20	21	10	13
Netherlands	14	70.6	25	19	16	21	4
Canada	15	69.8	24	24	8	25	15

**Fig. 2. Ranking of countries by competitiveness of tax systems**

Source: 2023 International Tax Competitiveness Index | Tax Foundation.



**Fig. 3. European ranking of countries by competitiveness of tax systems**

Source: 2023 International Tax Competitiveness Index | Tax Foundation.

- Estonian CIT does not include financial companies, credit companies, companies in bankruptcy or liquidation, beneficiaries of special economic zones and the Polish Investment Zone, as well as taxpayers involved in transactions such as division, mergers, etc.

- The company's revenue limit was PLN 100 million per year (including VAT).

In order to increase the efficiency of tax legislation application, the Polish government has carried out a "major overhaul" of the Estonian CIT, which had the following consequences:

- the tax became available not only to small businesses, but also to all companies regardless of their annual income;

- the obligation to make investment expenditures for certain purposes in a certain amount is completely cancelled;

- limited liability companies and joint stock companies were added to the list of legal forms of companies eligible for the tax.

The advantages of the Estonian CIT version 2.0 in Poland as of 01.01.2023 are as follows: (Table 3):

Table 3

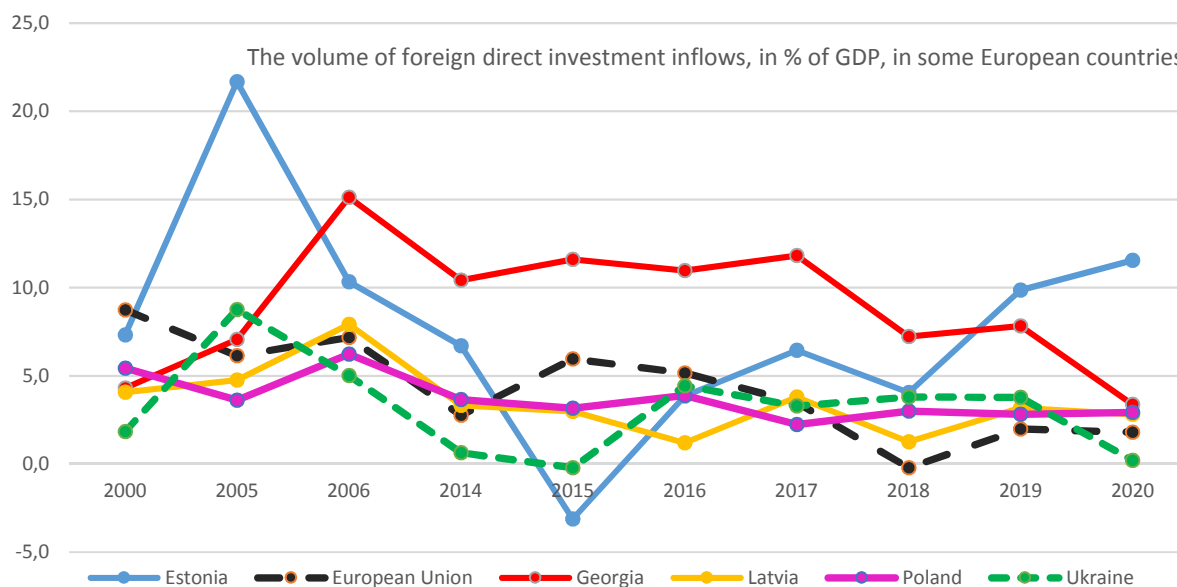
**Benefits of Estonian CIT version 2.0 (from 1 January 2023)**

Advantage	The essence of an advantage
<b>1. Estonian CIT for small and large enterprises</b>	No need to worry that if you do too much, you will lose the opportunity to pay the Company for the Estonian CIT
<b>2. Estonian CIT for different types of companies</b>	Various types of companies, except for joint stock companies and limited liability companies, can benefit from Estonian CIT
<b>3. Switching to Estonian CIT without any fees and difficulties</b>	When switching to the Estonian CIT, the Company does not pay the difference between accounting and tax calculations
<b>4. Switching to Estonian SIT without additional obligations</b>	It is up to the company to decide whether it will use the money saved on tax for investment, accumulation of reserves, or improvement of its own liquidity

Source: compiled by the author.

The stress tolerance of the taxation system for foreign investment in some European countries and the EU as a whole, which is extremely important for the post-war economy of Ukraine, is demonstrated in Fig. 4.

For example, the Estonian tax system, even in the context of the crisis caused by the 2019 pandemic, demonstrated an increase in foreign direct investment (FDI), confirming its first place in the ranking of competitive tax systems in the world.



**Fig. 4. Foreign direct investment inflows, as a percentage of GDP, in some European countries**

Source: World Bank Data. URL: <https://data.worldbank.org/>.

Poland and Latvia have also maintained stable positions over the past few years. Ukraine, on the other hand, had negative FDI growth during the COVID depression.

The advantages of the Estonian City for Ukraine are obvious: de-offshorisation; encouraging businesses to retain profits for expansion and modernisation of production; avoiding aggressive tax planning schemes, when an enterprise is deliberately made unprofitable in order to avoid paying income tax; reducing the corruption component through greater simplicity and transparency of the new tax administration, and, as a result, attracting investment. At the same time, Ukraine has not been able to move forward with its implementation for more than five years due to the indecision of politicians and the lack of guaranteed compensatory mechanisms to cover budget losses.

At the same time, it should be noted that the investment component was undoubtedly beneficial for Ukraine's post-war development. In addition, Ukraine has seen major regulatory shifts in the reform of industrial parks. An innovative fiscal regime, even if implemented locally (sectorally or specifically regionally), will significantly increase the investment attractiveness of Ukraine's economy. Industrial parks will form the basis of the framework for sustainable post-war regional development in Ukraine, especially in the regions where many enterprises have relocated. These are the regions on the border with Poland and the Baltics.

### Lithuania

The process of reforming the territorial organisation of power in Lithuania is also divided into stages. The first stage began in 1990 with the adoption of the Law on the Establishment of Local Self-Government Bodies, which introduced a new structure of local self-government. The law defined LS as "independent activities of residents of territorial-administrative units and LS institutions accountable to them, aimed at making and implementing decisions on internal issues" [24]. The law established two levels of government: administrative units of higher-level self-governments (44 rayon self-governments and 11 city self-governments) and lower-level administrative units (530 apilinkas), which were part of higher-level self-governments and financially dependent on them. The disadvantages of this division were as follows:

- it was based on the previous administrative-territorial structure,
- lack of a clear separation of functions of central and local authorities,
- no real economic and financial basis for the activities of local authorities was created.

These arguments led to the transition to the second stage of reforms. In early 2019, the government announced the consolidation of rayons. This helped to avoid duplication of functions and create an effective system of local governance. The two levels of administrative units: self-government (60 units) and counties (10 units) are shown in Fig. 5:





**Fig. 5. Administrative and territorial division of Lithuania**

Source: URL: [http://ukrexport.gov.ua/ukr/z\\_info/lit/1697.html](http://ukrexport.gov.ua/ukr/z_info/lit/1697.html).

Thus, since 2009, the following units have existed in Lithuania:

– *counties* (Lithuanian: *apskritis*) – the highest administrative unit of Lithuania, the main function of a county is land management and land reform. County administration is an integral part of the state administration and is implemented through the county governor, ministries and other government institutions;

– *self-government* (Lithuanian: *savivaldybė*) – the second level of administrative and territorial division of Lithuania. Territories of self-governments have common social, economic, ethnic and cultural interests;

– *seniūnija* – branches of local administrations that do not have the status of administrative-territorial units and are subordinated to self-government bodies, however, *self-government councils provide them with certain independent tasks and powers to perform within their territory*; the head is a starosta – a civil servant appointed on a competitive basis;

– *seniūnaitija* – formed from settlements or parts thereof (from one or more settlements with common borders, from one or more parts of settlements with common borders), regardless of whether the seniūnaitija are established or not. The chairman, an elder, is elected for a 2-year term, works on a voluntary basis and represents the interests of the residents of the seniūnaitija in the seniūnija, self-government bodies and state institutions operating on the territory of the self-government.

Self-government institutions in Lithuania:

– representative body: council of self-government;

– executive body: director of self-government administration;

– control body: self-government controller.

The self-government council is an elected body elected by the residents living on its territory for a four-year term. The council elects the mayor of the self-government from among its members.

The Lithuanian Basic Law gives local governments the right to develop and adopt their own budgets, set local tariffs and levy local taxes

*The mechanism of control implemented in Lithuanian self-government is extremely interesting and necessary for borrowing in the process of developing local self-government in Ukraine.*

The self-government controller is hired on a competitive basis, with educational and work experience requirements. The controller is accountable to the self-government council. His/her activities are based on the principles of independence, legality, openness, objectivity and professionalism. The self-government controller (self-government control and audit service) performs external financial and performance audits of the self-government administration, self-government administrative entities, and self-government-controlled enterprises. To carry out internal audit, the self-government council establishes a centralised internal audit service accountable to the director of the administration. He/she ensures the independence of the service's activities and organisational independence and cannot delegate this management function to other civil servants or employees of a public legal entity. The Internal Audit

Service works in accordance with the annual activity plan agreed with the Director of the Administration. It performs its functions by conducting internal audits and formulating recommendations based on their results.

At the same time, there are risks of applying this model of administrative - territorial system in the country, the main one being that when the responsibility for providing a significant part of services to the population lies at the local level, the central government may to some extent avoid responsibility, since the frontline executive units for the provision (or non-provision) of these services are municipalities. Such problems are rather the consequences of excessive decentralisation and the state's withdrawal from a number of local issues that local governments cannot handle on their own (example, maintenance of municipal property and ensuring the continuity of services to the population). In Ukraine, this issue remains relevant in the context of public consultations.

It is necessary to study and implement the Lithuanian experience of local administration branches – *sajūniai*, which, although not separate administrative-territorial units, are vested with certain independent tasks and powers by the councils of self-government within their territory. In other words, we have an exceptional example of delegation of powers from local self-government to a territorial unit managed by a civil servant (and not vice versa). This course of events is undoubtedly due to the level of development and self-awareness of the society where an effective system of local self-government has been built.

A convincing illustration of the study is the position of the countries in the *Doing Business ranking*: even in the pre-war period, Lithuania ranked 11th in the global ranking of business opportunities in the country, Poland - 40th, Ukraine - 64th out of a possible 152.

The Baltic States, as an important component of the EU and reliable foreign policy partners of Ukraine, are now not only testifying to the success of the modernisation of the local government and administration system, but also demonstrating an example of the proper implementation of EU values and principles for building a powerful local government and effective territorial organisation of public power on the basis of decentralisation.

The following factors should contribute to the successful completion of the local government reform in Ukraine:

- first, the victory of the Ukrainian armed forces over Russia's military aggression;
- secondly, the development of a legislative framework for the development of local self-government and the support of society, because without this, the reform makes no sense;
- third, qualified personnel capable of continuing the implementation of the local self-government reform.

It is worth noting that the positive experience of European countries and the commitments undertaken by Ukraine in accordance with the European Charter of

Local Self-Government in terms of the ubiquity and financial self-sufficiency of territorial communities prove that without decentralisation in modern Europe, it is impossible to make public administration effective and public services on the ground of high quality.

### Conclusions

To summarise the above, it can be noted that

1. Using the experience of post-war recovery is absolutely necessary. At least three countries that had to recover from the war are now among the world's top 5 economies (Germany, Italy, and Japan). The period of their recovery is called an "economic miracle", which indicates new opportunities for the post-war economies of the affected countries.

2. It is useful and important to use the potential and capabilities of neighbouring countries that have carried out effective reforms, primarily in the context of decentralisation, which has become a key to further socio-economic growth. Such countries, in particular, are Poland and Lithuania, given the proximity of territories, mentality, historical proximity, and correlation of development indicators in the early periods.

3. The classical model of corporate profit taxation in Ukraine is inefficient. In the context of post-war perestroika, it is advisable to carry out not only quantitative but also qualitative transformations, fundamental changes in the philosophy of management, and innovative modernisation, which will become a driver of the post-crisis economic development of the state. There is no doubt that a comprehensive solution to the problem is needed - not only a change in the taxation system, but also the introduction of a whole range of legislative changes in the area of business and investment protection, protection of private property and other guarantees, rights and freedoms. The main advantages of the Estonian CIT for Ukraine (even if it is temporary) are as follows:

- deoffshorisation;
- incentives for business entities to retain profits for expansion and modernisation of production;
- avoidance of aggressive tax planning schemes, when an enterprise is deliberately made unprofitable in order to avoid paying income tax;
- reducing the corruption component through greater simplicity and transparency of the new tax administration. As a result, attracting investment.

4. Both the Polish and Lithuanian models of local self-government are characterised by extremely broad powers of territorial units, while they are based on a high level of political activity and community consciousness, a high level of civil society development, and an administrative method of forming the basic level of the Polish administrative-territorial structure. The countries have changed the entire paradigm of public administration, which was a response to the problems associated with finding optimal relations between the regions and the political centre. Ukraine should partially use this experience, as European models of regional

policy that emerged as a result of administrative-territorial reform are characterised by a pronounced principle of participation that permeates all levels of local government.

5. It is necessary to study and implement Lithuania's experience in introducing a system of external and internal financial audit, as well as delegating certain independent tasks and powers to branches of local administrations to perform within their territory.

6. The reform of local self-government in Lithuania was successful, in particular, due to the government's willingness to carry out a forced merger if municipalities cannot reach an agreement. However, the main key to Lithuania's success is meaningful consultation at the local level and a certain degree of flexibility in adapting reform proposals. Rapid, coercive reforms initiated by the central government are likely to face resistance at the level of local democracy. Thus, dialogue with local civil society is a driving force for the

effectiveness of local government reform measures. This feature should be used by Ukraine in completing the local government reform process. After all, the primary subject of local self-government in our country is the territorial community, which includes a set of residents living in a certain territory with clearly defined boundaries, identifying themselves as residents of this territory and united by common interests to address issues of local importance both directly and through representative bodies on the ground.

7. Local authorities should develop and implement measures aimed at creating socio-economic processes that affect the development of territories, based on close and constant contact with the business sector and non-governmental organisations, using the best local resources. The quality of governance of Ukrainian local authorities has a significant impact on the opportunities for socio-economic development and entrepreneurship, as well as on public trust in public authorities.

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#### **Бородіна О. А. Фіскальна децентралізація та реформування місцевого самоврядування: адаптація в Україні досвіду Польщі та Литви**

Ефективна система місцевої влади – одна з базисних платформ для функціонування країни у кризових умовах та запорука успішного повоєнного відновлення економіки на усіх рівнях. Вивчення досвіду європейських країн, у першу чергу, країн-сусідів, значно полегшує побудову оптимальної моделі такої моделі.

У статті детально проаналізовано фіскальні інновації Польщі, з огляду на тотожність адміністративно-територіального устрою та ідентичність становлення органів місцевого самоврядування. Констатовано беззаперечно перевагу введення інноваційних фіскальних режимів (Естонський СІТ) для економіки Польщі. Висновки переконливо проілюстровано динамікою зростання ВВП Польщі та рейтингами Польщі і країн Балтії у світових рейтингах податкової спроможності.

Дослідження досвіду Литви у галузі реформування територіальної організації влади, виконане у статті, привело до констатації революційних явищ, які впроваджені країною-сусідом протягом обох етапів адміністративної реформи. А саме: наявність механізму фінансового самоконтролю, який реалізовано на субрегіональному рівні та виключний приклад делегування повноважень від місцевого самоврядування до територіальної одиниці, управління якою здійснює державний службовець (а не навпаки).

Надано дієві рекомендації щодо запозичення польського та литовського досвіду та адаптації його для сучасних умов розвитку України. Констатовано, що діалог з місцевим громадянським суспільством є рушійною силою ефективності заходів з реформування місцевого самоврядування. Ця особливість має бути використана Україною під час завершення процесу реформування місцевого самоврядування.

*Ключові слова:* децентралізація, фіскальні інновації, місцеве самоврядування, повоєнний розвиток, субрегіональний рівень, Естонський СІТ, Польща, Литва.

#### **Borodina O. Fiscal Decentralisation and Local Government Reform: Adaptation in Ukraine Experience of Poland and Lithuania**

An effective local government system is one of the basic platforms for the functioning of the country in crisis conditions and the key to a successful post-war recovery of the economy at all levels. Studying the experience of European countries, primarily neighboring countries, greatly facilitates the construction of an optimal model of such a model.

The article analyzes the fiscal innovations of Poland in detail, taking into account the identity of the administrative-territorial system and the identity of the formation of local self-government bodies. The indisputable advantage of the introduction of innovative fiscal regimes (Estonian CIT) for the economy of Poland has been established. The conclusions are convincingly illustrated by the dynamics of Poland's GDP growth and the rankings of Poland and the Baltic countries in the world rankings of tax capacity.

The study of the experience of Lithuania in the field of reforming the territorial organization of power, carried out in the article, led to the ascertainment of revolutionary phenomena introduced by the neighboring country during both stages of administrative reform. Namely: the presence of a financial self-control mechanism implemented at the sub-regional level and an exceptional example of the delegation of powers from local self-government to a territorial unit managed by a civil servant (and not vice versa).

Effective recommendations on borrowing Polish and Lithuanian experience and adapting it to modern conditions of Ukraine's development have been provided. It was established that dialogue with local civil society is the driving force behind the effectiveness of local self-government reform measures. This feature should be used by Ukraine during the completion of the process of reforming local self-government.

*Keywords:* decentralization, fiscal innovations, local self-government, post-war development, sub-regional level, Estonian CIT, Poland, Lithuania.

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## ENHANCING REGIONAL DEVELOPMENT WITH STARTUP ECOSYSTEMS<sup>1</sup>

In the aftermath of armed conflicts, the importance of rebuilding devastated economies and strengthening stability cannot be overemphasized. Security is a key component of the post-war environment. However, security without development leads to economic stagnation and civil society dissatisfaction, just as development without security threatens economic growth and can lead to complete economic collapse. Post-war reconstruction goes beyond mere physical reconstruction; it must include economic modernization, social cohesion, and the creation of effective governance structures.

Regional development on an innovative basis plays a significant role in stimulating economic growth in the wartime and postwar periods. The creation of innovative ecosystems that support the development of startups and small innovative enterprises contributes to the formation of a favorable business climate in the region and attracts investment. The development of new technologies and the use of innovative approaches can reduce the region's dependence on traditional industries and resources, making it more resilient to economic fluctuations and changes in the global market. The exchange of knowledge, experience, and resources between regions can enhance innovation potential and accelerate development, and the entrepreneurial network created within the innovation ecosystem can become a platform for the exchange of ideas and joint projects, strengthening interregional ties. In addition, innovations contribute to improving the quality of life of the population, expanding access to education, healthcare, and other social services.

Many countries have already achieved significant success in regional innovation development after armed conflicts. For example, South Korea, thanks to its emphasis on science, technology, and innovation, has demonstrated significant economic growth since the Korean War.

There are many bright examples of successful startup ecosystems in post-war regions. For example, the Iraqi city of Erbil has become a thriving startup hub, where initiatives such as the Five One Labs accelerator provide mentoring, training, and funding for entrepreneurs, fostering a vibrant entrepreneurial community [1]. Kigali in Rwanda is an innovation city,

a flagship project aimed at creating an ecosystem focused on high technology, innovation, and talent development to accelerate Rwanda's transition to a knowledge economy [2]. Sarajevo (Bosnia and Herzegovina) is one of the world's top 1,000 startup ecosystems. Sarajevo's startups are particularly prominent in the software and data sectors, as well as in the areas of medical technology, hardware, and the Internet of Things [3]. The island of Sri Lanka is a major trading center in the Indian Ocean and has one of the most liberal economies in South Asia. The startup ecosystem supports many international projects in various industries, including financial markets, manufacturing, transportation, telecommunications, retail, fashion, food and beverage, aviation, travel and hospitality, healthcare, and education. The ecosystem is developing advanced technologies and practices such as artificial intelligence, robotics, drones, blockchain, cybersecurity, intelligent automation, etc., technology services, technology products and knowledge, and other professional services. Sri Lanka's transformation into a global technology and Business Process Management center is the result of several compelling advantages that now also make the country a very interesting destination for international companies looking to find talent and opportunities in various technology sectors [4].

One of the mechanisms of innovative development that is gaining popularity around the world is the creation of startup ecosystems. These ecosystems serve as catalysts for economic growth, the creation of highly skilled jobs, and the development of entrepreneurial talent. Therefore, the role of startup ecosystems in the innovative modernization of regions, as well as the tools to facilitate and strategies for their successful development are relevant.

Several different approaches to research in the field of startups have been formed in Ukrainian economic science. Among the latest publications, it is worth highlighting the works of A. Kasich [5], O. Salikhova [6], T. Galakhova [7], N. Ivanchenko [8], M. Dyba [9], N. Sytnyk [10], and others. Most of these studies focus on analyzing the peculiarities of the organization and functioning of startups, their strategies and success factors. However, the external component of startups as part of the regional innovation ecosystem has not

<sup>1</sup> The article was prepared within the scope of the research work of the Institute of Industrial Economics of the National Academy of Sciences of Ukraine "Strategic directions of smart specialization of industrial regions of Ukraine" (state registration number 0121U114107).

received enough attention. This leaves a gap in understanding how startups affect economic dynamics, innovation activity, and social well-being in the regions.

At present, research aimed at studying the role of startup ecosystems in the post-war economic recovery of Ukrainian regions is of particular importance [11-15]. The startup ecosystem includes a wide range of actors, such as entrepreneurs, investors, accelerators, universities, and government. Understanding the dynamics and interaction of these actors in the context of regional development is key to creating a favorable environment for startups and maximizing their contribution to regional economic revitalization.

In many countries, startups are playing a significant role in regional development after armed conflicts. A study of international experience reveals several key principles of successful startup ecosystems. First, it is the existence of favorable legal and tax regulations that facilitate investment and entrepreneurship development. Second, it is the availability of qualified personnel and access to educational and scientific resources. Finally, it is a well-developed startup support infrastructure, including accelerators, incubators, investment funds, etc.

**The purpose of the study** is to identify the features of startup ecosystems, their impact on regional development, and to identify factors of successful functioning of such ecosystems based on the analysis of foreign experience.

Ukraine must take global trends into account and compete in the global business environment. Studying the experience of foreign startup ecosystems allows us

to learn the best international practices, increase the competitiveness of territories and ensure their dynamic development.

Until relatively recently, the term "startup" was used as a definition of every newly created enterprise and was usually associated only with e-business. However, in recent years, many international business schools have developed an academic definition of what a startup is.

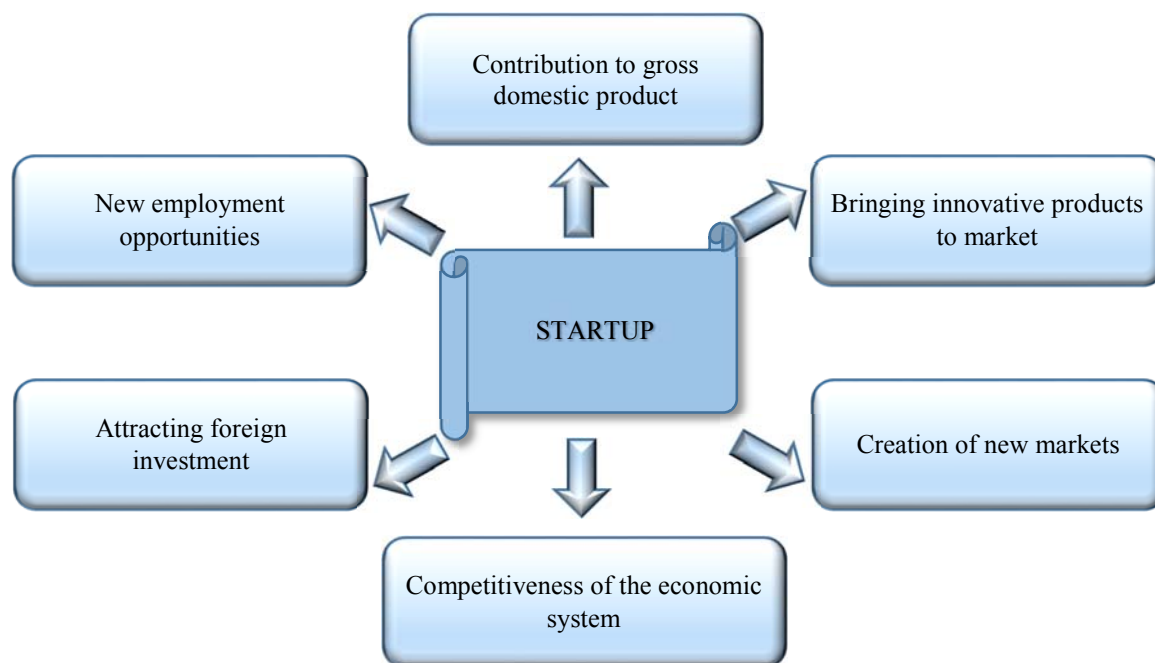
The most popular definition of a startup was given by the creator of the Lean Startup methodology, Eric Rice: "A startup is a human organization designed to create a new product or service under conditions of extreme uncertainty" [16, p. 24].

The famous American entrepreneur, founder of eight successful startups, Steve Blank, noted that a startup is "a temporary organization that is looking for a scalable, repeatable, profitable business model", while existing companies implement them [17, p. 14].

As defined by the European Startup Network, "A startup is an independent organization that is less than five years old and aims to create, improve and expand a scalable, innovative, technological product with high and rapid growth" [18].

Thus, startups play a different role in economic development, in particular, they are seen as engines of new technologies and challenges for existing economic structures (Fig. 1).

The decline in the number of startups is already being equated with the future non-viability of entire countries or individual regions, based on the following considerations.



**Fig. 1. The role of startups in economic development**

1. Startups often represent major innovations and new technologies. They can develop and provide services that were not previously products and improve

existing solutions. A decline in the number of startups could mean that a region or country is losing its ability to innovate and develop new ideas.

2. Startups create jobs for young professionals and entrepreneurs. They help to increase employment and reduce unemployment. This, in turn, can increase consumption and GDP. A decline in the number of startups could lead to fewer opportunities for young people and professionals in the labor market.

3. Startups can be catalysts for economic growth. They attract investments from venture capitalists, angel investors, and other sources of funding, stimulate consumption, and generate tax revenues that can be used to finance city programs and infrastructure projects. This, in turn, can enhance the economic well-being of a country or region.

4. Startups are often a source of new ideas, digital innovations, and technological progress that determine the competitiveness of a country or region on the global stage. They can offer innovative products, services, and business models that compete with foreign companies and promote exports of goods and services. A decrease in the number of startups may reduce interest in the territory, which may affect the availability of capital for new projects.

5. Exports and international competitiveness: Successful startups can expand their operations on the global market and become competitive on the world stage.

In recent years, a growing number of startups have been driven by modernization and creativity and have great potential to change the global economy. They can be founded anywhere, and often the greatest opportunities are in countries with the greatest need: underdeveloped countries, countries in conflict, and countries where entrepreneurship is new, so a small startup idea can grow into a big innovative solution that can change the future of a developing country. Therefore, supporting and creating an enabling environment for startups, including access to finance, education, and infrastructure, plays a key role in facilitating their contribution to a country's GDP. Startups can contribute to the formation of an innovation ecosystem. In turn, a strong startup ecosystem provides access to the resources, mentorship, and funding needed for startups to thrive.

Article [19] is a good reminder of the famous American economist Michael Rothschild, who was one of the first to use the analogy of biological ecosystems in the economy. He equated the economy with biological ecosystems in the sense that both are systems in which there is interaction between participants, because in business, companies depend on customers, suppliers, competitors, and other business entities, and their success is determined by innovation. Startups play an important role in such an ecosystem by supplying other participants with innovative products.

James F. Moore introduced the concept of a "business ecosystem" in his article "Predators and Prey: The New Ecology of Competition" published in the Harvard Business Review in 1993, where he presented

ecosystems in twenty industries and competition [20]. The main ideas presented by James Moore in this article:

- Ecosystem as a biological analogy, where different species coexist and interact with each other to survive and thrive, so do companies in an ecosystem compete and collaborate to create and capture value.

- In an ecosystem, companies interact with each other through networked relationships: as competitors, partners, suppliers, users, and other participants.

- Shared value arises from the interaction between flows in the ecosystem that can join forces to offer products or services that were difficult or impossible for individual companies;

- Dynamism and evolution: ecosystems are dynamic and constantly evolving, new companies can enter the ecosystem and old ones can leave it, and this creates constant changes in the dynamics of ecosystems.

- In an ecosystem, companies understand each other and interact to ensure their own success, and interdependence can contribute to collective development and growth.

In general, J. Moore called for considering the business ecosystem as a system, not as a set of different companies. This concept of a business ecosystem has influenced the current understanding of how companies compete and collaborate in the digital age and helped to understand how interactions and collaborations between companies can enable innovation and idea creation in the more complex and dynamic realities of modern business.

J. Moore's definition of an ecosystem was later refined by Ron Adner, who emphasized the special role of certain conditions under which an ecosystem turns into an economic ecosystem [21]. Such conditions include economic relations, competition between organizations, and the presence of interest groups that are directly or indirectly interested in the development of the economic ecosystem, and any success of a project or innovation depends not only on the company that develops it, but also on how it enters the ecosystem and interacts with other participants.

R. Adner presented innovation ecosystems as networks of companies, suppliers, customers, and partners that cooperate to achieve innovation goals [22]. This includes both direct participants and all those who contribute to the development of innovation processes. He also proposed a number of tools and methods for analyzing and managing innovation ecosystems to enable a company to participate more effectively in innovation processes and cope with challenges. His work has led to an understanding of how companies can successfully interact in today's environment where innovation is becoming increasingly complex and interdependent.

The startup ecosystem can be seen as one of the subsystems of the innovation ecosystem. The innovation ecosystem includes a wide range of organizations, institutions, resources, and relationships that jointly contribute to the creation and development of



innovations [23; 24]. The startup ecosystem includes not only the startups themselves, but also all other elements that influence their activities and growth, such as investors, mentors, experts, as well as regulatory authorities and, as a result, entrepreneurship support programs. Innovation networks and their digital support also play an important role here [25; 26]. Together, they create an environment in which startups can operate successfully and make an additional contribution to the innovative development of the economy and society.

A startup ecosystem is a set of entities that form a system of relationships in the process of identifying, supporting, developing, and commercializing startups [12]. The ecosystem includes incubators, accelerators, venture capitalists, business angels, service providers, and educational institutions. The need for a startup ecosystem stems from the fact that most startups fail. According to statistics, only one in ten startups will be successful. This high failure rate is due to a number of factors, including the fact that most startups are founded by people with no prior business experience. This lack of experience can lead to a number of mistakes that can lead to the failure of a startup.

The following are the main arguments in favor of creating a startup ecosystem:

1) access to resources needed for growth and scaling.

2) community and collaboration, because when an entrepreneur or innovator is part of an ecosystem, he or she is surrounded by like-minded people who are passionate about startups and innovation.

3) access to experienced mentors who can support startups in the early stages, provide access to capital, and help attract the best talent by connecting them with experienced professionals.

Thus, a strong startup ecosystem can somewhat reduce certain risks associated with starting a new business.

StartupBlink is the world's most comprehensive map of startup ecosystems and a research center working to identify the dynamics of startup ecosystems around the world and accelerate their growth, containing tens of thousands of registered startups, coworking spaces, and accelerators, creating a reliable benchmark for innovation around the world [27]. According to the Global Startup Ecosystem Index 2023: Top Countries, the first 3 places are occupied by the United States, the United Kingdom, and Israel (Table 1). Ukraine ranks 49th. Each country has an overall score, which is the sum of three components that measure quantity, quality, and business environment.

Table 1

**Global Startup Ecosystem Index 2023: Top Countries**

Country rating	Country	Rating change (since 2022)	Total rating score
1	USA	-	198,080
2	United Kingdom	-	51,218
3	Israel	-	49,573
4	Canada	-	34,490
5	Sweden	-	27,074
6	Singapore	+1	26,571
7	Germany	-1	25,939
8	France	+1	22,916
9	Australia	-1	21,503
10	Netherlands	+1	21,423
...	...	...	...
48	Slovenia	-1	4,720
49	Ukraine	+1	4,634
50	Hungary	+1	4,438

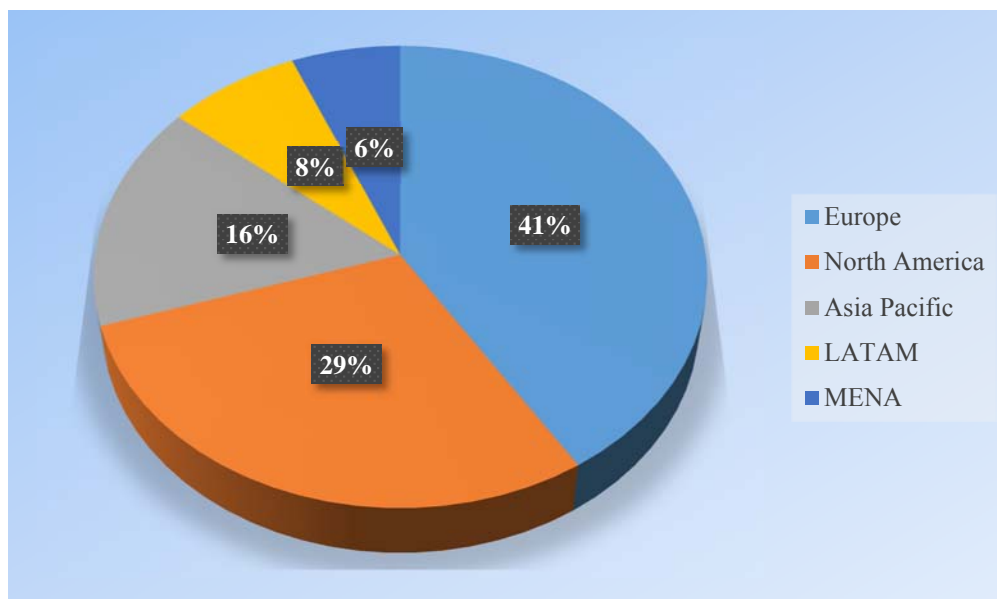
Compiled according to [27].

In a regional analysis of StartupBlink rankings, the two dominant regions, North America, and Europe, saw their combined share drop from 72.4% in 2022 to 70.1% in 2023, while the two smallest regions, LATAM and MENA, increased their overall share of the top 1000 from 11.7% to 14% (Fig. 2).

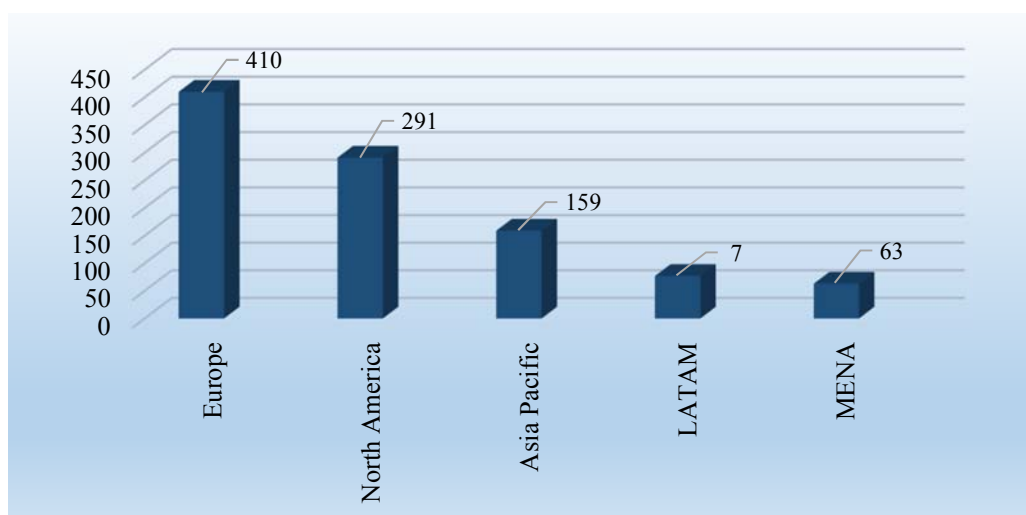
Fig. 3 shows the number of cities in the ranking by region and their distribution in the top 1000 cities in 2023.

It should be noted that although North America is not the region with the largest number of cities in the top 1000 (Fig. 2), it dominates the top 100 cities, leading

both in terms of the number of cities ranked between 1-30, with 12 cities (40%), and in terms of the number of cities ranked between 31-100, with 27 cities (38.5%). For comparison, Europe, which leads the way in terms of the number of cities in the ranking (41%), has only 6 cities in the top 30 (20%) and 22 cities in the 31-100 range (31.4%). Similarly, North America clearly dominates the top charts of all 11 startup industries analyzed: Software & Data, Healthtech, Fintech, Social & Leisure, Ecommerce & Retail, Hardware & IoT, Marketing & Sales, Edtech, Foodtech, Energy & Environment, Transportation.



**Fig. 2. Regional analysis by StartupBlink rating**



**Fig. 3. Number of cities in the ranking by region and their distribution**

Let's analyze in more detail the experience of two Scandinavian countries – Sweden and Finland – in developing startup ecosystems.

Sweden is consistently ranked 5th in the world, 2nd in Europe, and 1st in the European Union (EU), and Stockholm's ranking has increased by 4 positions, bringing the country into the global top 20 in 2022-2023 (Fig. 4).

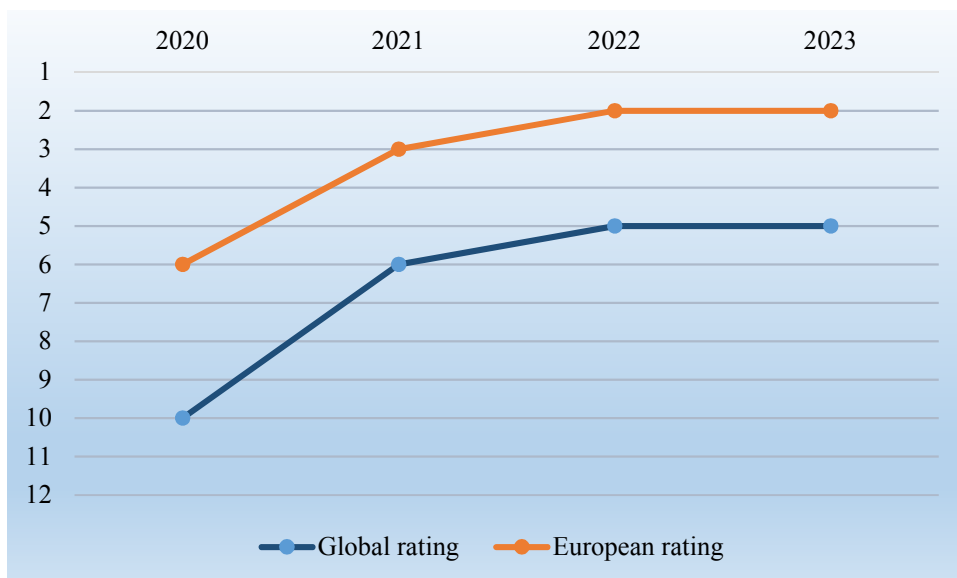
The startup ecosystem in Sweden capitalizes on the country's unique advantages, such as high quality of life, gender equality, strong business climate and global competitiveness.

Historically, Swedish entrepreneurs have created high quality global startups such as Spotify, Minecraft, Klarna, and King. Few European ecosystems have such achievements, which demonstrates Sweden's ability to become a leader in technological innovation in Europe. With a population of just over 10 million people,

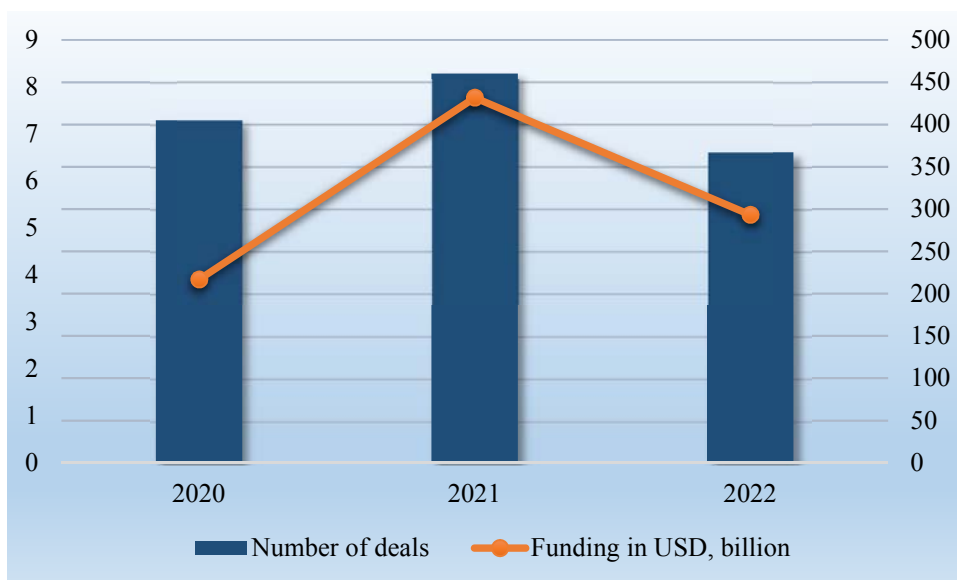
Sweden is a textbook example of how small countries can have a huge impact.

Ambitious entrepreneurial mindsets, high-speed internet connections, excellent English language skills, and public sector support make it easy for Swedish entrepreneurs to move forward globally. The support for the startup scene is reflected in the number of events, coworking spaces, and accelerators in Sweden, as well as the Nordic Demo Day, which brings together startups, investors, and corporations [28]. In addition, the Swedish innovation agency Vinnova stimulates the climate of entrepreneurship in the country [29].

The country has 19 cities in the global 1000, down from 21 in 2022. However, there are now 6 Swedish cities in the top 500, not 5 last year. Funding and the number of startup deals in Sweden have fallen during the COVID-19 pandemic, but the country has not lost its strong position in global and European rankings (Fig. 5).



**Fig. 4. Sweden's position in the world and Europe according to the Global Startup Ecosystem Index**



**Fig. 5. Financing and number of deals with startups, Sweden**

According to StartupBlink, Stockholm is the most powerful startup ecosystem in Sweden, with 728 startups [30], which is approximately 62% of all Swedish startups. In 2023, Stockholm's startup scene developed significantly and moved up 4 positions in the

Global Ecosystem Index to join the global top 20 ranking, registering the best momentum among this level and approaching the best European cities (3rd city in the EU), such as Berlin and Paris (Fig. 6).



**Fig. 6. Ranking of the startup ecosystem in Stockholm, Sweden**

The gap between Stockholm and other Swedish ecosystems continues to widen: the capital now has an overall score 7 times better than Malmö, Sweden's second-ranked ecosystem.

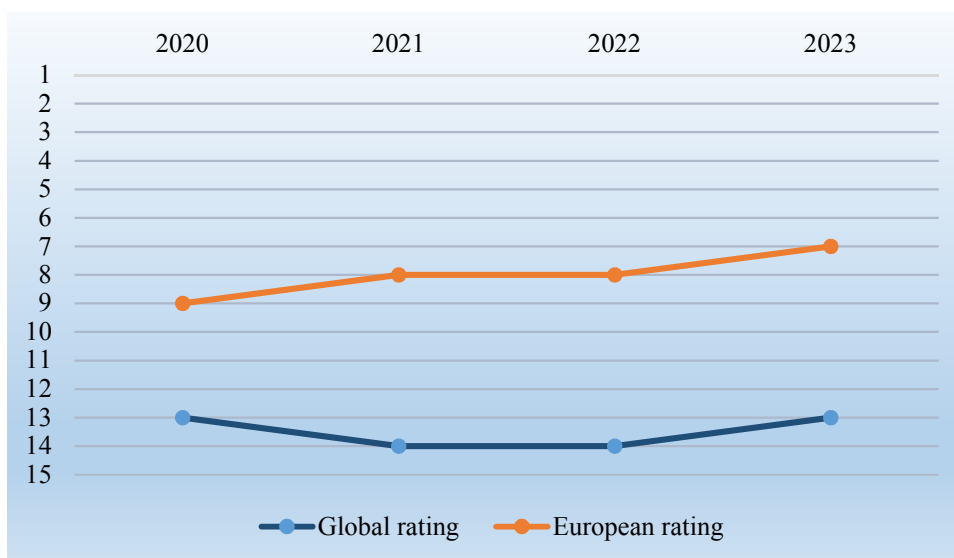
Stockholm's most popular industry is Fintech, where it ranks 9th in the world. Notable growth was registered for Stockholm in Hardware and IoT (11th) after moving up 19 positions and in Transportation (20th) after moving up 6 positions.

One of the challenges facing the growth of ecosystems is the high cost of living in Sweden, which makes it harder for startups to consider relocating if they do not receive investment at the initial stage. The country is taking steps to attract and support international talent to keep the Swedish startup ecosystem globally competitive. Initiatives such as the Swedish Residence Program for Self-Employment allow potential entrepreneurs to start a business in Sweden, as well as provide them with free access to higher education and a number of other benefits. In addition, Sweden remains a great place for entrepreneurs to test their ideas, expand them and go global.

Compared to Sweden, Finland is also famous for its innovative achievements and technological advantages. Both countries offer a developed infrastructure and actively support startups through government support programs. However, unlike Sweden, Finland may be a slightly better place for venture capital investment due to more limited access to capital. However, Finland's entrepreneurial culture is also strong, and the country is actively developing its startup ecosystems, providing a favorable environment for innovation and growth.

After two years of being ranked 14th in the world, Finland regained its ranking in 2020, moving up one place to 13th (Fig. 7). Finland also jumped up one position in the region, overtaking Estonia to rank 5th in the EU and 7th in Europe [27].

Finland boasts a thriving startup ecosystem, supported by key advantages such as world-class technology, a talented workforce, and excellent R&D capabilities. Finnish society is renowned for its stability and transparency, low bureaucracy and high openness to new technologies.



**Fig. 7. Ranking of Finland in the world and Europe according to the Global Startup Ecosystem Index**

Of course, the public sector plays a significant role, offering numerous incentives. In addition to low tax rates, the government offers financing and services for innovative companies in the early stages of development and supports universities in commercializing their ideas. For example, the Finnish startup permit allows international emerging entrepreneurs to set up a startup company in Finland. The permit is intended for founders of innovative startups from countries outside the European Union.

In general, Finland's business environment is attractive for foreign investment. Finland has a dynamic ecosystem of accelerators, angel investors and venture capitalists, which are strongly supported by the government.

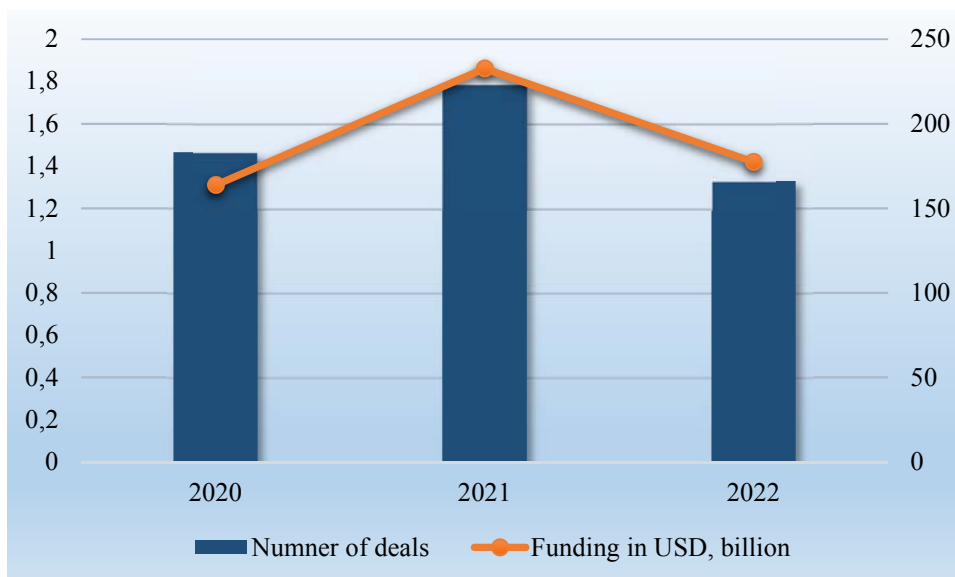
Thanks to all of the above, Finland has a proven track record of success in many industries, despite its small market size. Historically, Finland has demonstrated its unique ability to create cutting-edge global solutions through years of dominance by Nokia in the early days of the mobile phone industry. Even after Nokia's decline, new Finnish innovations continue to emerge. The country has consolidated its share in video games and has more and more technological innovations aimed at developing this sector. The gaming industry has spawned some prominent startups, such as Supercell and Rovio (creators of the Angry Birds game) and has attracted a lot of talent to Helsinki. In addition, Finland offers opportunities for company development, especially in the areas of bioeconomy, clean and smart



technologies, health and wellness, ICT and digitalization, and travel and tourism. For example, in 2022, the food delivery startup Wolt was acquired by its American competitor DoorDash for €7 billion.

Today, Finland is overtaking Sweden in some positions in the rankings: in 2023, Finland will have two cities in the top five Scandinavian countries, while

Sweden, Denmark, and Norway will have only one each. Finland is ranked 12th in the world and 4th in the EU in terms of business indicators, which indicates a friendly business environment for startups. Finland's startup ecosystems had a good year overall, as 6 of the 8 cities ranked in the top 1000 cities in the world had positive momentum (Fig. 8).



**Fig. 8. Financing and number of deals with startups, Finland**

Helsinki is one of the three cities with the largest jump in the TOP 50 (along with Munich and Guangzhou), moving up 5 positions in the Global Ecosystem Index and ranking 43rd in the global ranking (Fig. 9). According to StartupBlink, Helsinki's startup ecosystem has 483 startups [31]. This is about 71% of

startups and the strongest startup ecosystem in Finland. In Europe, Helsinki is currently ranked 8th (between Barcelona and Madrid), having pushed Dublin. In the Scandinavian countries, Helsinki retains the second place, ahead of Copenhagen and Oslo.



**Fig. 9. Ranking of the startup ecosystem in Helsinki, Finland**

Finland has 2 cities that made it into the top five, after Oulu gained 2 positions and is ranked 5th, overtaking Sweden's Malmö and Gothenburg, it entered the top 150 at 135th place after a huge jump of 60 positions. Oulu is now ranked 5th in Northern Europe. In the EU, Oulu has risen 21 places and is now ranked 26th with a very small gap to Budapest (25th). Thus, Finland now has two cities among the top 30 EU cities.

Finland is represented by Helsinki in the top 25 for Foodtech, where it ranks 15th, up 3 positions from 2022. Oulu ranks 52nd in the Healthtech ranking, a great achievement considering the city's global ranking.

In addition to its talented and successful entrepreneurs, Finland recognizes the importance of promoting its business environment through global events. Slush, one of the world's largest events for startups, attracts tens of thousands of participants, boosting the country's ranking.

With most of Finland's startups located in the capital, the city is becoming a major startup hub in Northern Europe, and organizations such as Helsinki Partners are working to attract and unite ecosystem stakeholders.

Table 2 shows the best ecosystem startups in Sweden and Finland.

Table 2

**Famous startups and ecosystem champions in Stockholm and Helsinki**

Stockholm, Sweden	Helsinki, Finland
<ul style="list-style-type: none"> <li>– Polarium – offers lithium batteries for telecommunications.</li> <li>– Epidemic Sound is a music company that creates music for online creators.</li> <li>– Einride is a technology company that develops and provides solutions for the transportation of goods based on electric and autonomous vehicles.</li> <li>– Spotify is a digital music, podcast, and video service that provides access to millions of songs and other content from creators around the world.</li> <li>– SoundCloud is a social audio platform where people can create and share sounds.</li> <li>– Klarna is an e-commerce payment platform for merchants and customers.</li> <li>– Fidesmo – unites the world of contactless capabilities into a single secure platform for device manufacturers and service providers</li> </ul>	<ul style="list-style-type: none"> <li>– RELEX Solutions provides an integrated retail and supply chain planning system.</li> <li>– ÖURA is a wellness app used to improve sleep.</li> <li>– Aiven is an information technology company that manages open data.</li> <li>– Supercell is a mobile game developer.</li> <li>– Nokia is a multinational communications corporation that manufactures mobile devices and network infrastructure.</li> <li>– Wolt is a food delivery company that specializes in real-time logistics optimization</li> </ul>

Compiled according to [27].

Compared to the European countries in question before the outbreak of full-scale war in 2022, Ukraine ranked 34th in the StartupBlink ranking. At the same time, Kyiv was ranked 23rd out of the 25 best cities in the world for marketing and sales, software, and data. Many world-famous startups were born in the country, such as Grammarly, GitLab, People.ai, Ring, and Bitfury.

In 2022, Ukraine dropped 16 positions in the StartupBlink ranking. However, already in 2023 Ukraine improved its ranking. This became possible due to the implementation of a number of projects to support startups and innovations and the reform of some institutions. For example, the Innovation Development Fund (another name for the Fund), established in 2018. The Innovation Development Fund (also called the Ukrainian Startup Fund), established in 2018, was transferred to the Ministry of Digital Transformation in 2022 [32], which simplifies bureaucratic procedures and expands support for the country's startups. Projects and initiatives to support Ukrainian startups are also regularly implemented, both in collaboration with funds from other countries and directly by government agencies [33]. According to Pavlo Kartashov, Director of the Ukrainian Startup Fund, under martial law, this

institution focuses on supporting innovative projects aimed at the priority needs of the state. For example, a grant support program for dual-use projects was created to increase the country's defense capability and post-war reconstruction [34].

Despite the ongoing war, Ukrainian startups and the country's IT sector have demonstrated resilience, and entrepreneurs continue to run their businesses and remain committed to success even in these difficult circumstances. Some Ukrainian startups have relocated, but 95% of startups at least partially remain in Ukraine, and 55.7% continue to operate exclusively from Ukraine (according to a survey by TechUkraine in partnership with the Ukrainian Startup Fund, the Ministry of Digital Transformation of Ukraine, Emerging Europe, Tech Emerging Europe Advocates, Global Tech Advocates, and TA Ventures) [35]. The most popular destinations abroad are the European Union (38.6%) and the United States (10%). Nine out of ten startups confirm that they need financial support to continue operations and/or expand. Nevertheless, many startups said they plan to expand their operations in the short term.

Even in the crisis, there are many promising startups developing in Ukraine. Some of them are presented in Table 3.

Table 3

**Examples of Ukrainian startups that received investments in Q1 2023**

Name	Business area	Attracted investments, USD million
DressX	Virtual clothing store	15
Kolibrio	Automated auction system on the blockchain	2
Fuelfinance	Software for financial management and planning of startups	1
Deus Robotics	Warehouse robotization	1,5
GeekPay	Solutions for mitigating risks and tracking payments in digital currencies	N/A
Awesomic	Service for finding designers for business	0,8
Harmix	A service that automatically matches music to videos	0,5
Aspichi	Virtual reality solutions for surgery and prosthetics	0,5

Compiled according to [36].

Ukraine is developing military and technical solutions at a rapid pace [37]. Projects that used to take 1.5-2 years to implement are now being completed in 2-3 months. Compared to 2014, the military-technical solutions industry has grown three to seven times, depending on the region. The Ministry of Digital Transformation has identified military tech as a priority area for the coming years. The Ukrainian Startup Fund supports this area and provides grants for projects related to the development of military technology, cybersecurity, and defense. Dozens of advanced military-tech startups have emerged in Ukraine during the war, including:

– Griselda is a software system for collecting, organizing and analyzing intelligence from open and closed sources.

– ST1 is an autonomous drone for searching and marking explosive objects, which speeds up the demining process and saves the lives of sappers.

– Khyzhak (Predator) is an infantry tactical system that increases the effectiveness of machine gunners in modern mobile combat.

– Airlogix is a reconnaissance system designed for reconnaissance and artillery adjustment of the GOR UAV.

– Temerland – Scorpion-2 unmanned robotic platform that can be used in the defense and civilian sectors.

– FuelWell – equipment to reduce fuel consumption [38].

In April 2023, the Defense Tech cluster Bavel was launched – a single platform for cooperation between companies, the state, and the military, offering organizational and technical support for development, as well as access to accelerators and incubators [39]. An important advantage of Ukrainian military-tech startups is the fact that their developments are tested on a real battlefield and meet the needs of a state at war. This allows companies to adapt to the military environment faster and demonstrate the effectiveness of their innovations in practice.

Despite the war, the state has invested UAH 4.7 billion in the development of small and medium-sized businesses under the government grant program eRobota, launched by the Ministry of Economy together with the Ministry of Digital Transformation, the Ministry of Agrarian Policy, the State Employment Service, and the Oschadbank to support Ukrainians who want to become self-employed and promote entrepreneurship in difficult economic times [40; 41]. "These are investments not only in business revitalization – new companies have been opened, existing ones have increased production and are mastering other areas – but also more than 20,000 new jobs for Ukrainians in these companies", said Economy Minister Yulia Svyrydenko.

The eRobota grant program consists of six different programs:

– "Svoya Sprava" – grants for any microbusiness in the amount of up to UAH 250 thousand. The grant recipient must create at least one job;

– "Novyi Riven'" – grants of up to UAH 8 million for the expansion or creation of processing enterprises. The goal of the program is to increase the share of processed products, in particular in exports. The grant recipient is obliged to create up to 25 jobs;

– "Sviy Sad" – grants for the creation or development of horticulture, berry growing and viticulture – up to UAH 400 thousand per 1 hectare. Employment of 6-10 permanent and 125-425 seasonal workers, depending on the crop and planting area.

– "Svoya Teplytsia" – grants for the construction of new greenhouses – up to UAH 7 million for 2 hectares. The grant recipient must create at least 14 jobs;

– "IT startup" (under development);

– "Start v IT" – grants for training new skills in the field of information technology (under development).

One of the ways that Ukrainian startups can receive assistance is through separate funding programs from international companies. For example, the USAID Competitive Economy of Ukraine program has supported the participation of 348 Ukrainian businesses from the IT, creative industries, food and furniture sectors in 31 international trade missions in countries such as the United States, the United Kingdom, France, Spain, and Germany since the beginning of the full-scale war [42]. The grant program is being implemented in partnership with the Ministry of Economy of Ukraine, the Ministry of Digital Transformation of Ukraine, the Ukrainian Startup Fund, and the Office for Entrepreneurship and Export Development.

A study of the startup ecosystems of Finland and Sweden shows that there are additional opportunities for innovative development of Ukraine's territories during the war and post-war periods. These Scandinavian countries have successfully overcome difficult periods and implemented strategies that promote innovative growth and economic development. Considering the experience of Sweden and Finland, Ukraine can implement a number of measures to improve the preconditions for regional innovation development:

1) Lessons from the experience of Sweden and Finland point to the necessity of creating a startup support infrastructure, including accelerators, incubators, technology parks, and state support programs.

2) Ukraine should pay special attention to education and research to ensure access to qualified personnel and innovative technologies.

3) Reforms in legislation, taxation and legal protection of investments can make Ukraine more attractive to investors and entrepreneurs.

4) It is important to stimulate the development of startups in the regions, especially those affected by the war, which contributes to accelerated development and reduction of social and economic inequality.

5) Ukraine can use the experience of Sweden and Finland to develop partnerships and international

cooperation in the field of innovation and entrepreneurship.

The research has shown that despite Sweden and Finland's tremendous achievements in the field of startup development, most of these structures are located in the capitals of the countries. This suggests that although this practice is effective on a national scale, it does not have a qualitative impact on regional development.

On the other hand, it should be noted that the population of Sweden is about 3.5 times smaller than that of Ukraine, and Finland is about 7 times smaller. The same applies to the number of populated areas and large cities.

In the post-war period, Ukraine has a unique opportunity to intensify regional development by mobilizing the potential of professionals who have relocated from the occupied and frontline territories to other regions of the country. These professionals have valuable knowledge and experience that can be used to create new startups and innovative projects.

The process of forming a startup ecosystem around these professionals can give impetus to the development

of new businesses or the innovative transformation of traditional sectors of regional economies. However, in order for this initiative to bear maximum fruit, a set of appropriate regulatory, organizational, and infrastructural measures must be implemented to ensure favorable conditions for the work and development of such specialists.

The development of specialized support programs, a focus on education and research, and the creation of communication platforms and communities for professionals can stimulate innovation and entrepreneurship in the regions. This will help strengthen the technological and digital components of regional economies and their competitiveness, create new jobs and high value-added activities.

Thus, the use of the potential of specialist relocation is a promising and effective tool for stimulating regional development in post-war Ukraine. With the right approach and support from the authorities, it can become an important factor in the accelerated recovery and modernization of the Ukrainian economy on an innovative basis.

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**Литвинський Р. В. Посилення регіонального розвитку за допомогою стартап-екосистем**

Значну роль у стимулюванні економічного зростання у воєнний та післявоєнний періоди відіграє регіональний розвиток на інноваційних засадах. Створення інноваційних екосистем, що підтримують розвиток стартапів та малих інноваційних підприємств, забезпечує формування сприятливого бізнес-клімату у регіонах та залучення інвестицій, зменшує залежність регіонів від традиційних галузей, створює висококваліфіковані робочі місця і розвиває підприємницькі таланти.

Метою дослідження є визначення особливостей екосистем стартапів, їхнього впливу на регіональний розвиток та виявлення факторів успішного функціонування таких екосистем на основі аналізу зарубіжного досвіду.

У статті проаналізовано досвід формування й розвитку екосистем стартапів у Швеції та Фінляндії, виявлено їхні унікальні переваги, історичні досягнення та поточні тренди. У Швеції спостерігається високий рівень глобальної конкурентоспроможності, зокрема завдяки активній підтримці державного сектору та сприятливому бізнес-клімату. Фінляндія славиться своїм інноваційним потенціалом, стабільним бізнес-середовищем, привабливими умовами для стартапів та інвесторів. Результати дослідження свідчать про стійкий успіх і перспективи подальшого зростання обох екосистем у міжнародному масштабі.

У ході дослідження виявлено, що не зважаючи на величезні досягнення Швеції та Фінляндії в сфері розвитку стартапів, більшість таких структур розташовано в столицях країн. Зроблено висновок, що хоча подібна практика є результативною в національному масштабі, але не дає якісного впливу на розвиток регіонів.

В умовах повоєнного періоду в Україні існує унікальна можливість для активізації регіонального розвитку через мобілізацію потенціалу фахівців, які релокувались з окупованих та прифронтових територій в інші регіони країни. Процес формування екосистем стартапів навколо цих фахівців може дати поштовх розвитку нових видів бізнесу чи інноваційній трансформації традиційних секторів регіональних економік. Для успішної реалізації такого підходу необхідно впровадження комплексу відповідних заходів регуляторного, організаційного та інфраструктурного характеру.

*Ключові слова:* інноваційний розвиток, стартап, повоєнне відновлення, регіон.

**Lytvynskyi R. Enhancing Regional Development with Startup Ecosystems**

Regional development based on innovation plays a significant role in stimulating economic growth in the wartime and postwar periods. The creation of innovative ecosystems that support the development of startups and small innovative enterprises ensures the formation of a favorable business climate in the regions and attracts investment, reduces the dependence of regions on traditional industries, creates highly skilled jobs and develops entrepreneurial talent.

The purpose of the study is to determine the features of startup ecosystems, their impact on regional development, and to identify the factors of successful functioning of such ecosystems based on the analysis of foreign experience.

The article analyzes the experience of formation and development of startup ecosystems in Sweden and Finland, identifies their unique advantages, historical achievements, and current trends. Sweden has a high level of global competitiveness due to active support from the public sector and a favorable business climate. Finland is known for its innovative potential, stable business environment, and attractive conditions for startups and investors. The results of the study demonstrate the sustainable success and prospects for further growth of both ecosystems on an international scale.

The study found that despite Sweden and Finland's tremendous achievements in the field of startup development, most of these structures are in the capitals of the countries. It is concluded that although this practice is effective on a national scale, it does not have a qualitative impact on regional development.

In the post-war period, Ukraine has a unique opportunity to intensify regional development by mobilizing the potential of specialists who have relocated from the occupied and frontline territories to other regions of the country. The process of forming startup ecosystems around these professionals can give impetus to the development of new types of business or innovative transformation of traditional sectors of regional economies. To successfully implement this approach, a set of appropriate regulatory, organizational, and infrastructural measures must be implemented.

*Keywords:* innovative development, startup, post-war recovery, region.

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