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Optimization of the Working Capital of Industrial Corporations According to the Criteria of Economic Evaluation of Synergetic Development Effects: Models, Methods, Tools

Abstract. *The article presents theoretical and methodological principles of the development of industrial corporations proposed by the author and illustrated in the context of the machine building sector. The author focuses on the application of synergy effects, which are seen as the most promising factor in terms of specific development of corporations and integrated corporate structures. A method for estimating the economic effect of synergy for machine-building corporations is proposed, which is based on the analysis of additional income from an innovation project, taking into account the initial cost of fixed assets and the cost of the innovation project as a whole. The author shows that the method could help to accelerate the innovative development of machine-building corporations.*

Keywords: *corporation, economic development, industry, models, optimization, synergy, working capital*

1. Introduction

The efficiency of corporations is closely linked to their development potential. The basis of the progress of the joint-stock sector of Poland and Ukraine is its transformation into corporate structures. The practice of their formation testi-

fies to the existence of a number of problems that hinder the effective functioning of such organizational entities. In the post-soviet camp countries, these forms of enterprise management were unknown. As a result, there were no theoretical foundations for the management of such organizational entities, and theoretical and applied models of management. The formation of methodological and applied developments will help increase the efficiency of corporations and its dynamic development.

The following domestic and foreign scientists have made a significant contribution to the development of corporate theory, methodological and applied foundations of corporate governance. In scientific works the problems of functioning the corporations are investigated, their essence is revealed, principles and mechanisms of their management are considered, conditions, structure and features of their formation and maintenance in the conditions of transition and market economies, etc. are analyzed. However, the obtained scientific results do not fully take into account the factors of development of machine-building corporations. In particular, there are no methods have been developed to assess the economic efficiency of machine-building corporations, which allow to draw comprehensive conclusions about the success of their operation, and no approaches have been proposed to calculate the synergy effect in corporations.

The concept of synergetic is popular in modern economic research, economics and management sciences. This is due to the fact that synergetic, as a concept, phenomenon and process, comprehensively and to the greatest extent characterizes the economic, managerial processes that are the results and consequences of development of corporations, mechanisms, systems and technologies of joint-stock companies. Therefore, various scientific schools are created that try to solve various problems of industrial corporations, in particular machine-building, as such, which often represent the corporate economy, joint-stock and corporate sectors of national economies within the theory and on the basis of synergy. One of the issues that their representatives are working on today is the problem of determining the synergistic effect of the creation (development) of corporations. By the way, here we believe that a corporation is a legal form of business that is different and separate from the specific persons who own them. The derivative terms from "a corporation" usually refer to phenomena, that is often relate to joint-stock companies and business associations.

The need to solve the outlined problems taking into account the specifics of corporate enterprises determines the relevance of research and development the recommendations for economically sound development of machine-building corporations based on improving their organizational and management structures and more fully taking into account the synergy effect in all their activities.

2. Analysis of publications of the problem

Recently, many domestic and international scientists made a significant contribution to the study of the problems of development the theory of synergetics and the synergistic approach. For example, they considered the concepts of synergy and synergetic, outlined the horizons of their application in economics, management and administration, revealed the principles, features of the theory of synergetic and synergistic approach, investigated the problem of assessing the synergistic effect, etc. At the same time, the question of determining the effect of synergy from the development of corporations is insufficiently studied. This is due to the fact that only methods have been developed to assess the impact of synergies on the activities of industrial and machine-building corporations in particular. These methods, as a rule, do not provide for the application in the complex of conceptual provisions and methods of synergistic approach to assessing the impact of synergies on their activities in the context of joint-stock companies management. Therefore, they cannot be effective in practice or in the process of determining the synergistic effect of corporate development.

At the same time, neglecting the tools of corporation management in machine-building makes economically efficient management system, development of enterprises on the basis of synergy, the corporate sector of the national economy impossible.

In the scientific literature there are concepts and methods for studying the stages, trends and results of the development of complex systems, which are appropriate to interpret machine-building corporations. Concepts and methods form the basis of evolutionary theory, cybernetics, theory of synergetic. Evolutionary theory, which does not take into account the transitional and revolutionary processes of systems development, is essentially no different from the approaches of cybernetics. Therefore, the former should be considered as part of the latter.

The essence of cybernetics is that the development of systems is seen as an equilibrium and self-regulating process that can be interpreted as inverse or inverse.

The theoretical basis of the synergistic approach is the results of analyzing the nature and potential of cooperation, during which there is interaction, coordinated cooperation between individuals with the same and common interests. Economic processes are divided into dissipative and equilibrium [Adachi 2012: 65-66; Brown & Taylor 2004: 52]. Into the equilibrium systems, the development is impossible. Only dissipative have the ability to develop. And the further the development process is from equilibrium, the more effective it is.

This approach differs from the usual one for classical economic theory. The basics of the evolution of market laws are represented by dogmas, paradigms and paradoxes of achieving equilibrium. The approach, considered by Lorraine Talbot [2019: 115-117], calls into question the effectiveness of the principles of control of systems that take into account the principles of cybernetics. Confidence in the principle that the main task of management is to create tools that compensate for and neutralize the effects of disturbances on the objects of management has been especially undermined. Instead, Talbot claimed that perturbations develop systems [Talbot 2019: 125].

Shann Turnbull proposed to analyze the development of complex and self-organization of open systems based on a synergistic approach. The main postulate is the position in which the imbalance is created and maintained by the flow of resources from the external (exogenous) environment. Imbalance leads to the creation of complex and stable structures of systems, to self-organization. Systems develop due to imbalance and self-organization [Turnbull 2020: 185].

The results of research by Turnbull and Talbot is differ. However, they analyze similar phenomena and processes. They have scientifically proved that the coordinated coherent action of different forces under certain conditions can manifest itself in the effects of emergence, animation, synergy, and so on. The effects contribute to the development of systems, providing transformations of their states [Talbot 2019: 125; Turnbull 2020: 185].

The consequence of the application of a synergistic approach is the expansion of the categorical-conceptual apparatus of modern economic theory by supplementing the concept of synergistic development. This is a universal category for describing the transformations of states of heterogeneous economic systems during development, which occur in quasi-stationary, transient and stationary modes of operation, during crises, in unstable states, which lead to dualistic decisions. The well-known signs of synergism from the development of systems are the presence of structural (qualitative), phase transformations of their states, uncertainty, nonlinearity, inversion, no equilibrium [Torre 2019: 328-329].

The author believes that synergistic development is a category for describing the progress of homogeneous systems created by the integration of elements, which causes substitution (natural changes or metamorphoses, artificial transformations or transformations) of states of systems that are the main cause of synergism. Substitution or mutation is an integral part of evolution, "moving forward," the development of systems. In contrast to the existing ones, in the proposed definition the word "heterogeneous" is replaced by the word "homogeneous," the synergism from the development of systems is due to the synergistic effect, the other effects are not taken into account.

Heterogeneous economic systems are complex. They are formed from a different elements. The latter are differentiated by criteria. Homogeneous are formed

from homogeneous, with similar or similar properties. The development of machine-building corporations on the basis of the theory of synergetic, synergistic approach can take place under the observance of the following conditions by the participants of corporate relations. This is the construction and improvement of homogeneous management structures. Their implementation necessitates a change in characteristics of the systems.

Now the synergy of the development of machine-building corporations, most of the experts in economic theory and corporate governance understand such features of enterprises as the transformation of their states, the ability to develop evolutionarily and revolutionary, with manifestations of ambivalence, multiphase, emergence, consistency, multiple and systematic changes in phase portraits. These manifestations lead to the effect of synergism, increase in the number of elements, complication of systems, changes in intensity and forces, redistribution of connections [Keay 2012: 217-218].

The basics of cybernetics and synergetic are similar. This is the concept of dynamics and methodology of self-organization of systems. The concepts themselves are different. If the basis of cybernetics is general theory of control of equilibrium systems, then synergetic – no equilibrium.

The disadvantage of research on the synergistic effect of the development of machine-building corporations is that it is analyzed not in terms of the faces of the prism, not in the plane of its inherent types, but in the context of others.

The main reason for the synergy effect from the development of machine-building corporations is the metamorphosis and transformation of organizational management structures. The management structures include services, departments and participants in corporate relations, types of economic, operational activities of enterprises. "Immediate" determination of the effect, in particular from the development of corporations, is unlikely, because its essence is complex.

The classic typology of synergistic effects from the development of machine-building corporations shows that, in addition to the primary effects, it is necessary to distinguish between derivatives. Secondary ones usually concern the operating activities of machine-building corporations. Only after analyzing the features of economic and operational activities of enterprises, the problems of their progress, identifying typical effects that may occur and generalizing the results, it is appropriate to proceed to the calculation of the effect of corporate development.

If we analyze the differences between machine-building corporations and business associations based on the use of synergy theory, it follows that corporations are complex functioning organizational and economic systems with synergies from development and synergistic effects as common features of enterprises.

Machine-building corporations protect and provide protection to enterprises, and thus, protect participants in corporate relations from the negative effects of the business environment. The protection is natural, and protection is an artificial

reaction of systems to an aggressive environment. Due to the delegation of tactical management functions, the state of enterprises is being transformed.

The result of transformations of the states of machine-building corporations is a revision of their organizational and economic essence. The enterprises have not only exogenous, one-sided connections, but also those that are designed to metamorphose, transform the endogenous environment. The improvement and development of corporate relationships with internal, intra-firm environments, usually initiated by intra-firm participants in corporate relations, encourage the transformation of systems of interaction with the external one. The enterprises have the opportunity not only to respond to actions, metamorphoses and transformations of the environment, but also to predict and influence them. By the way, the development of corporations, quantitative changes and transformations of the internal environment lead to qualitative: improvement of management systems, improvement of the environment, change of conditions, development of enterprises.

Machine-building corporations by the criterion of "forms of relations of organizational and legal forms with the environment" are a type of enterprises that are transitional, because, incidentally, unlike syndicates, which are exogenous, and holdings that are endogenous, do not have direct relation to exogenous and endogenous.

Given the results, the effective in terms of complexity of the foundation and organizational and legal forms, effectiveness, functionality in mechanical engineering, and those that, in the author's opinion, should include the following: first place is occupied by joint stock companies, second by corporations, third – holdings.

The principles of synergetic contain conceptual provisions and methods of dialectics, principles of theories of self-organization and systems, cybernetic and processional-structured approaches. They also cover the provisions and methods of situational theory, cybernetics, and situational approach. The main advantage of the direction of economic synergetic is that it describes on a scientific basis not only inverse quantitative but also qualitative processes.

The advantages of the direction include the fact that economic synergetic can explain:

– the emergence of the phenomenon of corporation in the economy, the reasons for their creation;

– the stages and processes of scientific and technical, industrial, organizational and economic and socio-economic evolution of corporations;

– the appearance of phenomena and the processes of corporate governance, corporate management in the economy, the reasons for their occurrence;

– the general trends and main problems in the progress of corporations, the reasons for changes in organizational and legal forms, the spread of corporate pro-

cesses, features of a business processes of enterprises, the development of joint-stock companies and integrated corporate structures;

– the base problems, directions and prospects of education for corporations, integrated corporate structures, corporate and non-corporate economy, joint-stock and corporate sectors of national economies of managers, economists and managers of higher qualification, etc.

The direction makes it possible to study and explain the listed phenomena, processes both in general and at the example of industry, such as machine-building subsectors, and the other.

Signs of the imperative of development from the standpoint of synergetic, in particular machine-building corporations, shown below in Table 1, are proposed and quite successfully, in the opinion of the author.

Table 1. The characteristics of the imperative of development of machine-building corporations from the standpoint of synergetic

Imperatives	Theory of synergetic
Reasons	Nonlinearity, uncertainty, non-equilibrium, inversion, nonlinear environmentalism
Forms	Stationary and non-stationary regimes, phase, structural, qualitative transitions, crises, catastrophes, bifurcation, fluctuations
Properties	Self-organization in the form of nonlinear environmentalism, deterministic chaos, equal probability of deterministic and stochastic states during bifurcation
Factors	Hierarchy, positive (developing) feedback, cooperation, autocorrelation
Methods	Modeling based on theories of catastrophes, bifurcations, phase transitions and methods of fuzzy logic, artificial neural networks, chaos, fractals, etc.
Results	
Intermediate	Taking into account the reasons, the use of forms and properties, taking into account factors, the application of these methods*
Final	Many possible states, different trajectories of development
Consequences	
Intermediate	Taking into account the causes, the use of forms and properties, taking into account the factors, the application of these methods allows you to predict many possible states and different trajectories of development, equilibrium, and invariance*
Final	Obtaining many possible states and different trajectories of development*

* Suggested by the author.

Source: based on Fadeyeva 2012: 185-186.

Using the conceptual provisions of the theory of synergetic, I. Fadeyeva [2012: 213] proposed a method for estimating the presence of the phenomenon of synergism using the coefficient of synergistic action (1):

$$\alpha = \frac{\beta - \chi}{\delta - \varepsilon} \tag{1}$$

where:

α – the coefficient of synergistic action;
β – a general economic assessment of the synergy effect, monetary units (m.u.);
χ – the cost estimation of expenses for achievement of effect of synergy, m.u.;
δ, ε – the values of indicators that correspond to the established mode of operation of the object of study.

According to Fadeyeva [2012: 214-215], if $\alpha = 0$ (2), then synergism is absent in the system and if a positive effect is observed, then $\alpha > 0$ (3). Naturally, if $\alpha < 0$ (4), then anty synergism is observed.

The effect of synergism can be determined on other grounds, based on the law of the synergism. The author finds confirmation of fidelity of scientific thought by M. Bondarchuk [2013: 35-36]. For the production and economic structure, "which is a machine-building corporation," there is a set of elements in which its potential is greater or less than the potential of individual elements. The law of synergy reflects the presence of a systemic effect, when a system from a simple sum of elements is transformed into a system that has a new quality.

More over Bondarchuk [2013: 24-25] believes and claims that the synergy can provide the machine-building corporation with a positive net acquisition cost as (5):

$$\phi = \varphi - [\gamma - \eta] - \iota - \kappa \tag{5}$$

where:

ϕ – the positive net acquisition cost of corporation, m.u.;
φ – the combined value of corporations, m.u.;
γ – the valuation by corporation of its own value, m.u.;
η – the market value of shares of corporation, m.u.;
ι – the premium paid by corporations (one to another), m.u.;
κ – the cost of acquisitions of corporations, m.u.

In this case, she argues that if expression (5) is converted into

$$\phi = [\varphi - (\gamma + \eta)] - (\iota - \kappa) \tag{6}$$

then the value in square brackets reflects the synergistic effect [Bondarchuk 2013: 32].

There are the other methods of calculating the effect of synergy, in particular from the development of corporations, including in industry and engineering. They mostly concern the definition of methodological essence of synergism effect. These methods of calculating the synergistic effect have a number of disadvantages. The main shortcomings of the methods of calculating the effect of synergism from the development of machine-building corporations, the author proposes to include the following:

– the definition of "established mode of operation of the object of study" is debatable. It is unclear what is meant – the capacity of machine-building corporations, the actual volume of manufactured products and so on. It is impossible to establish the numerical value of the synergistic coefficient without the specified indicator;

– it can be applied retrospectively when enterprises have been integrated into machine-building corporations and the actual values of the obtained financial results are known (at least the market value of the joint-stock companies). However, it is mostly impossible to use them to predict the numerical value of the synergistic effect;

– does not explain the essence, does not provide a method of determining the indicator "overall economic assessment of the synergistic effect", which, by the opinion of the author, is more important than the synergistic effect, as it should determine the value of the assessed effect;

– it is unclear how in practice to determine the combined value of two and/or more enterprises that create machine-building corporations. The market value of enterprises will depend on the actual, and if the forecast value is determined, the expected profitability of the formed machine-building corporations. Profitability, in turn, will depend on the importance of the synergistic effect caused by the development of machine-building corporations;

– reveal to a greater extent the essence of the synergistic effect;

– the synergistic effect is considered from the standpoint of enterprises as systems, without separating their components – operating, financial and investment systems, which, in our opinion, in the development of machine-building corporations will change differently. To quantify the effect, it is desirable to consider separately the types of activities and then determine its generalized value.

3. The purpose of the article

The purpose of the article is to propose an author's method for determining the effect of synergy from the development of corporations at the example of machine-building. The main tasks due to the purpose of the work are analysis, logical generalization and taking into account the existing experience of determining the synergistic effect, guidance and testing of the author's proposed method of calculating the synergistic effect from the development of machine-building corporations.

4. Research methodology

The object of research is the process of determining the effect of synergism from the development of industrial corporations, the subject – the theory of syn-

ergetic and methods of calculating the synergistic effect for joint-stock companies in machine-building. The methods of analysis (documents and situations), hypothetical, economic and mathematical modeling, concretization, synthesis, systematization, generalization, principles of synergistic approach are applied in the work.

5. Presentation of the main results of the research

The author's method of determining the effect of synergy from the development of machine-building corporations is based on the principles, that is below in Table 2, namely the consolidated positive and negative sides, which, in our opinion, are inherent in the process of joint-stock company development.

Table 2. The main properties of the development process of machine-building corporations

Properties	
positive	negative
Concentration of capital of enterprises strengthens the effect of scale, promotes the education of scientific intelligentsia, economists, managers and managers of the highest qualification, the accumulation of intellectual capital, the development of innovation and joint-stock companies	Leads to the monopolization the market by joint-stock companies
Improves the competitive conditions for the development of joint-stock companies in relation to international competitors	Creates conditions for the establishment of joint-stock companies monopoly prices for products

Source: own elaboration.

In order to confirm or definitively refute the relevance of the development of machine-building corporations on a scientific basis, it is necessary to assess the benefits that will arise and the possibility of reducing the negative properties of the process.

An accomplished and indisputable fact is that in the process of development of machine-building corporations there will be an effect of scale. There is no doubt that the concentration of capital of enterprises will contribute to the training of scientific intelligentsia, economists, managers for engineering corporations and senior management, the accumulation of intellectual capital, its commercialization, the progress of innovation and the joint-stock companies, their evolution on an innovative basis play an important role. This fact, in the author's opinion, is

more important than obtaining the effect of scale from the development of machine-building corporations.

A common factor that negatively affects the development of innovation by industrial corporations and joint-stock companies is the lack of funding. This is relevant for most of the Polish and Ukrainian machine-building corporations. In different periods and in different countries the problem of deficit of financing of innovative activity of the enterprises was solved differently. For example, they created special funds to finance innovation activities by recalculating part of the profits of enterprises, allocated funds from budgets or other sources in the form of grants for it. A popular method for machine-building corporations is to attract and use their own funds.

The advantage of industrial corporations using their own funds over those involved in the development of innovation and joint-stock companies is that the concentration of capital allows companies to plan and implement the most optimal options for educating scientific intelligentsia, economists, managers and senior management, accumulation of intellectual capital, development and machine-building corporations.

Thus, if a certain industry is represented by a certain number of enterprises, each of which has relatively identical annual indicators of efficiency of production and economic activity, then to implement innovative projects that are most attractive to the industry, business owners must allocate for these purposes, and its management – rationally use the appropriate amount of money (denote the cost of the project. Then, if each of the companies will develop projects independently, independently of each other for non-external funds, it is likely that each company will spend more than a calendar year on their implementation. This is a negative point, because over a long period of time, innovations developed by enterprises may lose relevance not only for them but also for the market. Competition will unfold and be conducted only between these enterprises. This will lead to the loss of the effect of replication of innovations by enterprises.

If companies simultaneously produce and make a joint management decision to establish industrial corporations based on them with the appropriate consolidated indicators of efficiency of production and economic activities, then under such conditions, it is likely that joint-stock companies will finance innovative projects during the calendar year from their own funds. The cost of the projects will be less than the amount of profits that industrial corporations will receive from their implementation.

Thus, first of all, the development of machine-building corporations contributes to the concentration of capital. This makes it possible to accelerate the implementation of various and the joint innovative projects. Secondly, competition between enterprises that are part of machine-building corporations is disappearing. The focus is on the development and competition between machine-building

corporations, representatives of the corporate sector of the national economy of Poland and Ukraine and international competitors. Thirdly, there are conditions for enterprises to replicate innovative projects. The latter reduces their cost, which creates the conditions for obtaining a synergistic effect from the development of machine-building corporations.

To explain the nature and reasons for the formation of the effect of synergy from the development of machine-building corporations, it is advisable to determine the effectiveness of fixed assets of enterprises that are part of the joint-stock companies, and directly the effectiveness of fixed assets of corporations themselves. To do this, apply the efficiency ratio of fixed assets, which is calculated as (7):

$$\lambda = \frac{\mu}{\nu} \tag{7}$$

where:

λ – the coefficient of efficiency of fixed assets of the corporation;

μ – the profit received by the corporation, m.u.;

ν – the initial cost of fixed assets of the corporation, m.u.

It is obvious that in the first case it is appropriate for machine-building corporations to implement innovative projects when the efficiency of their production and economic activities will increase. Hypothetically, the efficiency ratio of enterprises that are part of machine-building corporations, after the implementation of projects will be a specific and positive value for enterprises. So, then we need to calculate the sum of the synergy effect from the development of machine-building corporations, the cause of which is their creation.

In order to continue the calculation of the synergy effect from the development of machine-building corporations, it is necessary to determine additional indicators related to innovative projects – this is the time of their development by enterprises and additional profits that will be received by joint-stock companies from their implementation.

The term of development of innovative projects by machine-building corporations can be determined by the next formula:

$$o = \frac{\pi}{\varpi} \tag{8}$$

where:

o – the period of development of the project by corporation, years;

π – the cost of the project of the corporation, m.u.;

ϖ – the cash flow that the owners of the corporation need to allocate, and the management of enterprise to use rationally for the project (in our case, μ), m.u.

It should be noted that from a theoretical point of view in this case, the period of development of innovative projects by enterprises that are part of machine-building corporations will be less than a calendar year. We also take into account that the author's method of calculating the magnitude of the synergistic effect from the creation (development) of machine-building corporations involves taking into account only the exact values of the obtained indicators. It means that the received period of time of realization of innovative projects cannot be rounded up to the whole value of the month.

The additional profit that will be received at one of the enterprises, which is part of the machine-building corporations after the implementation of innovative projects can be determined by the expression (9):

$$\theta = (v + \pi) \times (\vartheta - \lambda) = (v + \pi) \times \rho \tag{9}$$

where:

θ – the additional corporation profit that will receive after the project implementation, m.u.;

ϑ – the efficiency ratio of the corporation that is part of the machine-building corporation after the project implementation;

ρ – the increase in the efficiency of the fixed assets of the corporation.

Thus, after mastering innovative projects, enterprises that are part of machine-building corporations begin to receive additional profits, the total amount of which will correspond to the value of the synergy effect from the development of joint-stock companies.

The author proposes the following formula for calculating the effect of synergy from the development of machine-building corporations (10):

$$\sigma = \theta \times o \frac{\sum^{\varsigma} (\varsigma - 1)}{(\varsigma = 1)} \tag{10}$$

where:

σ – the effect of synergy from the development of the machine-building corporation, m.u.;

ς – the number of enterprise that are the part of the corporation and which have implemented innovative projects.

From formula (10) it is seen that the indicators that most influence the value of the synergistic effect from the development of machine-building corporations are the value of additional profits and the number of enterprises that are part of the joint-stock companies. In turn, the value of the indicator of additional profits of enterprises depends on the cost of innovative projects and their efficiency.

Table 3. The indicators of efficiency of machine-building corporation

Indicators	Sum
The initial cost of fixed assets of the enterprise, m.u.	3200
The volume of products sold by the enterprise, m.u.	8400
The profit received by the enterprise, m.u.	480

Source: own elaboration.

In order to explain the mechanism of formation of the synergism effect from the development of machine-building corporations, to test the author developed and proposed in the method of its definition in practice, consider the following example. We suppose that the engineering industry of Poland and Ukraine is represented by five enterprises that are the same or different in organizational and legal forms, but each of which has relatively identical annual indicators of efficiency of production and economic activities, listed below in Table 3.

To implement an innovative project, which is the most attractive for the engineering industry, its owners need to allocate the company, and its management – to rationally use near 1500 m.u. Then, if each of the companies will independently develop projects for their own money, then, in this case, each of them will spend more than 3 years on their implementation, which is a negative point, which is described above by the author.

Now suppose that five companies simultaneously developed and adopted a joint management decision to create on their basis a machine-building corporation with consolidated annual indicators of efficiency of production and economic activity, which are given below in Table 4.

Table 4. The indicators of efficiency of machine-building corporation

Indicators	Sum
The initial cost of fixed assets of the enterprise, m.u.	16000
The volume of products sold by the enterprise, m.u.	42000
The profit received by the enterprise, m.u.	2400

Source: own elaboration.

Therefore, as we can see from the Table. 4, under such conditions, machine-building corporations can finance with their own funds the implementation of innovative projects during the calendar year, as their value is less than the amount of profits that joint-stock companies will receive from the implementation of projects.

To explain the essence and reasons for the formation of a synergistic effect from the development of machine-building corporations, we use the previous example. First of all, we determine the efficiency of the use of fixed assets of enterprises and machine-building corporations. And since it is advisable to implement

an innovative project when the efficiency of its production and economic activities will increase, in this case, the author assumes that the efficiency ratio of the enterprise, which is part of the machine-building corporation, after the project will be 0.2. In the future it is necessary to calculate the amount of the synergy effect from the development of the machine-building corporation.

We will continue the explanation of the mechanism of formation and calculation of the synergy effect from the development of machine-building corporations by determining the values of indicators of the term of development of innovative projects and additional profit that will be received by joint-stock companies from their implementation in enterprises based on continuing use and consideration of the previous example. If we substitute the numerical values of specific indicators in formula (8), we obtain that the duration of the development of an innovative project at one enterprise, which is part of the machine-building corporation, will be 0.625 years or 7.5 months.

Substituting in expression (9) the numerical values of specific indicators, we obtain that the additional profit of the enterprise will be 19.58 m.u. per month or 235 m.u. in a year.

If we substitute the values of specific indicators in formula (6), we obtain the total amount of synergistic effect from the development of the machine-building corporation on the basis of the introduction of joint ventures by joint ventures, which will be 14687.50 m.u.

At the same time, the problems of this method arise when calculating the value of additional synergistic profit, which is not always possible to calculate.

Accordingly, we propose to use another method of calculating the synergy effect. It is based on the calculation of additional profitability of funds invested in the investment project, obtained from the joint activities of members of the corporation. This method proposed to determine the synergistic effect of the activities of corporations (for example, the holdings in machine-building) by analyzing the results of the implementation of innovative projects in corporate associations. It is proposed to calculate the additional return on funds invested in the investment project by the following expression:

$$\tau = \upsilon - \omega \tag{11}$$

where:

- τ – the additional profitability of funds, that was invested in the investment project (its the participant of corporations, which arises as a result of joint implementation of the project);
- υ – profitability of the participant of corporations, which arises after the joint implementation of the investment project;
- ω – profitability of the participant of corporations, which arises before joint realization of the innovative project.

Accordingly, the average additional return on investment in the investment project, all participants in the corporations, which arises from the joint implementation of the investment project by the participants of the holding, will be calculated as (12):

$$\xi = \frac{\sum\limits_{\psi=1}^{\psi} \xi}{\xi_1} \tag{12}$$

where:

ξ – the average additional profitability, invested funds in the investment project, all of participants in corporations, which arises as a result of joint implementation of the investment project;

ψ – the number of the enterprise, which is part of the holding in machine-building, and which implemented an innovative project;

ξ_1 – the total number of enterprises included in the holding in machine-building.

The profit of the holding in machine-building, which implements by the investment project, taking into account the calculated values synergy effect, it is proposed to calculate by the next expression:

$$\alpha_1 = \sum_{\psi=1}^{\psi} \sum_{\beta_1'=1}^{\beta'} \times \left(\frac{\chi_2}{\left(1+\frac{\delta_2}{100}\right)^{\varepsilon_2}} \times (\xi+1) \right) \tag{13}$$

where:

α_1 – the profit of the holding, taking into account the effect of synergy, which implements the investment project, m.u.;

β' – the total duration of the innovation project, years;

β_1 – the number of the period of time in which the profit was received;

χ_2 – the profit of individual participants of the holding, received during joint activities, m.u.;

δ_2 – the inflation rate, per cent.

The expression (13) is calculated as the sum of profits, that received from the joint activities of members of the corporation discounted by the inflation rate in a particular period of time. In addition, the formula (13) reflects the increase in machine-building holding profits due to the synergistic effect.

From the expression (13) it is seen that the main indicators that affect the value of the total profit of the holding are the profit of individual enterprises of the holding, the number of enterprises forming the association, inflation rate, duration of innovation project and additional profitability resulting from synergy.

The calculation of this method of additional profitability of funds invested in the investment project is presented below. The additional profitability of funds invested in the investment project of each of machine-building holding participants included in the project were: 4.0%, 6.0% and 3.0%. Accordingly, the average additional return on funds invested in the investment project was 4.33%. Accordingly substituting these data in the formula (13) and using the information from the previous example, we obtain the following value of holding's profit, taking into account the effect of synergy that equal to 15548.53 m.u.

6. Conclusion

Thus, it is determined that the machine-building corporation is a joint-stock company based on the pooling of capital of legal entities and (or) individuals, acquires the status of a legal entity, has limited liability of owners, the possibility of free transfer of property rights within legal limits, forms a collegial management system. the decision taking into account a share of owners in the capital and in connection with specificity of functioning creates opportunities for achievement of synergetic effect from cooperation of participants of corporate relations. Each of their types has a certain ideology of their foundation and development.

From the standpoint of a systems approach, machine-building corporations are essentially complex systems. Analysis of literature sources has shown that their research can be conducted on the basis of evolutionary, cybernetic and synergistic approaches. In essence and methodological means, the evolutionary approach is proposed to be considered a subtype of cybernetic. One of the important features of corporations – enterprises are characterized by a synergistic effect. At the same time, its quantitative definition is practically not given in the economic literature.

The article develops the theoretical foundations of corporate development, which are based on the formation of opportunities to achieve additional synergies. The paper also substantiates the possibility of obtaining an additional effect from the merger of several subjects of corporate relations.

Among other things, the method of determining one of the types of synergism effect that arises in the process of development of machine-building corporations is developed in the work. The proposed method is based on taking into account the possibilities of concentration of capital of enterprises on the basis of which corporations are formed. It is scientifically proved and substantiated on the basis of conducted researches that application of the developed method allows to es-

tablish the basic factors influencing size of synergistic effect from development machine-building corporations, possibility to accelerate innovative development of the enterprises and joint-stock company as a whole.

The proposed method on a scientific basis partially reveals one of the manifestations of the synergistic effect of the development of machine-building corporations, as the developed and presented indicator is complex and complex in nature. To more fully explain its essence, it is necessary to study the operational, investment, innovation and financial activities of enterprises.

The method of determining the effect of synergy from the development of machine-building corporations will be useful for both existing and new enterprises with a satisfactory general condition, which implement or develop investment and innovation activities, focused on its evolution by attracting and using their own funds.

Also in the article proposes a methodical approach to determining the economic effect of synergy for a corporations, which is based on the analysis of additional profits from the implementation of an innovative project by the author. The calculation of additional profit is carried out by taking into account the initial cost of fixed assets and the cost of the innovation project as a whole and allows to increase the level of innovation of the machine-building corporations.

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Optymalizacja kapitału obrotowego korporacji przemysłowych według kryteriów oceny ekonomicznej synergicznych efektów rozwoju: modele, metody, narzędzia

Streszczenie. *W artykule przedstawiono autorskie teoretyczne i metodologiczne zasady rozwoju korporacji przemysłowych na przykładzie sektora budowy maszyn. Skoncentrowano się na zastosowaniu synergii jako najbardziej obiecującej pod względem specyficznego rozwoju korporacji i zintegrowanych struktur korporacyjnych. Zaproponowano i przedstawiono metodę szacowania ekonomicznego efektu synergii dla korporacji produkujących maszyny, opartą na analizie dodatkowego dochodu z projektu innowacyjnego z uwzględnieniem początkowego kosztu środków trwałych i kosztu projektu innowacyjnego jako całości. Dalsze wykorzystanie tej metody w praktyce umożliwi przyspieszenie innowacyjnego rozwoju korporacji budujących maszyny.*

Słowa kluczowe: *korporacja, rozwój gospodarczy, przemysł, modele, optymalizacja, synergia, kapitał obrotowy*