

Analysis of network integration in evaluation of new industrialization

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Abstract – The basic sign of new industrialization as a modern stage in the development of productive forces is the use of information and communication technologies as a tool that ensures, inter alia, the stable and effective functioning of network integration of production and economic entities that cooperate to produce complex, including innovative products. At the same time, the scale and efficiency of using information and communication technologies in no way can provide an objective assessment of the phenomenon of new industrialization, since it is obvious that the real benefits of applying the principles and methods laid down in them are realized as the effects of production economics. In this regard, a priori assuming that production networks exist not only as a formalized set of relations of technologically related enterprises, but an orderly process of information processing, let us imagine an *industrial park* as a special case of the network organization of production, the effects of which are completely objective for perceiving qualitative changes in productive forces and relations. The industrial park is a fairly common method of arrangement for the innovative production in industrialized countries. Under the terms and conditions of the Russian economy, the potential of industrial parks is underutilized. Mainly, because initially, in their development, there is a desire to create organizational and infrastructural conditions (one of the arguments of attractiveness) for locating production, preferably of a larger number of independent resident enterprises. The future socialization of their relations can be and is considered as a possible prospect for the development of the park structure, but is not mandatory. Meanwhile, the efficiency of the industrial park as a specific object of management will be obviously always higher where, in addition to localization effects, additional effects arise, caused by the development of technological interaction of residents of park structures. The article provides the results of the analysis of methods and approaches to assessing the efficiency of the industrial park as an example of the network organization of production. An attempt was made to substantiate the expediency of using indicators of the dynamics of transaction costs in assessing its effectiveness. As a conceptual basis for solving this problem, the author suggests the so-called algebraic approach to representing the object of study as a multicomponent system in which the interaction of elements mediates the appearance of effects (called “additional”) that have a transactional nature. The features of this approach are illustrated by graphs characterizing the influence exerted on the dynamics of absolute and relative transaction costs by changing

the scale of exchanges and the economic performance of participants in the network organization.

Keywords - new industrialization, network organization, “additional” effects, composition and structure of transaction costs, algebraic method, efficiency of industrial park.

I. INTRODUCTION

Functioning in a competitive environment is the daily norm for the vast majority of business entities. At the same time, they attract significant funds and make considerable efforts to find a position in the market that would minimize the transaction costs that arise (non-production costs that accompany the exchange processes), but allowed, nevertheless, to achieve the desired results.

In this regard, it may be argued that the competitiveness of industrial enterprises, among other things, determines the amount of funds allocated both to search for and attract buyers, suppliers, and to obtain various kinds of licenses, to ensure workflow processes; monitoring the quality of products; its promotion in new and developed markets. In addition, one may not but take into account that this amount of funds is adjusted (in a large number of cases in the direction of increasing its normal value) by the costs of risk prevention caused by the peculiarities of the mentality of Russian entrepreneurs, the established business ethics, manifestations of opportunistic behavior on the part of counterparties, and information asymmetry and ingrained corruption. These facts give grounds to assert that the costs arising in the exchange processes are inevitable, and their accounting and analysis for the purpose of minimization are relevant areas of economic research.

In support of the relevance of the research topic, we note that the growing interest in the analysis and evaluation of transaction costs is due to their high level in both developed and developing economies. According to Western experts, the proportion of transaction costs in the total costs of a company when operating in traditional markets is from 1.5 to 5%, and when entering new markets increases to 10-15% [1]. In developed countries, a significant, and in other cases, an ever-increasing share of transaction costs is caused by a significant

increase in the number of actual economic ties, which inevitably leads to an increase in the number of transactions made. In addition, the results of some empirical studies show that in countries with advanced industrial economies, the net effect of technological change is just the increase in the costs of transactional processes [2]. Therefore, the authors believe that the localized interconnection of enterprises-residents of the industrial park, mediating the presence of technological relations, with a single management operator and a clear development concept, creates prerequisites not only for reducing the number of exchange operations, but is an additional incentive for locating innovative business in the parks.

The purpose of the study is to develop a methodological framework for identifying and analyzing transaction costs in evaluating the effectiveness of an industrial park with a developed network organization of production.

Research hypothesis If the industrial park asserts its right to exist by creating conditions that allow resident enterprises to get "additional" effects (the result of the development of *horizontal industrial integration*), which are reflected in the dynamics of transaction costs, then the efficiency of the industrial park itself, as an independent business unit, fully expresses summation savings in transaction costs incurred by each resident enterprise separately.

Level of the Problem Development

In economics, the analysis of the characteristics and properties of various forms of integration of the subjects of industrial relations is traditionally given considerable attention. But the first who made the main contribution to the study of the network forms of organization of production, localized in a particular area, were the representatives of the German geographical school – I.F. Tyunen and V. Launhardt. At the same time, aspects of the analysis of network forms in combination with studies of their effectiveness were actually developed only in the second half of the twentieth century. This happened due to the works of O. Williamson [3], R. Miles, C. Snow [4], U. Powell, L. Smith-Dora [5], D. North [6] due to the growing interest in "relational »Economics within the framework of institutional theory and concept of transaction costs, fundamentally developed by the founders of entire scientific fields and schools of neoclassical economics – Arrow K. [7], Stigler G. [8], Eggertsson T. [9], Milgrom P., Roberts J. [10].

At the same time, we note that the most advanced theoretical developments abroad are based on the consideration of the effectiveness of network interaction from the standpoint of measuring the value of relationships. For the first time, this approach was implemented by H. Hokansson, who proposed the ARA model (actors, resources, activities) to assess the effectiveness of the interaction of network partners [11]. Later, this model was modified by D. Wilson and S. Yantrania, who identified the strategic, psychological and economic components of the value of relationships [12].

In Russian economics, the main achievements in this area are related to the analysis of factors and criteria for the

effectiveness of network type organizations. Here the most famous are the works of such authors as Yu.F. Popov [13], G.L. Bagiyev [14], M. Yu. Sheresheva [15], OU Yuldasheva, V.A. Gorodilov [16]. At the same time, in a large number of cases, the authors assess the effectiveness of networks directly or indirectly associated with benefits as values that are formed in the process of interactions between the participants of the network organization. L.N. Drobyshevskaya and Kucheruk V.A. [17] summarize the existing approaches with the following thesis: "... the efficiency of interaction between network entities can be assessed from different perspectives: as the efficiency of the exchange; as the level of performance or achievement of planned indicators; as the degree of satisfaction of the interacting parties with the results achieved; as the level of resource interaction".

Finally, concrete achievements in the development of methods for evaluating the effectiveness of networks from the position of transactional theory are reflected in the works of foreign authors S. Michael [18], O. Williamons [19], J. Urbany, W. Bearden, A. Kaicker, M. Borrero [20], as well as Russian economists E.V. Popova [21], A.V. Aleshin [22], E.A. Zhukova [23], A.K. Lyasko [24].

II. RESEARCH METHODOLOGY

To achieve the goal and solve the problems of the present research, quite various methods and techniques were used, but complementary.

When solving the problem of identifying "additional" effects that are the result of horizontal industrial integration of resident enterprises of the industrial park, methods of general scientific character, elements of systemic and process approaches, analysis of cause-effect relationships and relations were used.

When developing methods for analyzing and evaluating the efficiency of the industrial, including the so-called, algebraic approach of the park, the authors have used as a necessary tool the methods of logical-structural, technical-economic, institutional analysis, decomposition, and graphic modeling.

In support of the practical significance of the developments made by the authors, the opinion on which was reflected in the conclusions and discussions of the research results, the method of expert assessments was applied.

III. RESULTS OF THE STUDY, THE SCIENTIFIC AND PRACTICAL VALUE THEREOF

In support of the methodological approach to the analysis of the efficiency of the industrial park, the following provision was adopted. The practical results of the industrial park (not only financial, but mainly economic) are, to a large extent, derived from the composition and performance of each resident participant in the network. This provision corresponds to the logic of disclosing the research topic, since it implies that the formation and development of an industrial park with a developed network organization of production are two complementary processes. Moreover, each is executed due to the management mechanisms wherein the set of methods and tools of regulatory and information support used by the subject of management (management company) forms a certain order

of relations with the object of management (resident of the industrial park). This allows each side to achieve the goals of functioning and development.

In terms of the process approach, an industrial park with a developed network organization of production can be represented by a kind of network of business processes in which the movement of goods or services is mediated by the movement of accompanying documents: their development, specification, transfer to another structure, etc. In fig. 1, this aspect is presented in the form of splitting the input stream into two components: the goods and services themselves, designated as “objects”, and the accompanying documentation, designated as “their models”. At the same time, external influences undergo a similar splitting into the influence of external content (material) and information factors (including the results of PR-actions, information attacks, etc.). Therefore, all non-production costs of exchanging goods or services are formally taken into account in organizing the network interaction of residents of the industrial park, which are, respectively, transactional in nature.

The possibility of using an algebraic approach to the analysis of transaction costs implies that in the structure of the business process under study, the system of document flow and information support of network exchange operations consists of three components. Namely: 1) basic objects; 2) typical transformations and typical combinations of “objects”; 3) the actual mechanism of approximation, which allows to present the result of applying typical transformations of basic objects and typical combinations of basic objects.

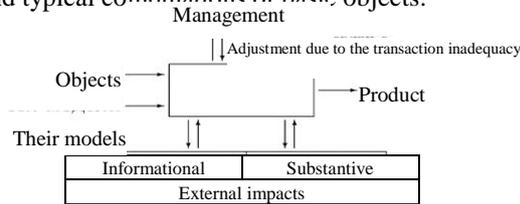


Fig. 1. Studied business process in the industrial park

In fact, the analysis anticipates agreement with the following assumptions:

1) *system of basic objects* consists of a list of basic documents representing (accompanying the transfer of rights) products or services, as well as a list of basic types of records adopted in the quality management system, etc.

2) *typical transformations and typical combinations* of transactions are presented in the system of services providing the formation and modification of product documentation (such services include the formal administrative component of the management system, considered as a mechanism for generating new documentation and rules for working with it).

3) as an *approximation mechanism* are the requirements for documentation, recording changes in it, movements recorded in the quality management system used, internal corporate and inter-corporate rules, legislation at various levels, as well as the rules for using documentation for organizing business processes, preventing or resolving disputes and others.

4) reducing the growth rate of transaction costs is the goal and result of the effective functioning of the industrial park as a long-term institutional form of organization of economic relations. Achieving these goals and objectives is formally ensured by the routinization and streamlining of documentation processes throughout the organization of network interaction.

The systematization of transaction costs is based on the economic and managerial model of K. Menard. This model offers the following grouping of transaction costs: informational, exchange scale, opportunistic behavior and isolation [25]. At the same time, the authors made the following assumption: due to their quantitative uncertainty, the costs of articulation are an integral part of the costs of information, the scale of exchange and opportunistic behavior. In this connection, the analysis actually involves working with three groups of transaction costs.

Information costs (CI) include the following categories of costs: CI.1 – costs for market analysis by the manufacturer (costs for obtaining industry information, costs for researching the competitive environment, costs for studying consumer information); CI.2 – the costs of market analysis by the consumer and the investor (the cost of finding and selecting suppliers and partners, the cost of finding and adapting exchange channels); CI.3 – market analysis costs from infrastructure positions (costs of finding options for moving and storing goods and semi-finished products; costs of organizing the movement and storage of goods and semi-finished products; costs of monitoring the movement and storage of goods and semi-finished products); CI.4 – costs for the provision and consumption of information services, information support (costs for services related to the legislative and regulatory framework, the cost of obtaining information about innovations, the cost of organizing promotional activities).

Accordingly, the total value of information costs is determined by summation: $CI = CI.1 + CI.2 + CI.3 + CI.4 + CU$, where CI is cost information; CU – the sum of unforeseen informational costs (cost of isolation). The desired result is obtained on the basis of a comparison of the information costs of the resident enterprise before and after its entry into the industrial park (the results of calculating the effects are similar for cases of considering the costs of exchanges and opportunistic behavior). In the interpretation, the result expresses the advantage of the industrial park with the network organization of production, which ensures the obtaining of effects due to the inheritance of competences in the field of documentation, the formation of a common (or unified) culture of working with documents.

Costs of the exchange scale (CE) are determined on the following grounds: CE.1 – costs of the preparatory stage (costs for building a model for the transfer of goods, costs for formalizing the process in the form of instructions, rules, etc., costs for conducting negotiations, representation costs); CE.2 – the costs of the current stage (the costs of determining by the authorized subject the list of documents and their forms necessary for documenting the product creation process, the costs of analyzing and adjusting the documentation process); CE.3 – costs of the control phase.

The value of this category of costs is determined by the sum: $CE = CE.1 + CE.2 + CE.3 + CU$, where CE is cost exchange; CU – the costs of isolation, due to unforeseen violations of the control procedure, the need to clarify or recheck its results, etc.

Please note that in the case of a small number of transactions, the preparatory stage of the administrative component is very significant in the total amount of transaction costs. In addition, the remaining stages require a greater expenditure of resources, perhaps due to the underdevelopment of the park infrastructure (for example, the operator must spend resources on preparing for the implementation of his duties – that is the scope of the required competencies requires updating). At the same time, it is obvious that when transactions go “in the flow” this component of costs decreases.

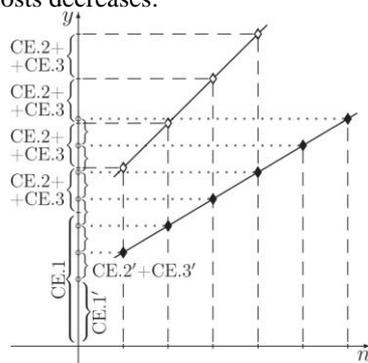


Fig. 2. Dependence of transaction costs on the scale of the exchange (n is the number of exchange operations) for an independent market participant \diamond and for a subject of the industrial park.

In the case when the activity of the resident enterprise is carried out within a single structure of the industrial park, these costs are reduced by accelerating the coordination of the relevant models and documents, reducing unproductive workflow that does not require prior official correspondence.

Opportunistic behavior costs (CO) are considered in two aspects: CO.1 – the costs of endogenous opportunism (costs caused by non-fulfillment of residents' contractual obligations, costs of controlling the obligations of the resident, moral hazard costs, losses from the departure of an interdependent agent of the production chain); CO.2 – the costs of exogenous opportunism (the loss of funds as a result of inflation, the receivables of the customer, the costs of controlling the obligations of the customer, the losses from theft, lies, deception).

The cost of opportunistic behavior is calculated as $CO = CO.1 + CO.2 + CU$, where CO is cost opportunism; CU – deduction costs.

To reduce the risk of negative effects of opportunistic behavior, it is necessary to take into account which conditions contribute to their occurrence and, if possible, take into account the influence. Conditions for the emergence of opportunistic behavior: incomplete or asymmetric information about the factors influencing the search for a partner and the conclusion of a contract; fuzzy specification of property rights; low incentives to fulfill the conditions of the contract; degree of severity of sanctions for failure to fulfill the terms and conditions, provide for by the contract.

For the purposes of the analysis, two variants of the consequences of opportunistic behavior are singled out: the consequences of the so-called “linear character” and “non-linear character”. In the first case, the counterparty exhibiting opportunistic behavior supplies a large number of a homogeneous product or service (in the case of a service, this could be, for example, servicing a certain number of well-known clients). Accordingly, the income linearly depends on the quantity of this product or service (“service quantity” means the number of satisfied customers, or, for example, the amount of garbage removed, etc.). In this case, the results of the counterparty’s activities k are presented as a random value of the volume of received income D_k . In this case, absolute transaction costs can be represented as the difference $ATI = 3D_k - M[D_k]$, and the relative costs – as the relation $OTI = (3D_k - M[D_k]) / 3D_k$, wherein $3D_k$ – planned income from the counterparty’s activities k , $M[D_k]$ – mathematic expectation of income from counterparty k . The main problem of planning in this case is not only the random nature of the quantity D_k , but also the absence of reliable information about the law of distribution of this quantity. In the case when the counterparty is a resident of the industrial park, over time it becomes possible to draw conclusions about the patterns of distribution, which is relevant for the case of shortage of goods or services provided by counterparty k .

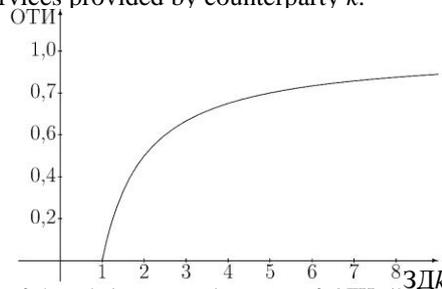


Fig. 3. Graph of the relative transaction costs of $OTI = (3D_k - M[D_k]) / 3D_k$ from the planned income $3D_k$ from the counterparty’s activity k when $M[D_k] = 1$.

The graph in fig. 3 illustrates an obvious idea: the closer the planned income from counterpart k ’s activities to the mathematical expectation of this income, the closer OTI is to 1, although ATI may be high.

Quantitative characteristics of transaction costs. Let Π – the price of goods for the final consumer, Π – costs (specific) directly for the design, testing and production of a unit of production. The composition of P does not include, for example, the cost of packaging design and manufacture, product packaging, etc. Then, to assess the level of transaction costs, you can use the following characteristics: $\Delta_{\Pi P} = (\Pi - \Pi - T) / (\Pi - T)$ – share of non-production costs in the price of goods excluding transaction costs, $\Delta_{\Pi P T} = (\Pi - \Pi - T) / (\Pi)$ – share of non-production costs in the price of goods, taking into account transaction costs.

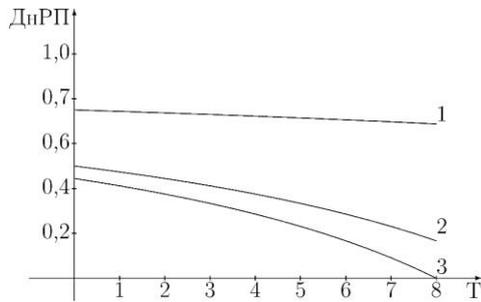


Fig. 4. Graphs of the share of non-production costs in the price of goods excluding transaction costs $ДнППТ = (\Pi - \Pi - T) / (\Pi - T)$ from T: 1 – $\Pi = 18, \Pi = 10$; 2 – $\Pi = 20, \Pi = 10$; 3 – $\Pi = 40, \Pi = 10$.

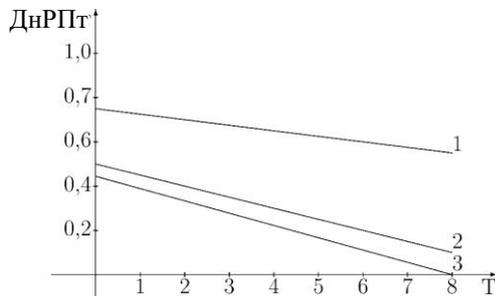


Fig. 5. Charts of dependence of the share of non-production costs in the price of goods, taking into account transaction costs $ДнППТ = (\Pi - \Pi - T) / \Pi$ from T: 1 – $\Pi = 18, \Pi = 10$; 2 – $\Pi = 20, \Pi = 10$; 3 – $\Pi = 40, \Pi = 10$.

The dependence on T of the share of non-production expenses in the price of the goods excluding transaction costs $ДнППТ = (\Pi - \Pi - T) / \Pi$ is linear.

Moreover, commercial and administrative expenses, referred to the cost of production by residents of the industrial park, as well as the amount of income tax paid by them – this is the composition of costs and expenses, in which all transaction costs of a business entity are present. In other words, formally in the calculations of transaction costs should be used “costs of sale” or “business expenses”, whose composition is strictly defined by the order of the Ministry of Finance of the Russian Federation No. 94 dated 31.10.2000.

Following the above requirements, the authors propose the following formalized assessment of transaction costs: $TC_i = CC_i + MC_i$, wherein TC_i – transaction costs of the i -th resident; CC_i – selling costs of the i -th resident; MC_i , management expenses of the i -th resident [20].

The materials of the study [27], made by D.S. Mironov, A.E. Plakhin and A.B. Stavrova was found that in the Sverdlovsk region the most successful is the industrial park “Chimpark Tagi”. In this regard, we believe that testing the method of evaluating the effectiveness would be expedient on the example of this industrial site. Transaction costs of residents of the industrial park are presented in Table 1.

TABLE I. COMMERCIAL (C), MANAGERIAL (M) AND TRANSACTIONAL (T) EXPENSES ON THE EXAMPLE OF INDIVIDUAL RESIDENTS OF THE INDUSTRIAL PARK “CHIMPARK TAGIL” 1

Resident of the Industrial Park	Costs ²	Reporting period ³		
		2015	2016	2017
PJSC Uralchimplast	C	289,389	279,063	290,275
	M	355,502	334,907	377,949
	T	644,891	613,97	668,224
Ural Plant of Plasticizers LLC	C	5,1	12,189	7,82
	M	17,606	42,453	23,188
	T	22,706	54,642	31,008
UHP Amdor LLC	C	27,14	22,39	21,676
	M	21,47	21,575	20,662
	T	48,61	43,965	42,338
Huttenes-Albertus LLC	C	241,496	184,93	183,55
	M	106,7	103,27	105,33
	T	348,196	288,2	288,88

Analyzing the data, the authors note the fact that participation in the activities of the industrial park provides residents with opportunities to significantly reduce transaction costs or, in any case, reduce their growth rates. For example, if we consider the results of PJSC Uralchimplast activity, then in 2016 its transaction costs were reduced by RUB 30.921 million. Taking into account the results of 2017, it can be argued that the growth rates of transaction costs were significantly lower compared to their dynamics in 2013 and 2014, when the company independently formed a system of economic relations.

The statistics of the Ural Plasticizers Plant also testifies to the positive changes obtained as a result of industrial cooperation in the industrial park. We note that a significant increase in transaction costs in 2016 was caused by the processes of diversification of production and the creation of its own brand Kompanit.

The best effect in the form of reduction in transaction costs is demonstrated by UHP-Amdor LLC. The resident managed not only to reduce the growth rate of expenses, but also to lay the foundation for reducing transaction costs in the following years.

The analysis of empirical data reveals the expected regularity: with the increase in the number of residents of the Tagil chemical park, the transaction costs of each of them receive positive changes (reduction) in growth rates.

IV. CONCLUSION

The quantitative and qualitative assessment of transaction costs is quite time-consuming process. This is due, firstly, to the diversity and heterogeneity of the resources used, each of which requires consideration (temporary, monetary, informational, etc.). In addition, secondly, not all of these costs appear explicitly. It is these difficulties in the

¹ According to Spark EDB // URL: <http://www.spark-interfax.ru>; Geographic information system “Industrial parks. Technoparks. Clusters” // URL: <https://www.gisip.ru/>; Association of Industrial Parks of Russia // URL: <http://www.indparks.ru/>; Tax statistics and analytics of the Federal Tax Service // URL: <https://www.nalog.ru>; Corporate Information Disclosure Center // URL: <http://www.e-disclosure.ru/>; “Industry Review. Industrial parks of Russia”. Issue four. // Association of industrial parks. – 2016.

² In million RUB

³ The color marks the year when the resident’s industrial activity began in the industrial park.

observability and measurability of transaction costs that create barriers to their full practical accounting within a particular organization. In view of the variety of the objectives that require consideration of transaction costs, in our opinion, it is impractical to be limited to only one characteristic of these costs. To assess the level of transaction costs should form a system of their characteristics.

The use of an algebraic approach to the analysis of transaction costs has allowed us, in the end, to propose an algorithm for estimating the absolute values of the various components of these costs and the share of these costs in the various components of total costs. In the framework of this study, the authors limited themselves to typical combinations in the form of a superposition of all the components of transaction costs, reflected in the final formula as a representation of the total costs as the sum of the corresponding values. Obviously, while the authors can only offer an empirical mechanism for approximating the above formulas, correcting the values of the parameters according to the results of the analysis of real business processes.

In the course of the study, it was shown that a resident of the industrial park gets the opportunity to reduce exchange costs due to localization and close interaction with other participants of the network organization, including by reducing and speeding up unproductive workflow and other factors. Finally, the effect of reducing exchange costs depends largely on the frequency of transactions and the number of participants united by a single technological chain.

V. DISCUSSION OF THE RESULTS

The main problems of measuring transaction costs and finding ways to achieve the effects of minimizing them in industrial parks are as follows:

- failure to comply with the technological exchange due to the lack of specialization of the industrial site (an example of the majority of industrial parks in the Sverdlovsk region);

- uncertainty and implicit nature of transaction costs, the lack of a methodology for their accounting and forecasting in the development of a conceptual model of the industrial park;

- low incentives to fulfill the conditions of the contract (which is often due to unfavorable conditions that create barriers to the fulfillment of contractual and contractual obligations);

Proposed measures to minimize transaction costs for residents of industrial parks include:

- improving the use of information technology and electronic communications (the effect expresses a reduction in the cost of implementing agreements and speeding up the management decision-making process);

- allocation of a single (priority) specialization of production, expanding the possibilities of technological exchange;

- self-regulation in the implementation of market transactions (the effect of independent examinations, dissemination of information, out-of-court settlement of disputes of constantly interacting entities);

- use of a process management model (the effect of automating business processes, reduces the time for management decisions and the cost of each transaction);

- use of personalized connections of senior managers (the effect of the secondary regulation of the legal process of contracting and the primacy of informal obligations to fulfill the terms of the transaction);

- encouraging partners to fulfill the terms of the agreement (the effect of discounts and reduction of costs for managing receivables);

- standardization of measurement, accounting and reporting methods (effect of management accounting organization by responsibility centers, use of standard contracts, differentiation of contract terms depending on the frequency of transactions, the level of uncertainty and asset specificity).

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