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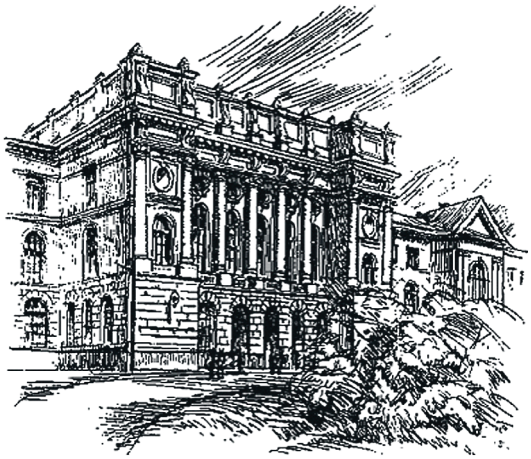

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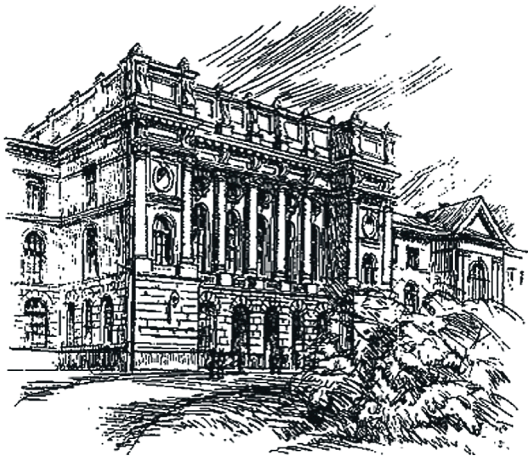

НАУЧНО-ТЕХНИЧЕСКИЕ ВЕДОМОСТИ

САНКТ-ПЕТЕРБУРГСКОГО ГОСУДАРСТВЕННОГО ПОЛИТЕХНИЧЕСКОГО УНИВЕРСИТЕТА

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Экономика и управление в образовании

ПОЗДРАВЛЕНИЕ

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советник при ректорате Санкт-Петербургского государственного политехнического университета

В феврале 2014 года В.В. Окрепилов отмечает юбилей. Владимир Валентинович за время трудовой деятельности прошел путь от рабочего завода радиотехнического оборудования до руководителя крупного предприятия, общественного и научного деятеля.

Владимир Валентинович успешно сочетает руководство крупнейшим территориальным органом Госстандарта России с научной, педагогической и общественной деятельностью. Академик Российской академии наук, доктор экономических наук, профессор, заслуженный деятель науки и техники Российской Федерации, лауреат Государственной премии Российской Федерации в области науки и техники, председатель Северо-Западной секции содействия развитию экономической науки Отделения общественных наук РАН, заместитель председателя Межведомственного Северо-Западного координационного совета при РАН по фундаментальным и прикладным исследованиям, советник при ректорате Санкт-Петербургского государственного политехнического университета, председатель редакционного совета журнала «Научно-технические ведомости СПбГПУ. Экономические науки».

Автор более 150 научных и учебно-методических работ в области управления качеством, стандартизации, метрологии и сертификации, опубликованных как в нашей стране, так и за рубежом.

Желаем Вам, Владимир Валентинович, дальнейших успехов в научной и редакционной деятельности.

Редакционная коллегия

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V.V. Glukhov, N.N. Kuzin

SYSTEM ASPECTS IN THE THEORY OF ORGANIZATION

В.В. Глухов, Н.Н. Кузин

СИСТЕМНЫЕ АСПЕКТЫ В ТЕОРИИ ОРГАНИЗАЦИИ

The system aspects of theory of organization are expounded in this article. The look of authors is expounded that principles of functioning of organization must at first form the system of principles. Principles must be based on connections, rules of construction of rational structures, and also organization and rationalization of processes.

THEORY OF ORGANIZATION, SYSTEM. PRINCIPLES OF ORGANIZATION. ECONOMY. ORGANIZATION.

Излагаются системные аспекты теории организации. Изложен взгляд авторов о том, что принципы функционирования организации должны вначале сформировать саму систему принципов. Принципы должны быть основаны на соединениях, правилах конструкции рациональных структур, а также организации и рационализации процессов.

ТЕОРИЯ ОРГАНИЗАЦИИ. СИСТЕМЫ. ПРИНЦИПЫ ОРГАНИЗАЦИИ. ЭКОНОМИКА. ОРГАНИЗАЦИЯ.

The basics of the theory of organization enable us to consider organization as an object of projection and management with the inherent mechanism of co-ordination through communications. This fact helps us to suppose that, from the point of economic cybernetics and a systems approach, organization can be considered with the criteria, applicable to a «living organism», which functions in an external environment and a diverse internal environment, in other words, represents a self-organized system. Having this conception in the «arsenal», the basics of the theory of organization enable us to construct any types of organizational structures, reflecting the principles selected above and based on the laws of organization, principles of its function and project. The consideration of these conceptual basics of the theory of organization makes it possible to predict that managers-economists will be interested in getting knowledge how the categories of social and economic organizations are examined as objects. An important value will have scientific interest, related to disclosure of the laws, and also the principles of organization in the conditions of the influence of human factor on the activity of the organization.

Considering the performance of social and economic organizations, it is desirable to emphasize that their structural construction depends on the kinds, types of firms due to their functions, organizational forms and forms of integration and co-operation typical of noncommercial organizations.

Taking into account the features mentioned above concepts and models, which reflect the stages of the development of the theory of organization, and also models of their construction, are needed. Considering the laws of organization, it is necessary to examine the properties of economic organizations, laws of their functioning, and also specific laws of social organization, because, even in generalizations every organizational system, which involves the man, does not stop being social.

For the substantial addition to the theory of organization with a further movement from sociology to economics, principles of functioning of the organization must form a system of principles at first, being based on system-organizing connections, rules of construction of rational structures, and the organization and rationalization of processes.

Any businessman, choosing a sort of activity and the scale of «construction» of the organization, must understand the fact that a «construction» could collapse, if it, as any system, would not have enough connections. Talking «a construction» in this aspect, we mean that a structure, scale and legal form of the organization which would give an answer to a question: «How will the caracteristics of the product be changing fixed in the system of economic document in dynamics and in the different intervals of time?».

Any organization involving people is a complex organism that can be named an «ant hill», if, without knowing its specifics and who does what, we try to examine its structure. Any organization has certain features, such as an image or format, major and minor traditions, cultural relations and reputation. If there is long-term strategy in the system of the organization, it is possible to argue that this structure can successfully develop and effectively use its resources.

Currently, there is a recognized definition of the theory of the organization with its principles, laws and rules of the development of the organization as an object, its evolution, mechanism of functioning, interdependence of its parts and elements with an external environment for the achievement of the new aims [1].

An earlier thesis was that a theory of organization is an area of scientific knowledge, which studies general laws explaining its structure, functions and the development of all the types of the organizations as complex dynamic systems, having a goal [2].

In the first definition, unlike the second, the theory organization is already identified as science. In our opinion, this is right. The second part of the first definition stating that the theory of organization is a science about planning new aims, also appears as successful. Despite the disputes, planning of new aims is an actual task of the theory of organization. What does it depend on? It follows from the essence of organization, in this case – its economic essence. Separate departments of the economic organizations is characterized by those properties, attributes and characteristics that, in certain terms, identify it as an object, for instance, as a firm. In fact, it is not a secret that the functional maintenance of the organization will be right, when its elements, properties and connections will identify it, for example, as a firm providing services, or enterprise producing bricks, etc. However, not only the internal construction will prompt us a difference in these objects (a hairdresser's or a factory) but also the projecting order of the organization.

Therefore, it is necessary to define the set of characterizing factors, which would fit for all types of organizations. Extremely important must be the activity of the organization, the composition of its directions, and the strategy of the market conduct, related to the scales of the firm. There is a specific set of such factors as a legal form, a quantity of the staff, and personnel, industrial, and administrative structures.

Creating (designing) the organization (the firm), it is necessary to get a clear idea of those tasks, which it will implement in a long-term on the basis of those rules, operating conditions, quantitative indexes and quality characteristics which will define the project. But to check the correctness of the organization with the methods, used to create it, in our opinion, is not right. In this sense, remembering the theorem of Gedel that if formal arithmetics is uncontradictory, a formula, asserting the absence of contradiction of arithmetics, cannot be created [3].

Explaining to the reader of this article the theorem of Gedel in a simplified version, we must consider the following thing... If you construct a theory using methods, based on correct laws, and there is enough knowledge for you in abstract areas, you probably will create it. However, to confirm the rightness of the theory using those methods, by which it was constructed, is not recommended, because of the incorrectness of such an approach. The proof of the rightness of the created theory must be carried out by the methods from another conceptual apparatus. If in mathematics there is

a large number of different methods, we will consider, that methods of economists-cybernetic engineers, realized in the theory of organization, do not compromise the theory. But will such an approach be appropriate for planning of the organization [4]? Obviously so, although he is fully or partly ignored by designers. Well, indeed, setting up a business a physical or a legal entity is unlikely to rely on scientific theories, but on intuition, experience, resources, personal connections, opportunities, etc.

Certainly, there are scientific approaches to the planning of the organization, which require an answer to the questions: in what organizational form will we work? What are our conceptions? What laws will we use? What principles in the planning of the organization will we follow? What should a production process be like? How will organizational culture be disseminated? As we can see, the theory of organization, in this case, uses the results of both related subjects and scientific disciplines to a great extent. In the planning of the organization the influence of sociology is great, because the theory of organization stems from it. The process needs social psychology, jurisprudence, management, economics, etc.

All questions listed above are of systemic nature and can be the factors that underlie the planning of the organization. Presenting the planning of the organization based on a whole set of factors, it is time to switch to the direct constructing of the model of the organization, so that a theoretical result will be obtained (most favorable). By creating the organization in practice using the simulation model and launching the organizational structure, we will arrive at the practical result. The estimation of the theoretical and practical results will show us how close we got to the desired theoretical result and what changes should be made in the model and in reality to correct the situation when the theoretical result is not attained.

Modeling the organization designs, while applying simulation models of organization, it is possible to create a large number of labor collectives and the production frames on the basis of reengineering, on which all foregoing postulates spread similarly; because a model is a system, which has some identical characteristics with an original. In this case the «original» means the personnel of the organization in the process of production under the inpact of different destructive factors, which require reengineering-processes [5].

Using a mathematical language, we have the following picture of the created simulation model of the management of a labor collective: the created model must be an ultimate goal of actions of the collective (complex function); having a large number of factors affecting the collective, beginning with directive influences of the leader of the higher level, influences of the external environment, the flow of information during work, time, etc. [6].

In any organization a team, a department, a bureau, a site as the elements of a system, which reflect private properties of a subdivision, and the structure of the system represents part of the properties in the designed object. Separate properties of the elements are substantially different, therefore they can be examined as partly independent ones. But taking into account their systemic integrity, these properties are in a subordinate communication, which allows us to examine the subdivision as a hierarchical subsystem of the economic system able to counteract destructive factors on the basis of reengineering. Examining the organization as socially polyhedral symbiosis, constructed on the basis of multidimensional classification and often being organized in a hierarchical order, it is possible to define the structure of mathematical model of organization:

– First stratum is an increase of the physical and psychological state of the collective;

– Second stratum is an improvement of quality of professional training, retraining and in-service training, and of technical equipment;

– Third stratum is an increase in productivity, performance of the collective and ability to execute an their work [7].

Each stratum describes certain properties of the subdivision, and intercommunication of strata reflects system integrity. The structure of models can include three links: levels of hierarchy, which model the proper hierarchy properties of subdivisions, being the basis of adjustment in case deviations affect the organization [8].

The designed subdivision is directly included into the firms, making an element of the economic system, thus becoming in relation to the designed subdivision, a metasystem [9].

A mathematical model in our case is a three-strata system. The connection between the strata is carried out through operators (theory of operators). The operators of the first strata control necessary regularities of an increase in the moral, psychological, and physical state of the collective in management. The operators of the second strata determine an increase in the efficiency of knowledge and technology, and, similarly, influence of the crosslinks on the efficiency, which in the end depends on external influences, the level of preparation of the collective, and terms of implementation of production tasks. The operators of the third strata ensure the production possibilities of the collective and their ability to execute their work. In future, it is necessary to conduct an analysis of distributing management functions in a collective exactly on the basis of the third strata of multitude-theoretic model of the organization, when the collective is prepared to implement production tasks and has enough appropriate technology [10–12]. A third, the main, stratum is a general system stratum, therefore the management of its features is co-ordinated with the requirements of the metasystem (economic system) which includes the designed subdivision (labour collective of the organization). This approach will substantially increase the number of methods of the organization theory concerning the planning of organizations of different types. A principle, uniting together all processes of the organization and managing activity, must be the principle of total introduction of the modern information systems at all performance stages of the system.

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E.R. Schisliaeva, O.V. Miroliubova

TRENDS OF INNOVATIVE ECONOMIC DEVELOPMENT IN THE RUSSIAN FEDERATION: SOCIO-ECONOMIC PROSPECTS FOR PUBLIC-PRIVATE PARTNERSHIP

Е.Р. Счисляева, О.В. Миролюбова

ТЕНДЕНЦИИ ИННОВАЦИОННОГО РАЗВИТИЯ ЭКОНОМИКИ РОССИЙСКОЙ ФЕДЕРАЦИИ: СОЦИАЛЬНО-ЭКОНОМИЧЕСКИЕ АТРИБУТЫ И МЕХАНИЗМЫ ЧАСТНО-ГОСУДАРСТВЕННОГО ПАРТНЕРСТВА

This article discusses the need for new approaches to improve the competitiveness of the Russian economy and prospects of Public Private Partnerships in Russia, based on the tendencies of innovation development. Innovative development ensures sustainable development of the economy. The analysis conducted by the authors has the main idea to evaluate the prospects of economic development and to identify the key areas of economic recovery.

INNOVATION DEVELOPMENT. CLUSTERS. ECONOMIC GROWTH. SUSTAINABLE DEVELOPMENT. DEVELOPMENT POTENTIAL. ASSESSMENT OF ECONOMIC PROSPECTS. PUBLIC-PRIVATE PARTNERSHIPS.

Проанализированы возможности повышения конкурентоспособности экономики России, перспективы развития государственно-частного партнерства, основанного на инновационных подходах. Инновационное развитие обеспечивает устойчивый рост экономики в целом. Анализ, проведенный авторами, позволяет выявить ключевые возможности оздоровления экономики.

ИННОВАЦИОННОЕ РАЗВИТИЕ. КЛАСТЕРЫ. ЭКОНОМИЧЕСКИЙ РОСТ. УСТОЙЧИВОЕ РАЗВИТИЕ. ПОТЕНЦИАЛ РАЗВИТИЯ. ГОСУДАРСТВЕННОЕ ЧАСТНОЕ ПАРТНЕРСТВО.

In the context of the subject-oriented study of innovative economic trends in the Russian Federation, it is necessary to analyze the forming stages of the institutional framework for technical research and high technology product development as well as the stages of technology commercialization process and public-private partnership infrastructure development in the field of innovation.

At present, the high-technology cluster in Russia comprises more than one hundred theoretical and practical fields of research; among them seventeen can be regarded as cutting edge and innovative: biotechnology and bioengineering, nuclear and spacecraft technology, biocompatible agents development, artificial intelligence and virtual reality systems as well as the development of recombinant vaccines, ultra-hard materials, membranes, catalysts, electron- and ion-plasma technologies, etc. The allocation of funds to support these and many other fields of research will enhance innovation and facilitate the economic growth in the Russian Federation.

Taking into account the fact that material production is based on theoretical and empirical research and the competitiveness of goods is to a large extent determined by their research intensity, the state support of innovation is an imperative element of market-institutional relations. This socio-economic phenomenon was pointed out by the founder of cybernetics N. Vinner, who said that «Modern society estimates the value of ideas in dollars and cents, though the value of ideas is much more lasting than the value of money. The discovery, which perhaps only fifty years later could be put into practice, has almost no chance of being profitable for those who paid for all the work done for its sake» [1, p. 267].

Due to the need for the public support of innovation and direct funding of scientific and

technological programs, a number of economic and legal acts for the innovative development in the Russian Federation were adopted: the Russian Federation Presidential Decree of 17 September 1994 on private investment stipulated the annual allocation of 0.5 % of GDP to fund research projects in 112 thousand economic entities; in 1997 the Federal Fund for the Assistance to Small innovative enterprises was established whose activity ensued an increased number of small innovative companies by 11–12 % with the volume of sales increased by 25 %; in 1999 the management company of the first Russian venture capital fund «Vinfin» was established by the Federal Fund for the Assistance to Small innovative enterprises together with the Ministry of Science and Technology, the Research and Production Center Soliton-NTT and the Federal Bank for innovation and development; and in 2004 the program «Innovative activities in Russia», which facilitated the development of regional innovation and technology centers with techno-parks, business incubators and other elements of innovative business was adopted [2].

However, many strategically important research projects aimed at the development of the national high-tech products failed or were only partially implemented as a result of poor economic investment policy of the state. Most of the national research centers lost major orders, which was one of the reasons for the lower output in the industrial cluster and reduced investment returns. As a result, the volume of investments in 1996 amounted to 29 % in comparison with 1991, and during the following five-year period the capital investment fell by 12 % as compared to 1996. Because of the long-lasting national economic crisis, the share of the consumer sector in 2000 decreased to 30.8 % from its figure of 53.4 % in 1990 and the share of resource-based sector in Russia 3.5 times exceeded its average value in other countries of the world community. The share of innovation and investment segment was significantly reduced, resulting in more than 2.5 times lower volumes of high technology production [3, pp. 38–45].

Realizing the need for the radical changes in Russian science and technology policies and the strategic importance of the national high-tech cluster, in 2006 the Government issued the Federal target-oriented program «Research and development in priority fields of science and technology complex of Russia for 2007–2012», and «The strategy of science and innovation development in the Russian Federation for the period up to 2015» approved by the Interdepartmental Commission on Science and Innovation Policy of the Russian Federation Ministry of Education and Science came into effect in 2006, the primary objective of both programs being the development of innovative scientific and technological potential of the state.

The strategy formulated the task of forming a cluster of fundamental and advanced research and development on the basis of so-called «scientific and technological corridors» that provide allocation of material and financial resources and targeted investment into enterprises of high-tech industry clusters ensuring high efficiency, modernization, and competitiveness of science-based technologies. The federal target-oriented program contains a comparative analysis of problems and challenges of the Russian Federation socio-economic development and suggests algorithms for their solutions in terms of science and innovation development (Tab. 1).

Equally important in terms of conceptual development is «The concept of long-term socio-economic development of the Russian Federation for the period up to 2020», approved by President Vladimir Putin in 2008. It sets the priorities for improving national competitiveness through the innovative activities at the enterprises with the advanced technologies and legislative support for the development of small and medium-sized innovative businesses.

According to the concept of long-term socio-economic development, the gross domestic product in 2020 will be 2.3 times higher than in 2007, the income of the population will be 2.6 times higher, the poverty rate will be reduced to 6.2 %. In 2015–2020 Russia is to enter the top five countries in terms of GDP (at purchasing power parity). The innovation plan for the national development implemented by the Government of the Russian Federation is highly resistant to a possible fall in the world prices for oil, fuel and raw materials: the growth rate of gross domestic product will fall by an average of 0.5 % in case of the world economic decline and lower oil prices (on average by $ 20 per barrel over the forecast period).

Table 1

The Stages and Socio-Economic Prospects for the Development of Science and Technology Cluster in the Russian Federation

Stage	Socio-economic prospects for Russian Science and Technology Cluster development
STAGE 1 The development of science, technology and engineering priority programs in the Russian Federation	1. Intensive development of science, technology and engineering in accordance with the list of crucial technologies for Russia. 2. The commercialization of technologies in accordance with the priority fields of science, technology and engineering. 3. The consolidation and concentration of resources on advanced scientific and technological developments through the introduction of public-private partnerships and through the research and development activities initiated by private businesses and innovative companies. 4. The engagement of young highly qualified specialists into research, and the development of leading scientific schools. 5. The enhancement of research in higher educational institutions. 6. The assistance to small innovative enterprises in scientific and technical field, and their integration into the system of scientific and technical cooperation
STAGE II The formation of the research sector and effective innovation system, providing technological modernization and competitiveness of the economy, and transformation of science and technology into the basic resource for sustainable economic growth	1. The development of the competitive research and innovation sector. 2. The formation of a cost-effective infrastructure for the national innovation system. 3. The intensification of innovation activities at the enterprises and organizations in the field of technology commercialization. 4. The improvement of the effectiveness of social and economic benefits of the national public-private partnership. 5. The development of competitive research organizations and institutions of higher education conducting fundamental and applied research. 6. The creation of computational and analytical tools for forecasting the scientific and technological development of Russia

At Krasnoyarsk Economic Forum in 2011 Prime-minister D. Medvedev made a presentation outlining the basis for the formation of the innovative Russian economy. «At the moment Russia is implementing a new government policy in the innovation sector of the Russian economy, which should be based on four «I»: innovation, investment, infrastructure and institutions. These are the priorities for the development of the national innovation system within the government economic policy,»- Medvedev said.

The implementation of innovation strategy in Russia involves substantial investment in high-tech sector of the economy, which can entail the problem of finding material and financial resources. In today's world economic crisis this problem can only be solved by inviting private investment into national high-technology cluster.

There is no doubt that the development of the national public-private partnership coordinating socio-economic interests of the state and businesses is of the strategic importance [4, 11]. Innovation policy in high-tech industries of the Russian economy should be based on the effective mechanism of public-private partnership and regarded as a guarantee of overcoming crises, providing structural modernization of the economy and competitiveness of production.

Public-private partnership in the innovation cluster of the economy can be seen as a market-institutional consensus reached between the government and private sector and generated for the effective and timely implementation of innovative projects in the areas of polymorphic research. It is based on the joint activities of the state research and educational institutions, the federal state unitary enterprises and private industrial, financial, and innovation businesses.

In terms of subject-oriented studies, it is necessary to differentiate the financial and non-financial institutions of innovation development: the former include the State Corporation «Bank for Development and Foreign Economic Affairs (Vnesheconombank)»; Investment Fund of the Russian Federation, «Russian Venture Company» Ltd and the regional funds; GC «Russian Corporation of Nanotechnologies», «Russian Investment Fund for Information and

Communication Technologies» Ltd, etc; the latter include technological and business innovation centers; research and technological parks; business and technology incubators; technology transfer centers and other institutions of the innovation infrastructure; special economic zones for technology development and experimental industrial production; regional development corporations; regional institutions for public-private partnership. The main socio-economic characteristics of these institutions as well as their management tools are given in Tab. 2.

Table 2

Main Socio-Economic Prospects for Public-Private Partnership in the Innovation Cluster

Socio-economic prospects	Contents and specifics in the innovation cluster
Socio-economic properties	1. Partnership shall be presented by both public and private economic sectors. 2. Relationships in the public-private partnership shall be stated in the official documents (agreements, programs etc.) and be equal. 3. Parties of the public-private partnership shall have common goals and clearly stated socio-economic interests. 4. Parties of the public-private partnership shall share costs and risks, participate in the usage of results.
Socio-economic factors, imbalances	1. High extent of financial and information uncertainty, variability and risk in the innovation sphere. 2. Long unprofitable period of innovation projects, which demotivates private investors. 3. Inability of small/medium-sized businesses to concentrate resources for innovation projects. 4. Inability of the market to provide cooperation, necessary for innovative breakthroughs, between science and business, internal innovation segments and corporate economic sector
Socio-economic targets	1. Breaking the stereotype of the socio-economic inability of the market to innovate. 2. Development of the socio-economic infrastructure. 3. Elimination of regional development imbalances caused by the specific government structure of the Russian Federation. 4. Reduction of private investors' innovation risks. 5. Support of innovations at early unprofitable stages in R&D. 6. Creation of favourable conditions to develop small/medium-sized innovation entrepreneurship. 7. Horizontal coordination between research institutions, innovation companies, and businesses
Socio-economic regulation tools	1. Information support of innovations: consultations on research areas, assessment of results, organization of researcher and specialist councils, creation of innovation data bases, advisory and consultation support to plan and implement innovation projects. 2. Staffing for innovation companies and infrastructure in order to regulate professional training for venture businesses, professional development programs for the managerial staff of venture companies, hiring and consulting by world leading specialists. 3. Creation of infrastructure for the innovation market: setting up stock exchanges to trade shares of innovation companies, high tech businesses, venture foundations etc.. 4. Economic and legal consulting on copyright, registration of innovation companies, drafting and conclusion of contracts etc.
Finance and investment regulation tools	1. Preparation of budgeting documentation to invest into the innovation sphere. 2. Grants and forgivable loans. 3. Guarantees, insurance and share financing. 4. Creation of mechanisms to attract investments from the Investment Foundation of the Russian Federation, Bank for Development and Foreign Economic Affairs (Vnesheconombank) and other investors. 5. Issue of infrastructure bonds. 6. Government guarantees and budgetary funding in compliance with regional laws: investment tax credit, government guarantees of Russian Federation subjects, municipal guarantees
Economic and legal regulation tools	1. Concession agreements on high technological markets. 2. Lifecycle contracts for innovations. 3. Consolidation of municipal projects in the public-private innovation cluster

Scientific research of the above−mentioned and many other market-institutional aspects of the Russian innovation sector shows insufficient development of all economic and legal units/ institutions which have to support the innovation policy; among them are specialized state and private corporations, which are expected to overcome the market inability constraining the social and economic development of the country.

Moreover, the laws regulating mechanisms of public-private partnership were passed in 59 subjects of the Russian Federation (St. Petersburg, Tomsk region, Republics of Altai, Dagestan, and Kalmykia) and these laws have significant administrative and economic disadvantages [5, 12].

Such disadvantages result from an inappropriate correlation between federal and regional public-private projects, contradictory in their legislation support; ineffective usage of socio-economic tools in promoting the Russian innovation sector for regional and national investors; inadequacy of economic and legal procedures leading to permanent collisions with the federal legislation; formal and bureaucratic decisions in the public-private partnership.

On the one hand, such an unfavourable socio-economic situation has a negative effect on the investment climate in Russia; on the other hand, it prevents Russia from developing and gathering pace of scientific and high technological clusters.

All categories of newly-introduced leading technologies − design, engineering; production, treatment, assembly; automated monitoring equipment; production information systems; integrated management and control etc. − show steady growth, which reflects the enhancement of the scientific progress and activation of innovative processes in the Russian economy. However, these processes are constrained by finance-investment barriers and political and legal collisions and obstacles.

At the Capital Investment Forum «Russia 2012» President V. Putin emphasized the necessity to overcome destructive trends in the Russian innovation sector, saying: 'The global economy needs innovation breakthrough. New economic centres are obviously going to appear all over the world. One of them can be in Moscow. Membership in the WTO, establishment of the Common Economic Space with Kazakhstan and Belarus make up promises for leadership. Russia is the sixth largest economy in the world and the third country richest in the gold reserves. However, according to the investment climate, we are shamefully rated 120 in the world. Unfortunately, poor realization of the rich potential is Russian's historical problem. Our short-term goal is to join the list of countries with most favourable business climate. We have to move 100 steps ahead, rated from 120 to 20».

Timely achievement of such important and indispensable goals, contributing to the steady scientific and technological development of the country, is impossible without establishing and stimulating the effective mechanism of public-private partnership in the Russian economy. Thus effective and proper implementation of public-private partnership is an essential prerequisite for the onward social and economic development of the country.

«By priority economic indices Russia keeps up with other EU countries, -stated President V. Putin at the Capital Investment Forum «Russia 2012», − but by productivity Russia 2.6 times lags behind; by energy usage effectiveness − thrice behind, GDP per capita − twice behind. Moreover, Russia lags behind in competitiveness. The latter is associated with the quality of professional resources and the ability to establish innovation economic system.

The economic and political structure of government institutions which manage the innovation sector is presented as the aggregate in Fig. 1.

In the process of Russia's innovative development, the regional component of the scientific and technological progress is gradually becoming more important, as the regionalization of R&D activities has gained the governmental support. This reflects the current market-institutional situation, socio-economic regularities and democratization trends in the Russian society. Innovation changes in the Russian economy have enabled to activate the processes of decentralizing scientific and technological management, delegating the rights of R&D ownership to the regions, taking responsibility for design and production of high technological products. This has dramatically modified the social, economic and political status of the Russian Federation subjects.

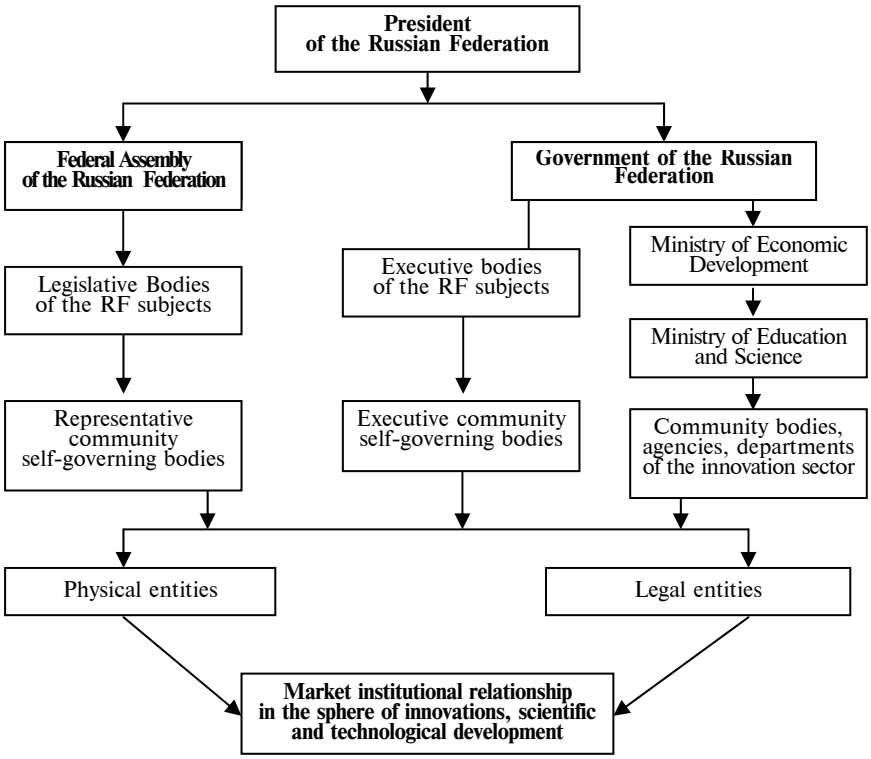

Fig. 1. Differentiation structure of the market-institutional management of the innovation development in Russia

Besides, it adds the R&D importance to North West Federal District, Russia. With its highest intellectual potential, the District obviously represents the «pole of the innovative growth» of the Russian real economic sector, encourages the development of high technological production and national science-based cluster, makes an unrivalled prerequisite for the scientific and technological breakthrough of the country.

Generalizing the results of researching the conceptual and methodological fundamentals, socio-economic imperatives of the innovative development in the conditions of globalization, evolution and mechanisms of public-private partnership in Russia during world-wide recession, it is necessary to draw the following conclusions:

1. Scientifically, innovation represents the socio-economic outcome of the fruitful and prospective public activity, which integrates creative and intellectual human abilities. Moreover, this outcome is targeted at maximizing the income and competitive advantages of both the economic subject and international community.

2. Globalization as a socio-economic imperative of the public progress regularly stimulates innovation clusters and venture activity, intensive labour division, deeper specialization of R&D production, economizing at the expense of production/ sales, cutting costs. It also contributes to the optimal allocation of resources throughout the world.

3. Stochastic market-institutional conditions of globalization permanently complicate the economic structure with such dominating elements as interindustrial science-based clusters which transform changing market science-based industrial relationships into pre-planned ones with the emphasis on such a finance and investment activity as venture business.

4. The evolution of the innovation sector led to the two autonomous paradigms in the high technological development – Eurasian and American – whose principles are of great R&D importance at the current transitional stage of forming the national innovation policy in Russia.

5. Main strategic factors of the steady innovation development are as follows: scientific and technological (forming and operating high technological clusters in order to improve

production facilities of the economic subjects); social and economic (implementation of socio-economic stimulators of the technological progress); managerial (creation and introduction of innovation algorithms to plan and manage industrial economic activity); legal (establishment of the effective economic and legal mechanisms to regulate the innovation and technological spheres).

6. While forming the Russian innovation strategy, a great socio-economic significance is given to algorithms of public-private partnership as market-institutional consensus between the government and business leading to the timely and effective realization of innovation projects in the polymorphous area of research. This partnership is based on the joint activity of state research and educational institutions; federal unitary enterprises; private industrial, financial and innovative business.

7. Public-private partnership as a socio-economic alliance is aggregated with the industrial and financial potential of state and entrepreneurial institutions which stimulate the development of the innovation system, on the one hand, and contribute to the polymorphous investments into the Russian innovation sector, on the other hand.

8. Putting to practice the innovation activity of the Russian economic subjects, aimed at the maximum realization of the socio-economic potential of the public-private partnership, will contribute to the modernization of the national industrial complex, formation of the high technological cluster on the basis of world scientific achievements, effective commercialization of the research outcome, implementation of the high technological development strategy, establishment of the socio-economic fundamentals for the Russian innovation community.

9. The issues of scientific interest are as follows: computational and analytical research of regional priorities, problems and development specifics of public-private partnership clusters as a whole and venture business in particular; verification of results with empirical and factual information attributed to the economic activity of subjects in North West Federal District, which is a representative scientific and industrial region in Russia and one of the largest development centers in Europe.

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NATURAL SCIENCE AND ENGINEERING METHODS IN THE INSTITUTIONAL ECONOMY

Е.Б. Колбачев, М.В. Передерий

ЕСТЕСТВЕННОНАУЧНЫЕ И ИНЖЕНЕРНЫЕ МЕТОДЫ В ИНСТИТУЦИОНАЛЬНОЙ ЭКОНОМИКЕ

The article gives an overview of modern trends of rooting scientific and engineering methods in economics and management. The article shows feasibility of their usage in solving problems of institutional economics – in particular, in order to prevent opportunism that takes place at the moment of conclusion of contracts for research and project works.

INSTITUTIONAL ECONOMICS. OPPORTUNISM. CONTRACTS. R&D ACTIVITIES. NATURAL SCIENCE METHODS. ENGINEERING METHODS. TECHNOLOGICAL MODE

Рассмотрены современные тенденции укоренения естественнонаучных и инженерных методов в экономике и менеджменте. Показана целесообразность их использования при решении задач институциональной экономике. В частности – для предотвращения оппортунизма при заключении контрактов на выполнение исследовательских и проектных работ.

ИНСТИТУЦИОНАЛЬНАЯ ЭКОНОМИКА. ОППОРТУНИЗМ. КОНТРАКТЫ. НИОКР. ЕСТЕСТВЕННОНАУЧНЫЕ МЕТОДЫ. ИНЖЕНЕРНЫЕ МЕТОДЫ. ТЕХНОЛОГИЧЕСКИЕ УКЛАДЫ.

Intensive development and application of methods of natural sciences and engineering methods in economics and management have begun about thirty years ago. There have been several reasons for that: first of all, there has been a dissatisfaction of traditional explanations of economic processes and phenomena; secondly, financial data mismatch with existed theoretical models, and thirdly, an imperfection of monetary valuation. A well-known academician L.I. Abalkin wrote about the construction of methodology of evolutionary economics: «... Dissatisfaction of science with its state is the first sign of exhaustion of the old paradigm and emergence of new needs. Its birth and further adoption is long and difficult process. At the first stage the system of analogs is used as a powerful incentive, addressing to the methods of other sciences with an established reputation. Such sciences are, for example, biology, genetics and thermodynamics, widely used ... in the analysis of cyclical dynamics of economic processes, or more generally – in constructing a theory of evolutionary economics...» [1]. Number of studies in recent years is devoted to the usage of natural science methods in economics and management [2, 3]. The position of the Russian Foundation of Fundamental Research seems to be interesting in part of establishing in 2013 the nomination of «natural science research methods in the humanities» [4].

Considering the ratio of monetary and natural indicators in economic systems, it is necessary to pay attention to the fact that it reflects an intense process of rapprochement between the natural and social sciences, which is a characteristic feature of modern scientific and technological revolution.

Use of scientific concepts in the economy of natural and technical sciences increases awareness of such features of economic (production, in particular) systems, as the absence of constant parameters in the processes, rapid changes of previously established trends, uncertainty of occurrence of specific events (e. g., crises), low predictability of dynamics in economic development.

The set of scientific and engineering methods, which have found its application in economics and management, is presented on Fig. 1.

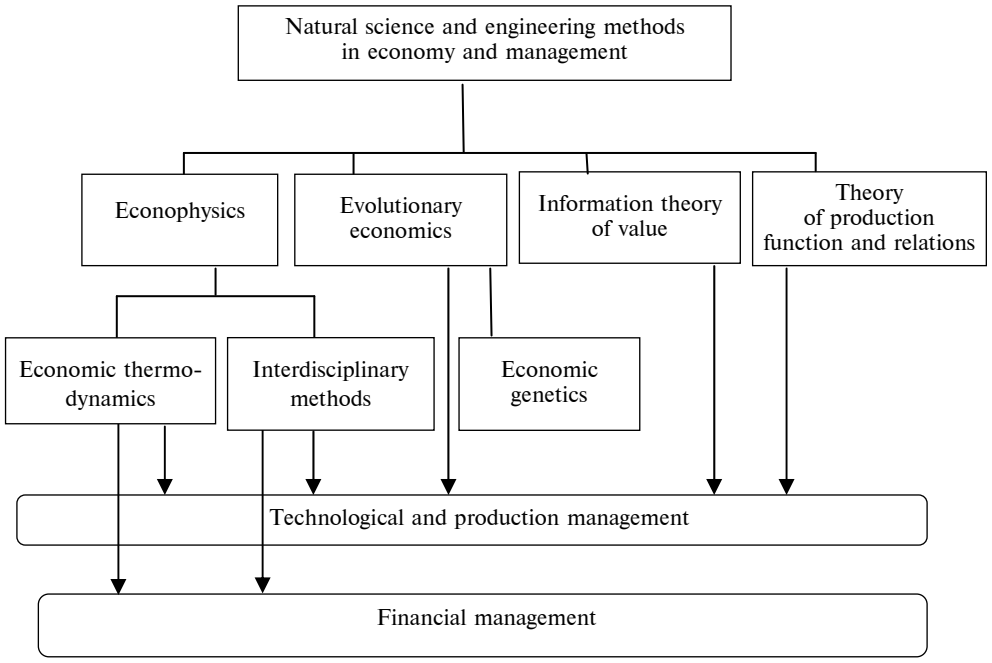

Fig. 1. Natural science and engineering methods in economy and managemen

The special place among them has econophysics, which appeared as the result of the researches in field of securities profitability dynamics, distribution of wealth and income in society using the methods of statistical physics, application of models of quantum mechanics to study the interaction of economic agents (similar to the interaction of elementary particles) .

It is possible to define two directions of econophysics development: based on the use of thermodynamics [5] and «interdisciplinary» direction, based on the integrated use of physical models and methods [6].

In our opinion, use of natural science methods in combination with methods of institutional economics seems to be promising – for example, in solving problems of preventing opportunistic behavior of market participants.

Let us take an example of contracts concluded in the field of engineering projects, research and development, engineering services. In fact, in this case we can talk about the activities of certain organizations related to the transfer of information and proprietary rights of creators of intellectual goods (manufacturers) to other subjects – consumers – under certain conditions.

In this case, there is a possibility of opportunistic behavior of developers interested in getting orders and information asymmetry, in which the customer of the project doesn't have full information about its parameters, and the developer does not know about real intentions of the buyer regarding the use of this project. The possibility of opportunistic behavior (from the side of sellers (developers) and from the side of customers (investors) reduces significantly in case a good tool is used for evaluation, that allows to quantify the qualitative characteristics of a product. Here integrated assessment is very important, because it allows to compare development of different sub-parameters. In the conditions of R&D that can be done by referring the analyzed project to a specific technological way.

In this case, to solve the problem of choosing the optimal technological options it is inevitable to use methods and tools borrowed from the natural sciences and engineering. Talking about it, it is necessary to note the attention that was paid to this question by various researchers, who considered ways of improving of economic development, its methodology and tools. During an integrated assessment of trust qualities of developments undertaken under engineering services, as noted above, it is perspective to assign the analyzed development to a particular technological system.

Table 1

Technological relations and the production functions [7]

Technological relations type	Function number	Function name
Pragmatic	1	Goal-setting, choosing the product to manufacture
	2	Grounding the product characteristics
	3	Developing the action program for the industrial engineering
Syntactic	4	Choosing the possible technologies
	5	Choosing the technological relations
	6	Grounding the production relations system
Semantic	7	Developing the technological processes system
	8	Fine-tuning of the technological processes
	9	Combination of the manual labor and machinery work
Cognitive and Emotional	10	Developing the system of the instrumental regulators
	11	Means of the instrumental operations' regulating
	12	Regulating of the instrumental process
Material	13	Investment goods reproduction
	14	Product reproduction
	15	Instrumental operating a subject of labor

In role of quantitative characteristic of technological structure can be a degree of materialization of information in production systems, deepening during transition from the previous mode to the next. As the most interesting approach in this field, we can mark out O.M. Yunya approach [7], who considered some technological relationships and functions implemented in any production system (Tab. 1). This approach can be used in the analysis of changes in information relationships within different technological structures.

The evolution of production systems brings changes to the information content of the labor process and the nature of media relevant information that determines the shape of the production system inherent in this or that technological way.

According to the mentioned above, the information processes which are materializing at cannon, machine and information stages of production development are shown in Tab. 2, made on the basis of [8]. The second quantitative characteristic of technological way is the dimensional scale of shaping processes, which is characteristic for the dominating technology causing economic results of production (Tab. 2).

The dimensional scale of shaping processes during the transition from previous to the subsequent technological way decreased. Within 1–4 ways it was connected with increase of dimensional accuracy of products of the mechanical engineering, causing their operational parameters, the fifth way was connected with emergence and development of the microelectronics operating with dimensional parameters of few microns.

Consideration of changes of materialization degree of information and dimensional scale of shaping processes corresponds to conceptual situation when each condition of a trajectory of economic development is defined by whole previous evolution of production systems [9, 12].

It is obvious that the sixth technological stage is marked by the next reduction of dimensional scales of shaping processes. It fully corresponds to results of researches successfully conducted now of the natural and live systems operated by behavior of nuclear and molecular objects from 0.1 nanometer to 100 nanometers in size.

Table 2

Timeframes and the basic characteristics of the technological orders

Time frame	Dominant techno-logical order	Characteristics of the technological order				
		Production development step	Basic economic resource	Dominant management concept	Level of the information's materialization	Dimension scale of the forming processes
1	2	3	4	5	6	7
1830	1	Instrumental	Materials (natural stuff)	Basic production management	15–11	1–0.2 mm
1880	2	Machine	Energy		11–10	100–50 micron
1920	3			Production management		50–10 micron
1950	4			Management of the enterprise	9	
1980	5	Informational	Information	Business management	8–6	10–0.5 micron
1995				Cost management		
2015	6			Managing the technological efficiency	5–2	100–0.1 nanometer

Transfer of shaping processes carried out within the sixth technological way on a nanolevel can lead to conceptual changes in the economic tools used in management of production systems in general and in rendering engineering services, in particular. It is obviously important that in this case the concept of extremely effective technologies offered in the mid-eighties of the last century [10] and gaining development nowadays [11, 13] can be almost realized. In this case as the extremely effective the technology providing the greatest possible exit of a target product (100% selectivity of the process) is understood. Degree of approach of real technology to extremely effective, which leads, first of all, to decrease in specific expenses for production, can be considered as an indicator of production efficiency.

The aforesaid represents a private example of successful use of natural-science methodology in the solution of tasks of the research and development and engineering activity – the most important transactional institute of intellectual mediation.

The assessment of projects by their reference to a certain technological way is used now in the engineering company «Polytech» and at the Southern Russian State Polytechnical University.

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CURRENT ISSUES OF THE RUSSIAN INDUSTRIAL POLICY

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АКТУАЛЬНЫЕ ВОПРОСЫ ПРОМЫШЛЕННОЙ ПОЛИТИКИ РОССИИ

The paper substantiates the importance of regulation of the industrial development in modern Russia; the problems of industrial enterprises and the existing sectoral priorities are discussed, the draft federal law «On industrial policy» is analyzed, and issues that may remain unresolved, if adopted, are identified.

ECONOMIC POLICY. INDUSTRIAL POLICY. INDUSTRIAL DEVELOPMENT. REGIONAL DEVELOPMENT. ECONOMIC REGULATION.

Обоснована актуальность регулирования промышленного развития в современной России, рассмотрены проблемы производственных предприятий и существующие отраслевые приоритеты, проанализирован Проект федерального закона «О промышленной политике» и выявлены вопросы, которые в случае его принятия могут остаться неурегулированными.

ЭКОНОМИЧЕСКАЯ ПОЛИТИКА. ПРОМЫШЛЕННАЯ ПОЛИТИКА. ПРОМЫШЛЕННОЕ РАЗВИТИЕ. РЕГИОНАЛЬНОЕ РАЗВИТИЕ. ГОСУДАРСТВЕННОЕ РЕГУЛИРОВАНИЕ ЭКОНОМИКИ.

Since the mid-1990s, the strengthening of the role of government has been a typical trend in the development of national economies. On the one hand, the government is responsible for the production of public goods; on the other hand, the government performs a regulatory function, creates and remodels market institutes, establishes rules for their operation [1].

The forms and methods of the governmental influence on economic processes are diverse. However, the regulation by establishing for businesses such «rules of the game» which lead to the desired results due to objective economic laws is preferable in a market economy compared to the direct impact or the setting of operation standards.

Important instruments of influence on the economic processes are strategic concepts, macroeconomic targets, indicative planning, and target-oriented development programs.

Macroeconomic, industrial, budget, tax, social, foreign and regional policies may be distinguished within the governmental economic policy depending on the regulation objects and objectives. All economic policies are closely interrelated. Their goals, objectives, methods of execution and control, resource provision and the expected results should be coordinated and aligned in a comprehensive strategic plan that includes a system of priorities, implementation phases, key indicators and possible alternatives.

An interest in the industrial policy has noticeably increased in Russia recently. The industrial policy has long been virtually ignored by the government. The researchers believe the main reason that caused the interest are serious problems in the Russian economy that cannot be solved only by the efforts of the business community which is now looking for new approaches to the government industrial policy [2, 16].

In 2010, when the industrial production index in the manufacturing sector was equal to 11.8 %, the debate about the role of industrial policy, the quality, quantity and the set of mechanisms attributed to this field seemed to be caused by the significant growth of the industrial

performance in the manufacturing sector [3]. However, in 2011, the index fell to 6.5 % and in 2012 – to 4.1 %. In various sectors of industry indices do not move synchronously and the level of the year 1991 was reached only in the energy minerals production [4].

In our opinion, an actualization of the industrial policy, an acute need for its development and implementation are evoked by objective processes in the Russian economy; and first of all, by a need to overcome the technological backwardness of the industrial capacity compared to most developed countries.

The Russian industry is currently characterized by the following problems related to the industrial policy:

1) a considerable wear and obsolescence of fixed assets. According to the State Statistics Committee, the depreciation of fixed assets of the manufacturing industry as a whole amounted to 43.4 % at the end of 2012 [5]. The depreciation of fixed assets, which in some areas reaches from 50 % to 75 %, does not allow Russian companies to produce products that meet the international requirements;

2) insufficient investment, low availability of credit resources inhibit the modernization and replacement of fixed assets. In practice, investments are made only in the most prosperous enterprises while other companies experience investment shortage. The share of investment in fixed assets constitutes slightly more than 13 % of the total investment in the economy and 16.8 % of the total book value of fixed assets in the manufacturing sector [5]. The lack of investment is compounded by capital outflows from the country, which, according to the Central Bank, constitutes more than $ 60 billion a year. This amount is more than 15 % of the total volume of investment in fixed assets in 2012;

3) the absence of the tax and monetary incentive instruments;

4) the ack of a transparent and supportive administration;

5) the lack of qualified specialists in industry.

The reasons mentioned above lead to the closure of businesses, to unemployment growth and, consequently, to a decrease in real incomes of the population.

Currently, the legislation base of the industrial policy in Russia includes nearly 60 federal laws, a number of Presidential decrees and orders, and nearly 100 governmental decisions and orders. Five major state programs on the development of the most important sectors of industry were developed and adopted to implement the Presidential Decree of 07.05.2012 № 596 «On the long-term national economic policy»: «The development of the aviation industry in 2013–2025», «The development of shipbuilding in 2013–2030», «The development of the electronic industry in 2013–2025», «The development of the pharmaceutical and medical industry in 2013-2020», «The development of industry and its competitiveness».

The concept of long-term socio-economic development of the Russian Federation until 2020, approved by the Federal Government on November 17, 2008 № 1662-r, states that the most important sector of knowledge, employment and income generation during the next 10 – 15 years will be basic industries, transport, construction, and agricultural sectors. Russia has a significant competitive advantage in these sectors. However, it is here that the main growth barriers and performance failures have been accumulated [6].

The concept determines the following priority industries: aircraft engineering, motor engineering, rocket and space industry, shipbuilding, radio electronics, atomic energy, information and communication technology [7].

The final products of these industries have stable and growing markets abroad. Currently, the share of high-tech industries in the Russian industrial export equals 7 %, is much below the average 23–25 % for the OECD countries [8].

As a result of the governmental programs, by 2020 Russia it is expected to create new full-fledged infrastructure of industries including embedded innovative industries and research centers of the leading global corporations, to carry out the modernization of fixed assets, to expand the range and volume of production, to increase the competitiveness of Russian enterprises.

However, the adverse situation caused by the industrial growth slowdown cannot be overcome by creating separate innovation centers or by the conversion of some enterprises to a new level of technology. An appropriate overall level of technological development in the manufacturing industry ought to be established to bring pilot samples into industrial series successfully.

The world experience shows that only the overall level of industrial development that can ensure the effective implementation of scientific development in the mass production capable of conquering world markets [9].

A holistic system of measures to support and develop industry is necessary to jump from the exploitation of the existing production capacities to the modernization and the creation of new industries.

The federal law on industrial policy should become a legal foundation of a long-term governmental industrial policy. The adoption of such a law is particularly relevant in terms of the WTO membership; it requires integrated measures to stimulate the development of separate industries.

The ministry of Industry and Trade of the Russian Federation presented a Draft Federal Law «On industrial policy in the Russian Federation», which is currently undergoing public consultation.

In accordance with the project «industrial policy is a set of legal, economic, organizational, educational, informational, social, infrastructural and other measures of governmental exposure to industrial activities aimed at the development of the industrial potential of the Russian Federation, providing competitive products, balanced and sustainable development of the industry for socio -economic development and security of the Russian Federation» [6].

The industrial policy is aimed at regulating the activities of economic entities as a whole and individual aspects related to the acquisition of production factors, manufacturing, distribution and sale of goods and services. The active role of the government should be combined with the use of effective market mechanisms. Regulation should cover all phases of the entity's life cycle and the life cycle of its products.

In accordance with the definition of industrial activities used in the draft law the area of industrial policy regulation includes only manufacturing industries. In our view, taking into account the urgent need for fixed assets updating and modernization in manufacturing industries, the construction complex ought to be included into the legal field of the industrial policy.

The industrial policy in different countries as well as in a country in different historical periods differs in its purposes and the composition of its methods and tools.

Depending on the priority goals, three types of the industrial policy can be distinguished:

1. structural policy, encouraging cross-sectoral and cross-regional capital cross flows for financing the changes in the sectoral and regional industry structure in line with the objectives of the industrial policy;

2. investment policy, providing and stimulating investments into the industrial development and infrastructure;

3. innovative policy, facilitating the interaction of business, scientific and innovative structures, the formation of the incentives to innovative economic activities, the establishment of governmental guidelines for an innovative model of development [10].

A traditional type of the sectoral industrial policy which influences the relative importance of individual industries and enterprises is called «vertical politics» and a new functional type is named «horizontal policies». The latter includes activities common to a large number of industries and enterprises in the fields of legislative support, protection of property rights, administrative barriers elimination, promote innovation and others. On the horizontal type of policy emphasizes the European Commission – the supreme body of the EU executive which proposes measures to ensure the competitiveness of the European manufacturing industry as the most innovations take place just in this area [11].

The objectives of the industrial policy of the Russian Federation stated in the draft law are a stable and innovative industrial development, the achievement and maintenance of high competitiveness of the national economy, providing on that basis the solution of social problems and the national security of the Russian Federation [5].

Thus, an innovation-oriented model of the industrial policy is declared a priority. However, under the circumstances, the Russian business has little incentive to increase innovation. The reasons lie in the strong competition from foreign high-tech companies, in the backwardness of the domestic technological base, and the lack of qualified personnel. So the government must execute the role of an innovative locomotive engine in Russia increasing the budget allocation to the science and technology development [12].

The industrial policy as a governmental activity in creating a framework for economic

entities affects the investment process because the flows of capital and investments are closely related [13]. Taking into account the situation of the manufacturing industry capital base, it can be concluded that the priorities of innovation model cannot be achieved without a coherent innovation policy providing the reproduction of fixed assets in the sectors where the pace of technological progress is relatively low alongside with investment in innovation.

The draft law proposes the following measures of financial support for enterprises:

1) the establishment of industry-specific development funds for lending to enterprises on terms competitive with the terms of lending in foreign countries;

2) the provision of subsidies for reimbursement of incurred and financing new spending on a competitive basis;

3) a special tax treatment or benefits for industrial clusters and industrial parks, for companies engaged in industrial leasing and companies executing projects of environmental safety improvement for industrial plants.

Under the conditions of resource limitations, the industrial policy improves the position of some sectors of economy and industry due to the relative deterioration of the other sectors [14].

Let us note that the industrial policy is effective only if the long-term benefit from the development of priority sectors exceeds the potential damage from slowing down others.

Regional industrial policy should be included into the federal industrial policy and coordinated with it in terms of goals, objectives and directions. A high degree of regional differentiation of industrial development in Russia and significant differences in the level and quality of life indicate the importance of regional industrial policy which aims to increase the competitiveness of industrial enterprises, to create accumulation funds for public needs. It is important to build approaches to formation of regional industrial policy priorities based on the type, stage of development and specificity of each region [15]. To date, the laws on industrial policy adopted in more than 40 regions of the Russian Federation.

It should be noted that the draft law does not establish any sectoral or regional priorities for the industrial development. Nor is the procedure for establishing these priorities and mechanisms for evaluating the results of the industrial policy implementation that shifts these important problems into sublegislative and to regional level and creates the potential reinforcement of existing imbalances of the industrial and regional development.

Thus, being necessary and timely the Draft Federal Law «On industrial policy of Russian Federation» does not provide adequate regulation of a number of important issues.

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THE ANALYSIS OF THE STATE OF INDUSTRIAL R&D ORGANIZATIONS IN ST. PETERSBURG

С.Ф. Давидюк, Е.П. Давидюк, Г.И. Дмитриев

АНАЛИЗ СОСТОЯНИЯ ПРОМЫШЛЕННЫХ НАУЧНО-ИССЛЕДОВАТЕЛЬСКИХ ОРГАНИЗАЦИЙ В САНКТ-ПЕТЕРБУРГЕ

The article presents and analyzes the results of the statistical survey of the R&D organizations and several innovation enterprises from the industrial sector of St. Petersburg in 2012.

ANALYSIS. R&D ORGANIZATIONS. INNOVATION STATISTICS. REGION. INDUSTRIAL ENTERPRISES. ST. PETERSBURG.

Содержит и анализирует результаты статистического обследования научных организаций, которые относились к промышленному сектору, а также ряд инновационных предприятий Санкт-Петербурга в 2012 году.

АНАЛИЗ. НАУЧНО-ИССЛЕДОВАТЕЛЬСКИЕ ОРГАНИЗАЦИИ. ИННОВАЦИОННАЯ СТАТИСТИКА. РЕГИОН. ПРОМЫШЛЕННЫЕ ПРЕДПРИЯТИЯ. САНКТ-ПЕТЕРБУРГ.

An analysis and assessment of innovation in any region of the Russian Federation has been always problematic due to the lack of statistical data, and sometimes even due to its complete absence. The political breakup of the Soviet Union in the 1990s has led not only to the collapse of the Soviet economy, but also dissolved the industrial and technological relations established between enterprises earlier.

This survey, conducted by» The North-Western Scientific-Methodical Center» at St. Petersburg State Electrotechnical University «LETI» in 2013, overviews the industrial R&D sector and provides additional material for the analysis of innovation in the regions of the Russian Federation. Moreover, this article allows to assess the scale, the structural characteristics, trends and, to some extent, the effectiveness of the current innovation in St. Petersburg.

The authors collected data from 307 scientific and educational institutions in St. Petersburg. Among them, 156 organizations were industrial companies and institutions which conducted R&D and innovation activities [4]. Furthermore, 94 of these companies and institutions were privately-owned and the rest – under the government jurisdiction of the Russian Federation. In addition, the survey overviewed 12 innovation – technological centers, which accounted for about a third of all the technology business centers and business incubators located in the city. That is, this survey covered all major types of urban organizations according to their scientific activities and property ownership. Although this survey is based mainly on the data collected from 2012, the authors refer to data collected earlier (during 2010 and 2011) in order to assess trends. It should be noted that this survey covers only the innovation centers from the manufacturing industry mainly.

By the beginning of 2013, the analyzed industrial sector of R&D employed the majority of scientific manpower in the city. That is, 48.7 per cent of all personnel were employed by the organizations surveyed in this article, including 5,700 scientists with PhD degrees; the rest were employed in academic organizations and universities. The cumulative annual funding of the surveyed industrial organizations was US$2.25b [1]; this funding included own capital

of business organizations – 45.3 per cent and state federal funds – 44.7 per cent; the share of foreign investments and the funds allocated from the city budget was low (3.4 per cent and 1.2 per cent respectively). Traditionally, industrial R&D organizations in the region carried out the goverment – sponsored projects. These projects dealt with the design and development of dual – use technologies and their manufacturing process on the production facilities of the city.

The main part of all received funding (70.2 per cent) intended to the completion of the government programs in the high – priority areas of science, technology and engineering of the Russian Federation, of which nearly half of the funding was intended for the development of advanced types of military and specialized equipment, 14.9 per cent – for conducting R&D in energy efficiency and energy saving programs, 13.7 per cent – for projects dealing with transportation and aerospace, 9.4 per cent – for environmental management projects and 8.4 per cent – for programs in the IT and telecom sector. Another part of the funding (US$678.5m) ensured the implementation of a number of targeted federal programs, including 36.8 per cent for various projects in the field of civil marine equipment (these projects will complete by 2016) and nearly as many (33.9 per cent) – for the projects in the field of electrical and electronic engineering (these projects will complete already during 2015), 8.5 per cent – for the R&D projects in the field of security, and 7.6 per cent – for the development of nuclear energy technologies of the next generation. The funding allocated for targeted federal programs focused on nuclear energy and related technologies included short-term funding (until 2015) and long-term funding (until 2020). While evaluating the financial structure of R&D projects and programs, it should be noted that the majority of R&D activities focused on the traditional industrial specialization of St.Petersburg, such as electronics, heavy machinery, energy and shipbuilding.

The effectiveness of R&D activities can be noted in the fact that the surveyed R&D centers published in various international venues and books 41 monographs (every 13th of all published monographs that year), 516 articles and 234 various publications only during 2012. The goverment – owned organizations had the largest share in all types of publications (90 per cent of all published monographs, 75 per cent of scientific articles and 96 per cent of textbooks and teaching aids).

The privately-owned institutes contributed mainly by publishing articles – 25 per cent, however only one out of 17 articles was published in international venues. In contrast, government -owned organizations published one out of 8 articles.

At the same time, the number of intellectual property objects created by privately- owned R&D organizations was higher. That is, privately-owned R&D centers registered abroad 21 patents in 2012 (75 per cent of all the patents registered abroad by this group of organizations). In addition, these organizations obtained 1349 patents in Russia (51 per cent), 70 industrial design patents (96 per cent), 464 patents for utility models (68 per cent), 594 registration certificates for databases and topologies of integrated circuits (64 per cent) and 121 know-how certificates (41 per cent). The share of private R&D centers (compared to the total number of patent applications) was 57.7 per cent, and all the patent applications registered abroad (there were 24 of them) were from private R&D centers.

During 2012, private R&D organizations received US$3.54m from sales of their intellectual property (97 per cent of sales of intellectual property among all surveyed institutions). Besides, private R&D organizations received US$1.6m (87.9 per cent) from production and sales during the same year, including sales of intellectual property US$0.52m (86.2 per cent). These organizations earned US$0.49m (96 per cent, i. e. almost the entire amount of sales abroad) [4, 11].

The analysis of trends and dynamics of these indicators is currently difficult; as such analysis requires a deep systematization and existence of a comparable range of surveyed enterprises and organizations. In addition, such kind of data and analysis is reliable and meaningful only regarding patents and patent applications confirmed by existing registration documents. The most general estimate of the dynamics of indicators of the analyzed R&D sector is unstable. However, it should be noted that these performance

characteristics are significantly inferior than the ones of major R&D centers of leading industrialized countries.

In 2011, the sales volume of innovation products and services in St. Petersburg was equal to US$5.2b, amounting to only 9 per cent of the total sales across all categories of products and services, which is obviously lower than the scientific and technical potential of the city [2, pp. 30–33]. In 2012 only the academic R&D organizations (which were covered in the referenced survey), manufactured products and services for US$1.8b, of which at least one third were related to innovation products (34.4 per cent). These sales volumes are lower than the ones in leading industrialized countries. While the typical problem is the insufficient adoption of results of R&D activities, the interaction between science and industry in the city needs to be improved. The state program titled «the Science. Industry, Innovations in St. Petersburg during 2012–2015 years», funded US$153.75m for the whole duration, aims to solve some of these problems.

It is a publicly known fact that St. Petersburg as well as the whole country need to implement active measures to stimulate small business. This is particularly important in case of small innovation business, as the results of this survey confirm the economic impact of innovation on business in general. Thus, the average number of patents, certificates and know-how applications registered by the companies – residents is 20.7 items, while the same indicator is only 6.3 items among all surveyed organizations. This suggests that certain most active and successful researchers are trying to commercialize the results of R&D activities in technology centers, business incubators and innovation centers. According to the survey in 2012, it resulted in the creation of 272 research spin-off companies, with about a fifth of these companies being started by young scientists and specialists. The spin-off companies hosted by business incubators and technology centers were the most initiative in attracting different forms of funding to finance their activities. Our analysis shows that the funding received by the research spin-off companies (resulted from academia) was mainly from non-governmental sources (91 per cent), while corporate (i. e. industry) spin-offs received the majority of their funding from various federal target programs (74 per cent).

The analysis of general conditions of business development in the largest cities of the Russian Federation, conducted with the assistance of the World Bank in 2012, showed that St. Petersburg was ranked only the 27th out of 30 surveyed cities in the Russian Federation [3, p. 2]. This, undoubtedly, has a negative effect on the development of innovative business opportunities [10, 13, 17, 21].

The Venture Capital Assistance Fund has recently made certain steps to change this situation and is contributing to the financing of the development of small innovative enterprises in R&D sphere of St. Petersburg. In addition, according to the Public Council for Small Business Development affiliated with the administration of St. Petersburg, one of the possible ways to revitalize innovation activity of small business could be the creation of an organization which will act like the official representative of the Federal Fund for Supporting Small Innovative R&D Enterprises on the basis of the technology center «Polytechnic». The Fund and St. Petersburg administration committee for Science and Higher Education have already signed an agreement on the creation of the representative. This action is vital as the Fund is currently financing a large part of the surveyed R&D organizations (US$0.196m) and the number of research projects completed in 2012, the results of which are ready for use equels 5285. Taking in account the ambiguity and subjectivity of the latter indicator, the gap is too large; a significant part of the city's science potential has not yet been utilized fully.

The city, particularly, needs innovation in the following five industrial areas: automotive, food processing, mechanical engineering and electronics, energy equipment manufacturing, and shipbuilding. The last three areas urgently require high-priority financial and organizational support from both the federal and the city governments. This is especially important since the government funding allocated for different levels of regional R&D industrial sector amounts to about half of all funding which is vitally important for the whole industry.

Traditionally, the success of innovation depends on how effective is the interaction and

the relationship between the R&D organizations and the industry. In addition, innovation of the industrial sector of St. Petersburg is largely determined by the conditions and development perspectives of the largest industrial enterprises of the city. Although the latter do continue to make profits, they are not in their best shape [13–15].

During the period of reforms, the amount of state-funded projects for typical products (energy equipment, ships, optical and wireless hardware) has decreased significantly; the depreciation and obsolescence of infrastructure on many factory sites reached 75–80 per cent; the factories experience lack of qualified personnel. Despite this, about a third of all 700 large and medium-sized enterprises in the city can be attributed as innovation enterprises, and their production processes are often based on the technologies and equipment imported from abroad.

Several large industrial associations either have ceased to exist (e.g. the «Sverdlov Factory» or the «Turbine Blades factory»), or have partially changed their product lines (like the «Izhorskij plant» and the «Kirov plant») [16].

Former highly specialized enterprises are overcoming economic difficulties and struggling with restructuring their product lines. For example, the Kirov plant which produced only tractors previously, started to manufacture subway carriages, trams and double-decker trains from 2013; manufacturing takes place in the Kirov-Skoda plant. The rolling stock has been designed by foreign specialists from the Skoda-Transportation while the majority of assembly lines and production processes used imported ready-made components. And only by the end of 2014, the management was tasked to achieve 60 per cent localization level of the local production. Although the success of this particular example of new products development can not be considered as an achievement of Russian science, it allows the plant to count on possible large state-sponsored orders in future. Another company, «The Kirov-Energomash» (the subsidiary of «the Kirov plant»), is going to revive its turbine production as it has received an order for the production of a steam turbine for the new nuclear icebreaker which is being built at the Baltic Shipyard. It is planning to utilize its proprietary technology already developed by Russian specialists. The implementation of this large order (US$61.3m) has already begun, although some legal issues need to be settled still [16, pp. 50–51].

The lack of large-scale state orders is one of the major problem that the plants are facing in the region. Although they may potentially acquire goverment orders by participating in state tenders, however this requires them either to change their production (partially or entirely) or to install and utilize new technologies and, therefore, conduct expensive upgrades of their production equipment. Pressed to survive in absence of adequate funding, many plants were forced to lease their production areas; often by converting them into office spaces for independent small and medium-sized enterprises. As large plants occupy considerable space in the urban areas where prices often reach as high as US$250 per square meter, these plants have a relatively low but steady income. Obviously, such economic activity does not stimulate innovation and generates low income for the city budget. It might be economically profitable to demolish these factories in order to use the site for residential buildings, shopping centers and other commercial real estate. Furthermore, is not always profitable for investors to rent existing production lines and areas on city's old factories when new smaller factories are created. As a result, Siemens is currently building new factory buildings for their production and maintenance lines of 172 and 295 MW gas turbines in Gorelovo community in St. Petersburg suburbs. «The Siemens factory» is expected to reach its full capacity production by 2018. However, by the end of 2014 only, the city lost about US$377m in potential investments, a possibility to organize a state-of-the-art high-technology production and to improve the situation at the labor market of highly-skilled professionals. To attract even more investors to the region, the government offers a number of tax exemptions: a zero tax rate for commercial real estate and a low income tax rate (13.5 per cent vs. usual 24.5 per cent) during the investment payback period [12, 15, p. 6].

Thus, the regional financial policy and active lobbying of the city's interests are closely related with the city's innovation climate and the ability to upgrade and rebuild its industrial infrastructure. For the sake of development of

the region, the city administration needs to take into account that currently city's industrial enterprises are focused too much on manufacturing large-scale machinery. Hence, for objective reasons, these enterprises have a relatively low level of R&D and weakly stimulate innovative activity. In contrast, the most modern high-technology manufacturing factories are located in urban areas; these are mainly medium and small-scale factories which are characterized by flexible management, focus on manufacturing high-technology products with a low consumption of raw materials and energy, and involvement of highly-skilled labor.

The industrial policy of the city should contain clear aims to support only those machinery-manufacturing enterprises which are capable of competing in domestic and foreign markets. Although city's multiple high-technology factories fall into this group, they require investments which exceed the financial capabilities of even largest enterprises. It is a well-known fact that, in order to attract the desired investments, a business needs to provide not only personnel and manufacturing capacities, but also to ensure the efficiency of the manufacturing process, to provide utilities and logistics, and to make sure that the project documentation is approved in a timely manner. Similar requirements are applied effectively in the developing regions of the Russian Federation, e. g. in Tatarstan [18, 20].

The development of shipbuilding as well as heavy machinery industries in the city remains problematic according to experts. M. Remizov, the president of the expert council affiliated with the administration of the Russian Federation, argues that the long-term strategy of the United Shipbuilding Corporation remains insufficiently defined which negatively affects its product line and innovative orientation. The State Scientific Center «Krylovskiy» – the leading research center in the shipbuilding industry, as well as all three St. Petersburg's shipyards which belong to the corporation (i. e. «The Admiralty Shipyards» , «The Baltic Shipyard» and «The Severnaya Shipyard») still determine the production specialization in the industry. Future orders depend on this specialization. These factories and shipyard need a serious modernization of the entire manufacturing infrastructure which will take into account the achievements of the technical progress and new logistics solutions in the global shipbuilding in the recent years. The time and financial costs required for such a modernization could be even higher than building a new manufacturing enterprise in St. Petersburg suburbs. Major investments in the modernization of urban shipyards are certainly justified. Without these investments, the state program «Shipbuilding Development in 2013–2030» (US$7.967b) which allocates only US$824m (8 per cent) for construction and modernization of shipbuilding enterprises will only increase the traditional gap between science and industry and will waste the efforts [16, pp. 31–32].

It should be noted that the foreign car assembly factories located in the city, despite their high-technology manufacturing processes, are far from solving the domestic innovation problems. With the localization level of less than 50 per cent they do not plan to increase the usage of domestic products in perspective. These factories provide employment for a relatively small proportion of a local skilled labor and their taxes correspond only to a small fraction of the city budget, thus minimizing their involvement in the innovative development of the region.

To sum up, St. Petersburg remains the major R&D center in the country, a concrete plan of industrial and innovation development in the long run urgently needs to be created to improve the city's innovation activity. So far, the published version of the state program «The strategy of socio-economic development of St.Petersburg until 2030» [19] raises more questions than gives answers regarding the regional innovation policy. Therefore, in addition to the above-mentioned recommendations, the authors suggest organizational measures which are not limited to direct financing only. These measures should include: the creation of a public system of regional incentives and tax exemptions and a simplification of the bureaucratic procedures required for registering an innovation business. Furthermore, the regional administration should monitor and analyze the innovation situation in the city, in order to be able to coordinate and plan activities of all the participants of the innovation process in the city.

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FORMS OF THE ORGANIZATION AND A TYPOLOGY OF THE INTEGRATED INDUSTRIAL STRUCTURES

А.В. Бабкин

ФОРМЫ ОРГАНИЗАЦИИ И ТИПОЛОГИЯ ИНТЕГРИРОВАННЫХ ПРОМЫШЛЕННЫХ СТРУКТУР

Modern campaigns to definition of the integrated structures on the basis of which the author's concept of «the integrated industrial structure» is formulated are analysed. The essence, the contents and forms of the organization of integration of managing subjects in Russia are revealed. The typology of the integrated structures reflecting their features and characteristic features is given.

THE INNOVATIVE ECONOMY, THE INTEGRATED STRUCTURES, THE INTEGRATED INDUSTRIAL STRUCTURES, CRITERIA OF CLASSIFICATION, TYPOLOGY.

Проанализированы современные походы к определению интегрированных структур, на основе которых сформулировано авторское понятие «интегрированной промышленной структуры». Выявлены сущность, содержание и формы организации интеграции хозяйствующих субъектов в России. Приведена типология интегрированных структур, отражающая их особенности и характерные черты.

ИННОВАЦИОННАЯ ЭКОНОМИКА. ИНТЕГРИРОВАННЫЕ СТРУКТУРЫ. ИНТЕГРИРОВАННЫЕ ПРОМЫШЛЕННЫЕ СТРУКТУРЫ. КРИТЕРИИ КЛАССИФИКАЦИИ. ТИПОЛОГИЯ.

Relevance of the study

The priority of the innovative development of the Russian economy is caused by the state innovative policy where the stimulation of competition is a key motivation factor for the innovative behavior of enterprises. However, the strengthening of competition in the internal and external markets force business entities to look for new opportunities for the effective implementation of business activity. One of the ways that allows enterprises to keep their positions in the market, to minimize risks, and to increase profits is an integration of business entities. Integration permits not only to increase the quality of management, to lower tax burden, to diversify production using surplus resources, but also to produce and to strengthen a synergetic effect of the joint activity, which arises due to the economies of scale [1, 23, 24].

The creation of integrated structures in Russia is defined as a perspective direction of development of the national economy. Joining efforts of business, science, and the state in the priority directions of the modernization and technological development of the industrial sector is one of the principles of the Strategy of innovative development of the Russian Federation till 2020, where special attention is paid to the creation of joint ventures with leading global manufacturers in such branches of the economy as mechanical engineering, pharmaceutics, electronics, and so on.

Thus, the state stimulation of the development of various forms of business entities integration in Russia increases from year to year, specifically this tendency applies to production associations which are known in research literature as integrated industrial structures (IIS) [8, 9, 16, 19, 22].

According to the Federal State Statistics Service of the Russian Federation, there is a tendency of business entities in Russia to integrate. During the period from 2005 to 2011 the number of merges and acquisitions among already existing legal entities increased by 15 %, while among private business this indicator reached 50 % in the same period [1–3, 7].

Comparing the ratio of the legal entities which have undergone processes of merges and acquisitions among all registered enterprises and

the organizations functioning in Russia, including private business, it should be noted that there is a tendency of strengthening the integration between business entities. This tendency is caused by a synergetic effect which is reached due to expansion of production and technological communications of companies, for example, due to sharing raw materials, energy and other resources, material base, merge of the capital and so on. Because of that, limits on cooperation can be lifted, barriers preventing joint economic development can be eliminated, creating favorable conditions for business management. Thus, research into IIS, their features, types and tendencies of development is one of the actual directions of research in modern economics, in particular, in corporate governance.

Purpose of the research

The purpose of the research is to formulate the concept of an «integrated industrial structure» on the basis of research literature analysis, to consider the essence and features of its functioning in the Russian economy, and also to present a typology according to appropriate classification features.

In order to achieve the goal of the research the following tasks are put forward:

1) to analyze modern approaches to the definition of information retrieval system in scientific literature and to specify the concept of information retrieval system;

2) to find out the essence, the contents and forms of the organization of integration of business entities in Russia;

3) to consider classification features of the information retrieval system and to suggest a typology, allowing to reveal their features.

The study of forms and ways of integration of business entities and features of various integrated structures (IS), including the information retrieval system, is one of the actual directions of scientific researches in the Russian economy. In face of globalization, dynamically developing market and increasing competition, the creation of IS is a strategic advantage to national economies, which strengthens their position in the world economic space [23–28].

Let's consider the features of IS development in Russia [4–28].

A rapid development of the integration of business entities in Russia began at the early 1900s. During the Soviet period, the accumulation of experience in the formation of various production structures and associations, including large sectorial and intersectional economic and regional complexes took place. It allowed to gain economies of scale and to simplify planning and control processes [3]. However, in the late 1980s cooperation connections were destroyed, the economic crisis began. Since the 1990s the need to overcome technological backwardness of the industrial enterprises and the activation of the innovative activity caused a new wave of integration, which resulted in the establishment of large corporations uniting a large number of enterprises and companies.

In the early 2000s, two tendencies of the development of integrated units in Russia appeared: strengthening of the state control in the corporate sector of the economy and mediation of private firms in the creation of sectorial, industrial organizations, etc. [12, 19].

The first tendency was outlined in the early 2000s when the first attempts to integrate economic structures being under control of the state were taken, and also attempts to consolidate the state equity stakes and the unitary enterprises [3]. The second tendency was that representatives of private businesses became initiators and mediators in any creation of the integrated structures; they offered specialized services of the creation and organization of business associations [4].

As a whole, the tendency of the creation of integration associations is caused by aspiration to provide stability in noncompetitive fields of the real sector of economy, and also to gain synergetic effect from the joint activity.

In research literature there is no unified definition characterizing the integration of business entities. Such Russian scientists as S.B. Avdashev, I.P. Bojko, I.M. Bunin, E.L.Drachev, A.A. Dynkin, A.M. Liebman, D.S. Lvov, G. Kleyner, Ya.Sh. Pappe, A.S. Pugiyev, A.D. Radygin, A.A. Sokolov, V.P. Chichikanov and others [13–20], were engaged in the research of IS. They introduced such definitions as integrated business groups, integrated industrial structures, economic systems, integrated corporate structures, integrated diversified corporate associations, corporations, megacorporation and so on.

In order to consider the essence of integrated industrial structures let's address the concept of integration.

In the Contemporary economic dictionary of B.A. Rayzenberg, the following definition of integration is given: integration – (from lat. integer – whole) – an association of economic subjects, deepening of their interaction, development of connections between them. Economic integration takes place both at the level of the whole country, and at the national level of enterprises, firms, companies, and corporations. It is shown as an expansion and deepening of production and technological connections, sharing of resources, association of the capital, and as a creation of favorable conditions for the implementation of economic activities with each other, and the removal of mutual barriers.

There are various criteria for the classification of types of economic integration, in particular, institutional, private-cooperative, macroeconomic, microeconomic, mesoeconomic, regional, interregional and so forth [6, 22, 28].

Within this research we will consider those types of integration that underlie the formation of the integrated industrial structures.

Let's consider a private-cooperative integration – integration at the level of enterprises. It represents an association of capital and assets of the companies, and as a result, the markets based on a network of direct connections [7] are created. Within this type, there is integration which assumes the association of enterprises operating in one branch on one market that allows enterprises to resist competition from the strong partners, and also integration due tu a merger of companies, functioning in different branches, but at different stages of production or circulation.

The private-cooperative type of integration represents the microeconomic integration by the territory and institutions involved; however some authors; consider mesoeconomic integration as a basis of the formation of integrated structures [12]. In this case, the integrated mesoeconomic structures are defined as rather steady in relation to changing behavior or interests of certain subjects and their groups, and also formal and informal norms used during a considerable period of time, or the systems of norms regulating decision-making, activity and interaction of social and economic subjects (physical and legal entities, organizations) and their groups [6]. There are three groups of integrated mesoeconomic formations: enterprise networks, economic associations, and integrated business groups.

Economic associations are voluntary associations of enterprises, companies, legal entities for the reason of joint activity, coordination of actions, ensuring protection of the rights, representation of common interests in other organizations.

However in this research it is necessary to go into detail in the concept of «integrated business groups» (IBG).

The concept of the integrated business group (IBG) was suggested by Ya. Pappe, S.B. Avdasheva and V.E. Dementyev in the work «The analysis of a role of the integrated structures in the Russian commodity markets» [21]. The integrated business group is a set of economic agents (or set of legal entities and individuals who are carrying out an economic activity) which possesses the following characteristics:

1) at least some of the agents forming this set, are commercial organizations, i. e. their activity is defined by a criteria of economic efficiency;

2) there are regular interrelations between agents with closer links than simply market links, i. e. this set constantly or periodically acts as a unit in some essential economic or administrative aspects. Thus rigidity of interrelations can be absolutely different – from a common owner of all enterprises and a simultaneous entry into one technological chain to a simple coordination of price, marketing or technical policy;

3) there is a center of key decision making, obligatory for all agents of this whole. Let us call it the central element, and there are two types of it. The first type is one of legal entities (this role can be transferred from one entity to another, but it shouldn not occur too frequently). The second type is a group of individuals, for example, the main owners and/or the top managers (thus the group has to have rather clear (maybe not formalized) borders and it should be changed rather slowly.

Another definition of IBG is given by D.S. Lvov, the main expert in the field of the economic theory of innovations and institutional structure of the economy: the integrated business

group is a set of enterprises and organizations with a coordination center operating on a regular basis. Thus coordination of actions of such a set is beyond usual contracts on commodity markets and on the loan market, but the status of partners in the group as certain economic subjects is preserves (legally independent enterprises and organizations) [10].

The concept the «integrated business group» replaced the concept of the «financial and industrial group» which was officially introduced in Russia in 1995 with the Federal law «Concerning financial and industrial groups». A feature of FPG is that it has to include a financial institution while IBG allows the inclusion companies of any sphere: industrial, trade, services sector or another non-productive sphere. Thus, the concept of IBG is broader than the concept of FPG, besides, they have different legal meaning as the concept of FPG is accurately defined by the legislation of Russia, and the concept of IBG does not have a unified definition in Russian research literature yet.

Along with concept of IBG the Russian scientists use the definition of the integrated economic system (IES) – a complex highly-organized association of highly-business entities which are carrying out coordinated economic activity on the basis of the consolidation of strategic resources and opportunities on a contractual or formal basis for the achievement of systemic and local interests for the period of these purposes [9, 11, 19]. The following features are identified:

– administrative complexity: IES represents the set of functionally, technologically and financially interconnected business entities interacting within definite organizational, economic and legal forms;

– regulation of economic system: IES represents the set of legally issued or independent participants uniting assets within contracts;

– integration of different types of resources: raw, material, financial, intellectual, information, labor and so on;

– various level of economic potential of elements of integrated systems;

– production complexity: IES includes different business entities and is characterized by branch and product diversification;

– existence or absence of a common coordinating center (centralization/ decentralization of these or those functions of management);

– existence of their own purposes and interests of business entities; need of coordination of the activity of business entities with each ether and with a coordinating center for the pursuit of common interests and achievement of common purposes of development;

– integrity and continuity of economic interests of the IES elements determined by systemic interests and purposes;

– existence of organizational, economic and production relations and interests for the purpose of effective management of resources and assets.

The concepts of IBG and IES are similar in their meaning; their essence is that they represent an association of business entities in a general view, without specifying features of interrelation, a form of existence and structure of business entities. IBG and IES represent the largest forms of private-cooperative integration, in literature they are classified by various indicators, including the form of united potential, where there are allocated, in particular, industrial, financial, or other. types of the integrated structures. Thus, the integrated industrial structures (IIS) are one of the types of IBG and IES, their feature is that their structure includes one or several industrial enterprises, i. e. the activity of the information retrieval system is anyway connected with production of industrial function.

In literature, the definition of information retrieval system is defined as the integrated corporate structure (ICS) with at least one industrial enterprise. The concept of ICS corresponds to the concepts of IBG and IES and is defined as a group of legally independent enterprises (organizations) which are carrying out the joint activity on the basis of the consolidation of assets or the contractual (contract) relations for the achievement of common goals, having the uniform coordinating center [11]. Therefore the information retrieval system possesses all features of ICS (IBG and IES), which allows to define this form of integration as an association of the business entities conducting the joint activity which is partly connected with production.

In order to specify the concept of information retrieval system, and also to considery their essence, we will address the definition of various forms of integration of business entities in the legal system.

Classification of ICS by organizational and legal forms			
Smykov V.V. [7]	Chernova E.G. [8]	Vinslav D.V. [14]	Mikhalenko D.G., Afonichkina E.A. [16]
Joint-stock companies; government organizations; unions	Investment holding; production holding; government corporation; joint venture; concession; public partnership	Corporation; concern; holding; financial and industrial group; joint venture; consortium; association; network organization	Associations and unions; simple partnerships; joint-stock companies with subsidiaries; holding companies and financial holding companies; banking groups; bank holdings; financial and industrial group; public partnerships; holdings

Fig. 1. Classification of ICS by organizational and legal forms

In the legislation of the Russian Federation there is no unified definition characterizing the integration of business entities, in the Fundamental Law of the Russian Federation the concept of «public associations» is used, however it is not applicable to all types of integration of business entities as it has its own scope of application. In this regard, it is extremely important to define what forms of the organization of business activity in Russia should be related to the information retrieval system.

Among the scientists considering processes of integration of business entities from the legal point of view, there is no consensus about what organizational and legal forms of the enterprises and the organizations to refer to corporate structures. According to Lazarev V.V., societies and their associations (unions) could be considered as the corporate organizations in the Russian legal system. But the consideration of such forms as economic associations, cooperatives, associations as IS is not correct as they do not have the characteristics which are used for IS in the professional community [13].

In literature, there are various classifications defining organizational legal status of integrated structures (Fig. 1). Chernova E. describes six organizational and legal forms of the integrated structures, among them investment holding, industrial and scientific holding, state corporation, joint venture, concession and non-profit partnership [8]. Mikhalenko D.G. describes the following forms of association of legal entities: associations and the unions, ordinary associations, joint-stock companies with subsidiaries, holding companies, banking groups, bank holdings, financial and industrial groups, non-profit partnerships and holdings [14].

However, in our opinion, it is necessary to consider existing organizational and legal forms of enterprises and organizations which can refer to IS in details, in order to define the given structures as an object of researches.

In the Russian legislation there are three groups of organizational and legal forms of business entities: legal entities – commercial organizations, legal entities – non-profit organizations, and business entities without the rights of a legal entity [12–16].

Thus, it is possible to define such forms of association of business entities as holdings and holding companies, and also financial and industrial groups, as the information retrieval systems.

The types of the information retrieval system by type of their formation are presented in Fig. 2.

To sum up, based on the legal understanding of IS and their economic essence, we will propose the author's definition of the information retrieval system: the integrated industrial structure is the complex economic system representing a legal entity (joint-stock company) or a group of legal entities (ordinary association, holding, FPG) which ensures the accumulation of the assets of its participants for the implementation of a joint economic activity on a contractual or formal basis for the purpose of the profit extraction, with industrial production being its primary activity.

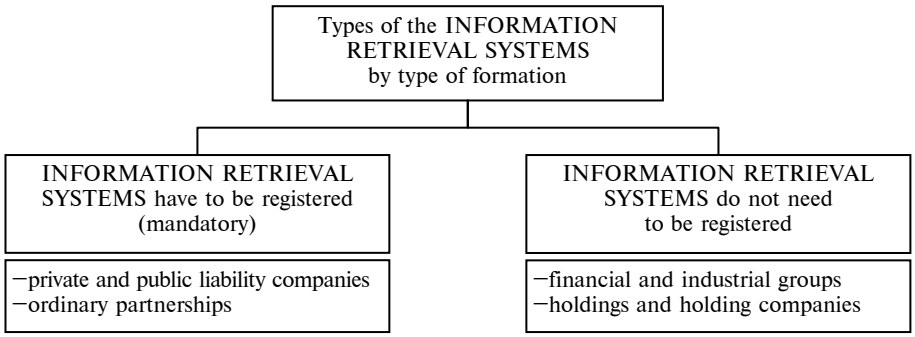

Fig. 2. Types of the information retrieval systems by type of formation

Classification of the integrated structures

Ambiguity of the terms to define an integration of business entities (IBG, IES, ICS, corporation, and so on) is the reason why there is no unified settled classification of IS in literature. Each author treats them in his own way, using those features which correspond with the chosen direction of the research [16–28].

Separate classifications of such a concrete type of associations of business entities as the information retrieval system are not used in Russian research literature, as the information retrieval system is considered as one of the types of ICS. However, in our opinion, it is reasonable to use the independent typology of the information retrieval systems since they represent complex economic structures, and the consideration of separate features will allow the facilitation of the process of their study and will allow to define their features and the principles of functioning more precisely.

Let's consider the existing classification of IS on the basis of the analysis [1–5, 9, 12, 15–29 and other] which can be used for the classification of the information retrieval system (Tab. 1)

In the table there are various approaches to the classification of IS which, in our opinion, can be used in the information retrieval system typology. These approaches characterize the information retrieval system from the point of view of integration process, however, distinctive feature of such structures is their industrial orientation; therefore it is also reasonable to consider the typology of the information retrieval system characterizing their primary activity. Thus, in our opinion, it is necessary to distinguish the information retrieval system by branch, by the type of consumed raw materials, by destination and character of finished goods, by extent of involvement of the information retrieval system in various stages of production, and by the extent of specialization (Fig. 3).

This classification allows to consider the INFORMATION RETRIEVAL system as the integrated industrial enterprise, reflecting its primary activity, that is industrial production. A similar consideration of the INFORMATION RETRIEVAL SYSTEM gives a chance to concentrate attention on the main goal of functioning of such structures, and also to study their essence and features in detail.

Conclusion

The conducted research completed the following tasks:

1) types of IS functioning in the conditions of the Russian economy were analyzed, such concepts as «the integrated business groups», «the integrated economic systems», «the integrated corporate structures» were considered, features of their definition by various authors were revealed, and also such type of integration of business entities as the integrated industrial structures was identified;

2) the concept of «the integrated industrial structure» from the economic and legal points of view was considered, its legal status, organizational and legal forms were defined, their features of formation in Russia were specified, the author's definition characterizing the information retrieval system as a complex economic structure, representing the legal entity (joint-stock company) or a group of legal entities (ordinary association, holding, FPG) which ensures the accumulation of assets of its participants for the enterprise purposes, on a contractual or formal basis for implementation of the joint economic activity which main type is industrial production, was proposed;

Table 1

The typology of the integrated structures

Classification sign	Authors allocating this sign	Types of the integrated structures
Stability of interrelations	E.L. Dracheva, A.M. Liebman [17]	1) long-term steady interrelations; 2) short-term interrelations (consortia, etc.)
Integration direction	E.L. Dracheva, A.M. Liebman, V. V. Smykov, A.L. Zagorsky [18], O.Yu. Chelnokova [25], O. P. Ivanov [26]	1) vertical; 2) horizontal; 3) radial; 4) ring; 5) conglomerate; 6) diversified; 7) mixed
Extent of integration (extent of capital centralization)	E.L. Dracheva, A.M. Liebman, M.M.Voronovitsky [21], Y.V. Yakutin [17]	1) direct administrative submission on the basis of state property; 2) rigid integration on the basis of corporate property; 3) holding (full, partial); 4) cross possession of actions; 5) loose association of assets without the right of a casting vote; 6) trust management by actions; 7) contractual integration; 8) partial cooperation on separate functions or kinds of activity; 9) integration on the basis of strategic alliances and optional agreements on joint activity; 10) long-term contract relations
Connections	E.L. Dracheva, A.M. Liebman	1) hierarchical; 2) network; 3) cyclic
Nature of the state registration	E.L. Dracheva, A.M. Liebman, O.Yu. Chelnokova	1) legal; 2) illegal
Purpose	E.L. Dracheva, A.M. Liebman, I.S. Shitkina [27], Y.Yakutin	1) increase in production within the available nomenclature; 2) production diversification; 3) growth of export opportunities; 4) economy of financial expenses; 5) replacement of competitors; 6) research and development implementation; 7) implementation of the state order
Resource provision	E.L. Dracheva, A.M. Liebman, Y.V. Yakutin	1) own resources; 2) financing in stock market; 3) financing at the expense of the bank credits; 4) government support
Status of the managing director of the center	V.V. Smykov, A.L. Zagorsky,	1) management company which does not perform independent production; 2) logistic center; 3) financial and industrial center; 4) production center; 5) scientific and technical center; 6) commerce and industry center
Independence degree of the enterprises entering IS	E.G. Chernova	1) cartel; 2) syndicate; 3) consortium; 4) alliance; 5) franchising association; 6) concern; 7) chain of deliveries; 8) cluster
Distinction of mechanisms for the management of joint activity	V.E. Dementyev [20]	1) possibilities of control with the titles of property of the united enterprises; 2) levers of coordination of a joint activity due to regulation of access to some production resources; 3) voluntary centralization of a number of powers by participants of the group
Nature of coordination of participants in the integrated structure (voluntary or compulsory)	I.S. Shitkina	1) unequal associations based on economic subordination and control (holding companies) 2) equal associations based on the voluntary relations – contractual forms of associations (ordinary associations)

Classification of the information retrieval system by its primary activity				
by industry sector	by the nature of raw materials consumed	by the nature of finished goods	by involvement in different stages of production	by degree of specialization
Power industry; fuel industry; ferrous metallurgy non-ferrous metallurgy; chemical and petrochemical industry; engineering and metalworking; timber, woodworking, pulp and paper industry, etc.	Specializing in mining industry; specializing in manufacturing	Producing means of production; producing commodities	Complete production cycle; incomplete production cycle	Specialized; universal; mixed

Fig. 3. The classification of the information retrieval system characterizing its primary activity

3) existing classification features for the analysis of different types of IS were considered and the information retrieval system typology depending on the type of their formation was proposed; also the typology of the information retrieval system characterizing its primary activity – industrial production – was proposed.

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FORMS AND METHODS TO IMPROVE THE COMMERCIALIZATION INTELLECTUAL PROPERTY IN RUSSIA

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ФОРМЫ И МЕТОДЫ СОВЕРШЕНСТВОВАНИЯ КОММЕРЦИАЛИЗАЦИИ ИНТЕЛЛЕКТУАЛЬНОЙ СОБСТВЕННОСТИ В РОССИИ

Science is the foundation for the development of civilization, any society or a nation. This is a recognised fact which does not require any further justification. However, currently it is understood both in the whole world and in Russia that the key strategic resource for survival, increased competitiveness of manufacturing enterprises and other organization is information. A shift towards science-driven production in the second half of 20 century was accompanied by the emergence of new types of information exchange. The dependence of economy on sources, volumes and quality of information (scientific and technical, economic, political one, etc.) has increased as well as the dependence on the level of information access, which resulted in appearance, in the 1980s, of a principally new economic category – national information resources. An intensive development of the economy becomes impossible unless there is effective information support. Information has turned into a strategic resource, the role of knowledge has increased dramatically.

RESEARCH AND INFORMATION ACTIVITIES. ECONOMIC EFFICIENCY. FINANCING R&D. INTELLECTUAL PROPERTY ITEMS.

Тот факт, что наука является основой развития цивилизации, любого общества и государства, общеизвестен и не требует дополнительного обоснования. Переход к наукоемкому производству во второй половине XX в. сопровождался возникновением новых видов информационного обмена. Возросла зависимость экономики от источников, объемов и качества информации (научно-технической, экономической, политической и др.), от уровня развития средств доступа к этой информации, что привело к формированию на рубеже 80-х гг. XX столетия принципиально новой экономической категории – национальные информационные ресурсы. Интенсивное развитие экономики становится невозможным без эффективного информационного сопровождения. Информация превратилась в стратегический ресурс, существенно возросла роль знаний.

НАУЧНО-ИНФОРМАЦИОННАЯ ДЕЯТЕЛЬНОСТЬ. ИНФОРМАЦИОННЫЕ ПРОЦЕССЫ. РЕСУРСЫ. ЭКОНОМИЧЕСКАЯ ЭФФЕКТИВНОСТЬ. ФИНАНСИРОВАНИЕ НИОКР. ОБЪЕКТЫ ИНТЕЛЛЕКТУАЛЬНОЙ СОБСТВЕННОСТИ.

When seeing information as a resource for development of a society or organization, they identify its major specific features: information is the most important resource for the society, enterprise or organization to develop. It decreases demand for land, labor, capital, minimizes the use of raw materials and energy; brings to life new industries; adds value to other resources, in particular, to labour: indeed, a worker with higher education is more appreciated than the one with secondary education. Scientific information is an important resource of social and historic practice for forecasting and the change of reality.

At the same time, modern economic conditions and common practice resulted in the situation when activities, initiated in the 1960s in order to provide enterprises and scientific research organizations with scientific and technical information, have practically been stopped. Departments and bureaus of scientific and technical information, even if they exist, are not involved in selective dissemination of information, differentiated and initiative service of scientific staff.

The theory of Information Systems is developing inefficiently, too, especially in the field

of scientific and technical information. This issue is important due to the fact that scientific research in the modern world is practically impossible without scientific communication, and an individual researcher cannot obtain new scientific results without collective work over the problem. The issue under consideration is getting exceptionally important in the conditions of modern Russian economy. On the one hand, modernization and upgrade of IT facilities of the home industry and demand for effective technology and innovation is growing. On the other hand, the IT, communication and intellectual property market in Russia is in its infancy and its mechanisms still do not fully contribute to the efficient distribution of intangible resources. The development of market transaction mechanisms in respect of intellectual property items (hereinafter IPI) and information resources (IR) is impeded by the insufficient theoretical elaboration of issues connected with essence of transactions on implementation of IPI and IR in the market, reasoning of different forms of commercialization and their specific influence on pricing of this particular economic resource. IPI commercialization in the market cannot be researched unless the essence of intellectual property relations and their specific features are identified. Moreover, issues related to the content of intellectual property and its functional characteristics have been developed enough, similarly, issues concerned with the understanding of its specifics compared to tangible property items and distinctions of the subject-object membership.

Problem of scientific communication. As scientific information activities are developing, it is becoming more and more obvious how important is scientific communication, the interaction between scientific institutions which is based on scientific and technical information, its distribution, provision of access to it, an increased efficiency of information maintenance.

Over a long period of civilization development, both government action and action of an individual which exceeds the limits of material production and service have been referred to unproductive expenses. Economic status of a nation was determined by existing material and energy resources, an effective financial distributional system.

During the research, the following major problems are to be tackled:

1. Assessment of the dominating role of science in the world progress of processes and technology, growth of the economic power of this country.

2. Development of science as an independent social institution and evolvement of its basic elements during transformation into a national competitiveness factor (technology, economic, socio-political and military competitiveness) starting from the middle of the 20 century.

3. To look into major properties of scientific information, such as practically non-decreasing potential effectiveness of information, replicability and frequency of use, dependence of actual implementation and effectiveness on the degree to which information is used, presence of value, cumulativeness, etc.

4. To analyze types and forms of scientific and technical information considering their use in new economic conditions, to characterize them and reveal risks they entail.

5. To suggest forms and methods to increase efficiency of information provision for scientific research.

6. To suggest economic methods and models for intangible assets economic efficiency assessment in order to maintain competitiveness of domestic producers.

7. To investigate ways for the efficient financing of national science through tax incentives and national monetary policy, internal sources of an enterprise.

Estimation of research subvention losses due to taxation of legal entities. Let us look into the leakage of money researchers experience as a result of the current taxation system. So, as a result of work done by a team of researchers (http://csr.spbu.ru/pub/RFBR_publications/es.html «Thin-film multilayer coatings beat cracks» by V. Tabakov, M. Smirnov, A. Cirkin 2007, 2008), there has been found a solution to increase cutting tools durability with the use of the new three-layer coating TiZrFeTiZrFeNTiZrN. This technology has been applied by a machine-building company OAO «Klimov», the leading Russian developer of gas turbine engines (http://en.klimov.ru/about/general). Let us calculate the amount of grant subsidies for the researchers and losses resulting from the current

taxation system. We assume that the Russian Fund of Fundamental Research (RFFR, www.rfbr.ru) has supported the scientific research project and paid, at the first stage (state of fundamental research development), 200 000 rubles to one of the scientists and the next year, at the second stage, paid 1,500,000 rubles to a team of 3 researchers as subsidies to put the technology into practice. According to the legislation, the team can receive the grant only through a legal entity.

The organization, through which the grant is financed, has the right for a specific «premium». Its amount is strictly limited: for the Russian Liberal Scientific Fund (RLSF, www.rfh.ru), it cannot be larger than 15 % of the total grant amount, whereas for the RFFR it is limited to 20 %. From the financial standpoint, this premium is justified by the necessity to cover expenses related with finance monitoring and technical maintenance of the research project. However, this is a direct deduction from the grantees' income. Furthermore, in case the money is transferred to the account of a legal entity and takes the form of salary, it is subject to the same taxation as salary payments (mandatory payments to insurance funds before 2011 were 26 %, in 2011 – 34 % and after 2012 – 30 %.) This is one more serious deduction from the grantees' income. This deduction appears automatically when converting an individual (researcher) into a legal entity (organization). Therefore, such a conversion influences destructively on the researchers' work motivation. The income of the researchers is automatically liable to income tax (13 %). This form of deduction cannot be controlled by researchers either and comes in force automatically. If we represent the initial amount of the research grant as GR, and the amount of money paid to the researcher as net income as NCF, the dependence between them within the current taxation system can be shown in the following way (in general):

$$NCF = \frac{(1-\alpha)(1-\beta)(1-\gamma)}{(1+\omega)} GR. \qquad (1)$$

And, in case some equipment should be purchased (R&D):

$$NCF = \frac{((1-\alpha)(1-\beta)GR - \text{R\&D})(1-\gamma)}{(1+\omega)}, \qquad (2)$$

where α is the share of overheads, related to the registration of scientific research work in RFSTIC (Russian Federal Scientific Technical Information Centre), bank commission for salary transfer into plastic cards, etc.; ω – salary payments quota in percentage (Mandatory payments to insurance funds, 30 %); β – the percentage of grant amount paid to finance monitoring and technical maintenance of the project (15 %); γ – income tax rate (13 %); R&D – expenses related to the equipment purchase in rubles.

Let us calculate the amount of grant paid to the project participants after taxes: the percentage of overheads α includes expenses on registration of the scientific research work in RFSTIC, bank commission for salary transfer to plastic cards and deductions for increased value of company's tangible assets. As a rule, this amount is not big and for average grants is $\alpha = 3–4$ %.

The amount of grant β, paid to finance monitoring and technical maintenance of the project is $\beta = 15$ % for RFFR. Although the regulatory documents stipulate the figure of 15 % as maximum (formally it can be equal to zero), in practice, it is the one used when dealing with grant subventions. According to the R&D conditions, some equipment should be bought in the amount of 500,000 rubles.

As one can see, at the second stage, instead of 1.5 million rubles, the researchers received 493,056 rubles after taxes, which is equal to 32,9 % of the initial amount. By now, the federal law «On amendment to article 217, part two of the Tax Code of the Russian Federation» has been passed. In accordance with the new version of the Tax Code (www.garant.ru, www.nalog.ru), taxes are not imposed on the incomes of individuals received by taxpayers in the form of grants (gratuitous aid) which have been given to support science, education, culture and arts in the Russian Federation by international, foreign and (or) Russian organizations included in the list of such organizations which has been approved by the Government of the Russian Federation. This list, according to decree No. 602 of 15 July 2009, includes Russian State Scientific Fund and Russian Fund of Fundamental Research.

We recalculate this figure without the income tax and receive the amount equal to 566,731 rubles. Anyway, the taxes are too high for individuals and the tax burden on grant

Table 1

Calculation of tax burden

Key figures	1 year		2 year		Total
	Rate	Amount, RUR	*Rate*	Amount, RUR	Amount, RUR
Amount of grant on R&D in machine-building (GR)		200 000		1 500 000	**1 700 000**
Overheads (a)	*3 %*	6 000		45 000	51 000
Finance monitoring of the legal entity (b)	*15 %*	29 100	*15 %*	218 250	247 350
Purchase of equipment and test samples (R&D)				500 000	**500 000**
Mandatory payments to insurance funds (w, MPIF = 30 %)	*30 %*	38 054	*30 %*	170 019	208 073
Net income of the researchers excluding personal income tax (as labor compensation fund)		126 846		566 731	693 577
Calculation of the personal income tax (13 %)	*13 %*	16 490		73 675	90 165
Net income of the researchers including personal income tax (NCF_1)		110 356		493 056	**603 412**
or in % of the grant amount		*55,2 %*		*32,9 %*	*35,5 %*
Net R&D costs (NCF_2), RUR.		**110 356**		**993 056**	**1 103 412**
or in % of the grant amount		*55,2 %*		*66,2 %*	*64,9 %*
Financial and tax burden, RUR.		89 644		506 944	**596 588**
or in % of the grant amount		*44,8 %*		*33,8 %*	*35,1 %*

subventions does not comply with any international or Russian standards. If we bear in mind the fact that grants themselves are a specific form of charity (in this case, state charity), this tax system seems to be absolutely absurd. Thus, the current Russian tax system is built in such a way that about a half of the given grants returns to the state treasury. Such a size of the tax burden is considered to be unacceptably high even for legal entities involved in commercial activities.

Methodical approaches to the assessment of scientific results effectiveness. One of the major conditions for science management optimization is the development of methodical approaches to the assessment of scientific results. In order to ensure comparability of different R&D types (Iakovleva E. (2011), Dzhazovskaya I. (2010), Lemechenko P. (2011), Novozhilov A. (2006)) – from fundamental research to development and demo programs – the most general criteria which reflect three fundamental aspects inherent in any R&D program should be defined: relevance – justification of importance, possibility and necessity for federal investment in a program; quality – justification of the way how the invested budget funds can provide the best quality of R&D; performance – justification of the effective use of investment (Internal corporate guidelines for assessment of R&D cost-effectiveness STO Gazprom).

To assess the effectiveness of technology during the operational stage, cost, profitability, elasticity and other factors are primarily used. Shareholder value of the company is often used to measure its financial performance. For the management of the company, the proportion of the expected free cash flow and weighted average cost of capital is the shareholder value of the company. Thus, economic assessment of R&D should arise from the system influence on this proportion. As a result, the following factors should be analyzed: cash flow, related with the commercialization of R&D results; capital investment for the introduction of the new system (problem of financing); an effect of the new system on the monetary evaluation of the risk for all company's activities; institutional constraints (taxes, duties, direct constraints, etc.).

Innovation cost-effectiveness. The relative cost-effectiveness of innovations ($EEff_{\text{R\&D}}$) can be calculated on the basis on elasticity factor (Novozhilov A. (2006)):

$$EEff_{\text{R\&D}} = \frac{P_{aac\ eff\ \text{R\&D}}}{P_{on\ \text{R\&D}}} \div \frac{C_{new}}{C_{old}}, \qquad (3)$$

where $P_{aac\ eff\ \text{R\&D}}$ – accumulated effect on R&D implementation in RUR; $P_{on\ \text{R\&D}}$ – profit on innovation activities (profit on R&D) in RUR; C_{new} – new expenses in RUR; C_{old} – old expenses in RUR.

Innovation company value growth. Appraisal of the value growth and effectiveness of an innovation company based on R&D multiplier (Iakovleva E. (2008), Kozlovskaya E. (2012)):

$$Eff_{Value} = V' - V = \\ = 0,5\left(\frac{V}{\varphi}\varphi' - \frac{V}{1-\varphi}(1-\varphi')\right) - V, \qquad (4)$$

where V is a market value of the company (RUR); V' is a market value of the company after having new R&D costs (RUR); φ – share of R&D costs; φ' – share of R&D costs of a new product; Eff_{Value} – multiplier effect in rubles.

Company's market value multiplication (R&D multiplier). The implementation of any investment project requires capital investment in fixed assets and working assets, as well as R&D costs. R&D multiplier can be used to build different factors of project effectiveness (as modification of profitability factor). It is believed that, since the long-term limitation of a company is fixed assets, the company's goal is not to return R&D costs within a short term, but to ensure increased company value. In some cases, especially for innovation companies, these two things coincide.

We can extend the definition of R&D multiplier as relation of R&D costs and new product development costs to the accumulated expenses of the company (Lemechenko P. (2011), Novozhilov A. (2006), Kozlovskaya E (2012)).

$$\text{R\&D multiplier} = \frac{\text{Costs of new product development}}{\text{Capital investment for production and sales of this product}}. \qquad (5)$$

Then, under the conditions of limited resources, expenses can be relocated to increase the share of R&D and new product costs and the effect (only related to costs relocation) can be expressed as shown in Fig. 1. Proportions between R&D costs and capital investments can be expressed through a so-called R&D multiplier.

We go back to our example and calculate the direct savings on cost for a machine-building enterprise OAO Klimov when using a new three-layer coating TiZrFeTiZrFeNTiZrN 1 «Thin-film multilayer coatings» (Tabakov V. (2008)).

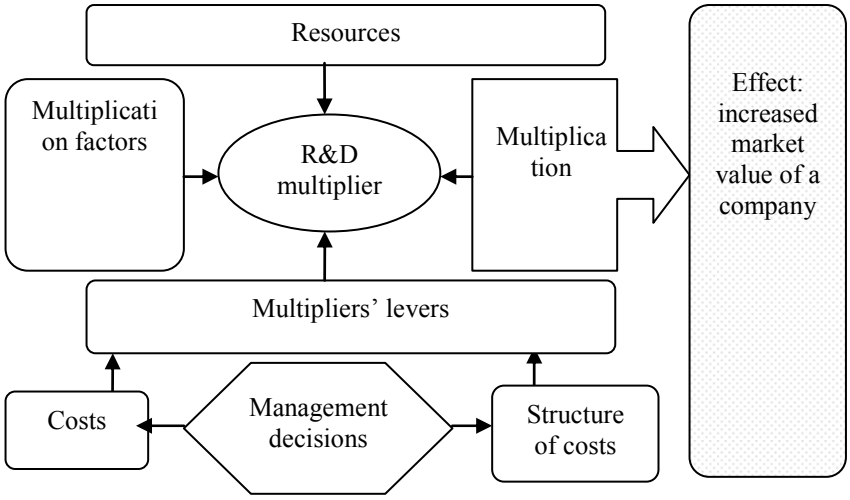

Fig. 1. Multiplication effect of the company's market value

The financial statements of the company say that the annual prime costs of OAO Klimov's products were 2,558,750,000 rubles in 2009. A considerable proportion of machine components and mechanisms are manufactured with the use of cutting. As the abstract of the scientific research says, the share of tooling costs can be 3–10 % of the products' prime cost, and the doubled life period of the tools, all other things being equal, can result in a decrease in prime cost up to 5 %.

Let us assume that the share of tools' purchase for a science absorbing industry in the overall costs of the products sold (prime cost) is 3 % (the lowest limit of the range from 3 to 10 %) and the saving on costs is 5 % (maximum value). Then the value of the first component of R&D implementation effect is 3 838 125 rubles (=2 558 750 000 · 0,03 · 0,05). We shall call the value identified as the direct effect of the innovation. Let us calculate one more index of R&D direct effect multiplication as a relation of the direct effect to the actual investments (modification of R&D multiplier by formula (5)) as:

Table 2

Multiplication index of R&D direct effect

Factors	Overall R&D costs (RUR) (from Tab. 1)	Relation «direct effect / investments», (shares)
Amount of grants	GR = 1 700 000	2,26
Net research costs	NCF_2 = 1 103 412	3,48

With the use of the «direct effect/investments» multiplier equal to 3.48, it is possible to evaluate the institutional losses in the RF taxation system as the product of overall financial and tax load (596 588 rub. in Tab. 1) multiplied by the value of the multiplier. This amount is equal to 2 075 181 = 596 588 · 3.48. With the application of the well-known principle of the time value of money, one can prove that, when removing part of the cash from the economic system, the state loses future profits from R&D commercialization.

Using financial statements data and direct R&D effect, the total value of the R&D result or effect can be formed:

Table 3

Calculation of the overall effect of R&D implementation

Factors	Amount, RUR
1. Profits from R&D (according to the accounting records)	472 667 000
2. Effect (savings on direct costs)	3 838 125
=Total overall effect of R&D implementation =1+2	**476 505 125**

Total overall effect of R&D implementation in the amount of 476 505 125 RUR will be used to identify the relative effectiveness of R&D result which the company obtained. In order to use the new technology OAO Klimov has to buy it from the researchers. The price of the new technology or its marginal cost must be calculated. According to the expert data, the «R&D costs/IPO cost» multiplier has a value from 15 to 28 (shares). The reason for the IPO price identification is the amount of finance used for IPO creation.

Let us consider two options for R&D financing: including losses in the taxation systems and excluding them. Let us use the data of Tab. 1.

Table 4

Identification of R&D cost at the stage of commercialization in terms of R&D costs/IPO costs multiplier

Factors	Option 1 (including losses in the taxation system)	Option 2 (excluding losses in the taxation system)
R&D costs/IPO cost multiplier (times)	20	20
Net research costs (NCF_2), RUR.	1 103 412	–
Amount of grants (GR), RUR.	–	1 700 000
Identification of IPO cost range for the company from and to, RUR.	**22 068 238**	**34 000 000**

So, the value of the new technology can be identified from 22 to 34 million rubles, i. e. we review the process when the intellectual property object is being commercialized. Now we can estimate the effects of the new technology purchase (IPO) for the end-user, OAO Klimov.

We will do this both including and excluding the taxation (institutional) limitations. With the use of the data from the company's financial statements, we can calculate the index of the relative effectiveness of the investment costs on the basis of the elasticity principle. Traditional factors of the investment effectiveness (NPV, IRR) cannot be used here, since there are no capital forming investment costs, in the proper sense of the word, i. e. in this particular case we talk about purchase of an intellectual property object for the end-use by a manufacturer.

Table 5

The factor of the relative effect from R&D introduction (elasticity of costs connected with IPO introduction)

Factors	Option 1 (including losses in the taxation system)	Option 2 (excluding losses in the taxation system)
IPO price, RUR.	22 068 238	34 000 000
Prime costs, including direct effect, RUR.	438 216 900	438 216 900
=New prime costs of R&D, RUR.	460 285 138	472 216 900
Overall annual costs of the company prior to IPO introduction, RUR.	528 532 500	528 532 500
Total overall effect of R&D introduction	476 505 125	476 505 125
Relative effect of R&D introduction (by formula 3)	**1,158**	**1,128**

According to the accountancy requirements, the value added tax is not applicable for this transaction and the costs are written off in the current period with the reduction of the taxable profits. Further more, let us estimate costs of IPO introduction in the company. We know OAO Klimov production costs on high-technology products with account of direct savings when applying IPO (R&D results) and they are going to amount for 451 770 000 × × 0,97= 438 216 900 RUR.

$EEff_{R\&D} > 1$ – Innovation cost-effectiveness grows, and it is going to be higher for option 1, since IPO price is lower. I. e. at the micro level (researcher-manufacturer), the stipulated innovation activity is effective. In order to identify the effectiveness at the macro level, for the whole economic system: state – researcher and manufacturer- manufacture, the relevant cash flows should be identified. To do so, the value of OAO Klimov should be calculated prior and after IPO commercialization. The value of OAO Klimov prior to IPO commercialization can be calculated via the method of direct capitalization of profit as equal to 4 274 480 000 rubles at the recapitalization rate of 15 %. At the same time, its balance value is equal to 3 837 437 000 whereas the value of the owned capital is 1 171 371 000 rubles. To identify the market value of the company after the IPO has been commercialized, by formula (*), the share of R&D costs should be defined (34.7 % before the IPO was purchased and 35.98 % after it) in the total amount of the company's expenses (2 663 971 000 RUR). The financial statements show R&D costs as 924 437 000 RUR and the IPO cost as 34 000 000 RUR, which are included into the above-mentioned expenses. Then the value growth by formula (*) is 36 832 506 or 0.86 % to the value of the company prior to R&D commercialization.

Let us calculate the relevant cash flows for the economic system (state-researcher-manufacturer):

Table 6

Projection of the relevant cash flows for the economic system (state-researcher-manufacturer)

Factors, RUR.	1 year	2 year	3 year	4 year
1. Efflux of grant subsidies, RUR.	−200 000	−1 500 000		
2. Money repayment through taxes, RUR.	89 644	506 944		
3. Direct R&D effect, RUR.			3 838 125	
4. Losses in obtaining direct effect because of the taxation system and substitution of relations			−2 075 181	
5. Growth in the company's value				36 832 506
6. Overall CF in the economic system	−110 356	−993 056	1 762 944	36 832 506
7.NPV	22 936 505			

If the same cash flows are calculated, but without losses in the tax system, the amount of the current net value will increase and NPV= 23 898 367 RUR with the discount rate of 13 %. I. e. the system effectiveness would grow by 4.2 %. The obtained amount is rather modest, but for the economic system as a whole it is quite significant, therefore the above-mentioned approach helps to tackle the problem of the use of the company's intellectual activity results, estimate the effects of the introduced R&D results both at the micro- and macro levels.

By the basis are mean a set of fundamental elements of the model. Some elements (income, capital) are deterministic in nature; others are probabilistic in nature and have features to consider when managing. For example, it would be profits from future innovation with multiplicative (explosive) character, particularly, in chains of consistent innovation and in combination with significant life cycle of innovations up to 55-60 years.

In addition, intangible assets and intellectual property that were previously seen as R&D costs, in the innovation environment must be assessed from the perspective of future benefits as factors which increase the value of the company's assets. When assessing the value of the invested capital, it is required to optimize the capital structure and justify the selection of discount rates and inflation.

In this article, we examine the individual elements of this spatial model: value and risk analysis: analysis of the institutional environment. It is necessary to develop a model of market value factors management towards the factor relevant to the indicators used for decision-making at the appropriate level of management of the company. The main problem with this is the need to integrate and share key factors accounting for risk and uncertainty, to determine the optimal capital structure in the financing of innovation. In addition to the important factors that affect the market value of companies engaged in innovation – such as the life cycle of the company, technology, product innovation, it is necessary to assess and characterize the more traditional factors, but with characteristics. Thus, some innovators have a main value of costs and their structure. Innovation costs are current and capital. Current costs are the production costs of innovative products, accounting rules for taxable business income deducted regardless of the result, and to manage the market value, they must be capitalized and the economic value of value added should be taken into account.

The analysis of the value of assets is based on the principles and approaches of economic cost-benefit analysis, including models and criteria for investment analysis, the analysis of the present value (discounted cash flows), the analysis of uncertainty and risks (methods of mathematical economy, economic theory of options, the concept of margin). There are restrictions of the practical application of VBM concept in the value chain management due to the absence of the adapted management methodology and mechanisms for the formation of the companies' market value available for companies' management in the face of innovative development and environmental variability.

Resume. The scientific and technical activity in this country is one of the most complicated areas from the standpoint of social and economic mechanisms, legislative environment, transparency and accessibility.

Unfortunately, so far, the government has not taken steps in order to transfer scientific and technical activity into a full-fledged sector of the national economy. So far, no definite mechanisms have been worked out for the use of scientific and technical activity results, i. e. intellectual property in the economy. It is the government that must pay special attention to the scientific and technical activity and create economic and legal framework which will enable an exchange of scientific information, the commercialization of scientific research and development results. Commercialization in the information system and technology market, intellectual property items cannot be studied without understanding the essence of economic and information relationships and their specifics. This is exactly the major scientific result of the declared research.

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STRATEGIES OF ORGANISATIONS BEHAVIOUR IN A CHANGING ENVIRONMENT

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СТРАТЕГИИ ПОВЕДЕНИЯ ОРГАНИЗАЦИЙ В МЕНЯЮЩЕМСЯ МИРЕ

Organisations behavioral strategies are examined. Organisations adaptation strategies concepts, methods and proactive innovative actions are considered. An adaptation of the organisations strategy to changing environmental conditions algorithm is presented. The necessity of constant changes of innovative organisations in the changing world is justified. The innovative strategy formation algorithm is presented. Organisations innovative projects effectiveness evaluation technique is described.

ORGANISATION STRATEGIES. STRATEGIES ADAPTATION. INNOVATIVE PROJECTS. CHANGING ENVIRONMENT. EFFECTIVENESS AND EFFICIENCY. RISKS AND OPPORTUNITIES.

Рассматриваются стратегии поведения организаций. Раскрываются понятие, методы адаптации стратегий и упреждающих инновационных действий организаций. Представлен алгоритм адаптации стратегии организации к меняющимся условиям окружающей среды. Обоснована необходимость постоянных инновационных изменений организаций в меняющемся мире. Приведен алгоритм разработки инновационной стратегии. Описана методика оценки эффективности инновационных проектов организаций.

СТРАТЕГИИ ОРГАНИЗАЦИЙ. АДАПТАЦИЯ СТРАТЕГИЙ. ИННОВАЦИОННЫЕ ПРОЕКТЫ. МЕНЯЮЩИЙСЯ МИР. РЕЗУЛЬТАТИВНОСТЬ И ЭФФЕКТИВНОСТЬ. РИСКИ И НОВЫЕ ВОЗМОЖНОСТИ.

The effectiveness and efficiency of business organisations, as the major businesses of any economic system, to a large extent depend on the environmental conditions of their function. Wherein, the environmental conditions consist of natural environment, as well as a system of institutional relations in the society, characterising informational, economic, social, legal, and other relationships with the rest of the organisation, with economic agents in the society within the existing institutional infrastructure.

The organisation environmental general property is its continuous volatility, influenced by external cosmic impacts, and due to the active human role, transforming the environment and changing the institutional infrastructure. For organisation as a subject of the existing economic relations, the environment, on the one hand, is a source of new business opportunities, in case the changing parameters are favorable for the organisation development and, on the other hand, it can also be **a** sphere of potential threats, in case an environmental parameters change is not favorable to the development of the organisation. It is a basic feature of the organisation and its management in the changing world. Thus, the efficiency and effectiveness of business organisations will depend, first of all, on the strategy choice, undertaken by man, and on how organisations use new opportunities, both currently and in perspective also, they depend on their ability to eliminate potential threats and corresponding negative consequences. Therefore, a priority in choosing a behavioral strategy of

organisation in the changing world is the identification and evaluation of an aggregate capacity of its new environment for the business development, as well as prediction and assessment of potential threats, which as a rule, have a probabilistic nature, and in case of their occurrence – direct economic losses and indirect social and reputational consequences.

The capabilities, potential threats and possible consequences, usually depend on the characteristics of the environment, the type of organisation, the type of its specific activity, the degree of development of the institutional infrastructure and the nature of social relations in society. Therefore, the combination of capabilities and nature of environmental potential threats will be different for individual organisations in different countries and within the country, and they will change over time, reflecting the nature of the technological structure of the economy, the state of environmental parameters and principles of formation and functioning of the institutional infrastructure.

Modern fast developing world requires organisations to implement constant changes in their activities by making adjustments to the strategy. The concept of «strategy» is widely used in science and in practice, and in a variety of interpretations and often without a proper definition. However, in the management theory, a term «strategy» has specific and well-established content as a set of solutions and plans (programs) for their implementation in the long run, ensuring growth and high competitiveness of enterprises, strengthening their market positions by enhancing the ability to adapt to a changing environment.

The strategy is based on a multi-criteria selection due to different scenarios. It should contain clear objectives, guiding rules, approval criteria and conditions governing their decisions and actions. Due to the information uncertainty, strategy does not always contain specific solutions and actions (they arise at the tactical and operational levels), and describes behavioral algorithms, based on a deep understanding of the company and the factors of competitive advantage. The strategy retains flexibility to provide the freedom for maneuver within the chosen course of action, and to respond to an environmental change, depending on the situation [1].

Modern organisations operate facing ever-changing environmental factors, so they develop business strategies to meet new realities. In order to identify changes in the organisation environment, it is necessary to carry out continuous monitoring of its factors. Based on monitoring data, organisations need to change or adjust their strategies to remain competitive on the markets [2]. The changes can be adapting to the situation and proactively creating new conditions and methods of activity. Such concept suggests a company's strategy to be flexible, that is, to adapt to changes in the external and internal environment. Initially used in biology, the term «adaptation» is used in technical, natural, and social sciences. Adaptation is a process of in-house management system interaction to the external environment in which requirements and expectations of participants are agreed [3]. The concept of adaptation, in its broadest sense, involves a set of theoretical principles, management principles, ways to implement its special properties, to adapt subsystem characteristics and its parts to change the complete system of which it is part. Adaptation, in a narrow sense, is an economic and mathematical tool, including a special built-in algorithm for models with a changeable structure, which ensure increased realism of the description of the object in uncertain dynamics [4].

An adaptive control system is a property which reflects its ability to respond quickly and flexibly to any changes and to develop adequate administrative impact, allowing the system to minimize the action of disturbing factors [3]. So, the adaptability is regarded as a systems property, manifested in their ability to adapt [5]. Adaptation has to be continuous, focused, and ever-changing.

Considering the above, it is possible to identify a number of requirements for a flexible strategy formation in a changing world:

1) constant monitoring of environmental changes;

2) the assessment of business organisations threats and opportunities in a changing world;

3) the accuracy, adequacy, timeliness and validity of the information control used in the enterprise;

4) consideration of a complex system of organisation's relations with other economic agents;

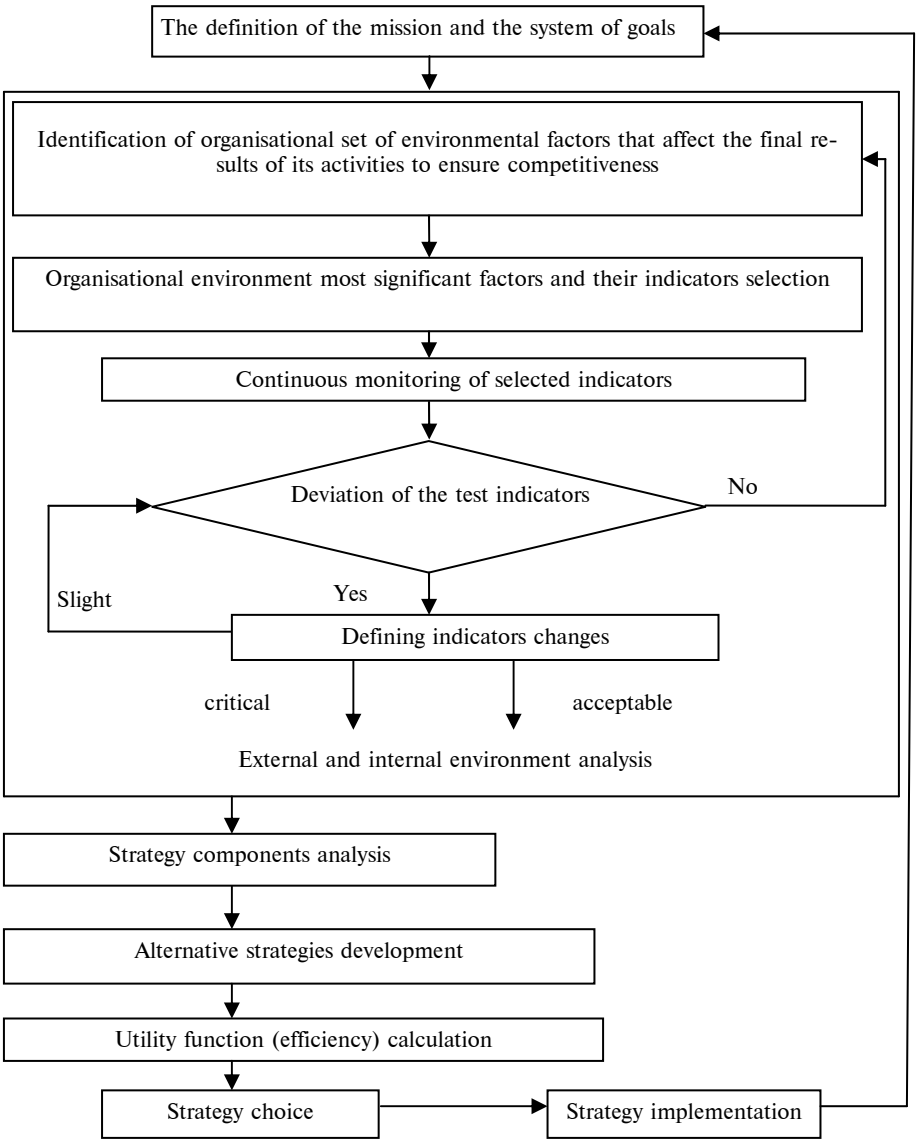

Fig. 1. An algorithm of organisation adaptation strategy to a changing environment

5) increasing the enterprises competitiveness through innovation potential;

6) making permanent changes in the preemptive strategy and policy, depending on external and internal conditions.

Adaptive algorithms are used for more effective analysis and company's strategy choice to achieve the main strategic goal of maintaining and enhancing competitiveness in a changing environment.

The proposed company's adaptation strategy algorithm (Fig. 1) allows linking the environmental factors change to the decision to revise the organisation's strategy. It is necessary to carry out continuous monitoring of the environment at every stage, and make appropriate changes in the strategy of the organisation.

Organisation's strategy adaptation involves a selection of appropriate mechanisms: 1) functional strategies change; 2) contingency planning activities; 3) competitive advantages through innovations; 4) production reserves identification, elements of sparing manufacturing use; 5) constant monitoring of environmental factors.

The first adaptation mechanism is to consider the overall strategy as complex of partial (functional) strategies. This complement each other depending on conditions. That provides

the strategy with flexibility and willingness to change the environment [6].

The second mechanism is based on the strategy construction as a clear plan of action. Multi-variant is ensured by the different states of the environment. For this method strict predefined actions are typical. On the one hand, the stability of the enterprise increases, and, on the other hand, the ability to promptly react to events is limited.

The third mechanism is focused on internal capacity and the environmental forecast. The mechanism involves a determination of the most advantageous position in competition. Most enterprises increase efficiency through innovations [6]. However, the possibility of innovative borrowings and high innovative changes threaten the long-term competitiveness of the enterprise. For enterprise strategy adaptation, a constantly updated technology base and a set of external and internal conditions, necessary for the innovative production, are required.

The fourth mechanism is focused on resource conservation, the organisational structure improvement, etc. The adaptation activity is to match a change in the environment with a change in the object as a result of targeted actions.

The fifth mechanism provides environmental factors monitoring in order to detect changes. Monitoring allows prompt response to changes.

The choice of an adequate mechanism for company's adaptation strategy expands its adaptive capacity, subject to a proper use in a dynamic environment.

Any organisation, functioning in a changing world, must change its activities strategy. The developed algorithm and the set of adaptation mechanisms allow to provide appropriate adaptation solutions.

However, in a constantly changing environment, one of the main organisations adaptation mechanisms should be permanent proactive actions – innovative changes that prevent future negative situations. Currently, innovations are the main mechanism for the competitiveness of organisations. Organisational innovative activities result, primarily, in the development and the implementation of an innovative strategy.

An innovative strategy is a system of organisational long-term development goals and measures to achieve them through innovation; focused on the development and the use of the organisational capacity as a response to environmental changes. The innovative strategies diversity (product, function, resource, management, etc.) is determined by the internal environment of the organisation.

Organisational innovative strategies include: innovative activities aimed at generating new products, technologies and services; an application of new methods in R&D, production, management; transition to the new organisational structures; the use of new resources, approaches to the use of traditional resources [7].

The process of organisational innovative strategy formation and implementation has the following characteristics:

1) organisational innovative activities are the basis of an innovative strategy, which is considered an optimal functioning means and the development of the organisation as a whole;

2) the main focus of organisational strategic analysis is innovation potential, level and degree of innovation activity assessment;

3) commitment to innovations and focus on innovation in all areas have to be in innovation-oriented organisations mission;

4) innovative strategies implementation efficiency is carried out through a comprehensive assessment of the organisation, which is directly relate to innovation.

Innovative strategies are a source of unfavorable conditions for management: an increase in the uncertainty of investment risks additional changes due to innovative restructuring, sharpening of the contradictions between the leadership.

In order to identify the organisations investment needs for innovative strategies development and implementation, the following stages are distinguished while developing new improving technologies [7]:

1) a research stage;

2) constructive (technological and production design) stage;

3) a concept stage (production process regulation and market launch concept formation);

4) expanded reproduction and distribution stage.

Summarising the existing approaches and the experience of successfully functioning innovative organisations, the innovative strategy formation algorithm is presented in Fig. 2.

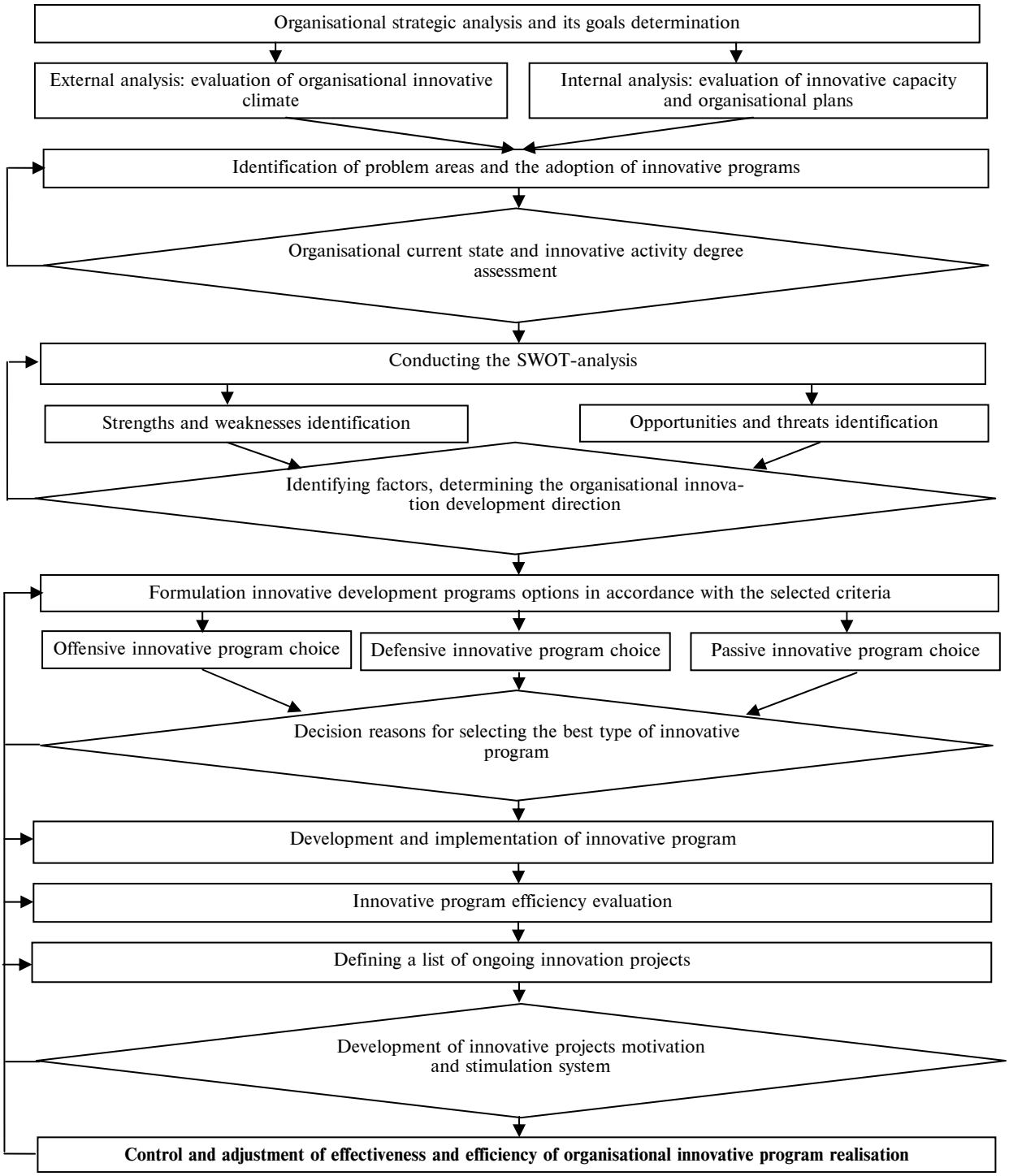

Fig. 2. The algorithm of innovative strategy formation

The organisational analysis provides possibility to determine precisely the innovative investment project (or program), which is required for the current innovation strategy implementation. R&D projects can be considered as real options, because at initial stages there are shortage and unreliability of financial information, but they can be stopped with a much smaller financial losses.

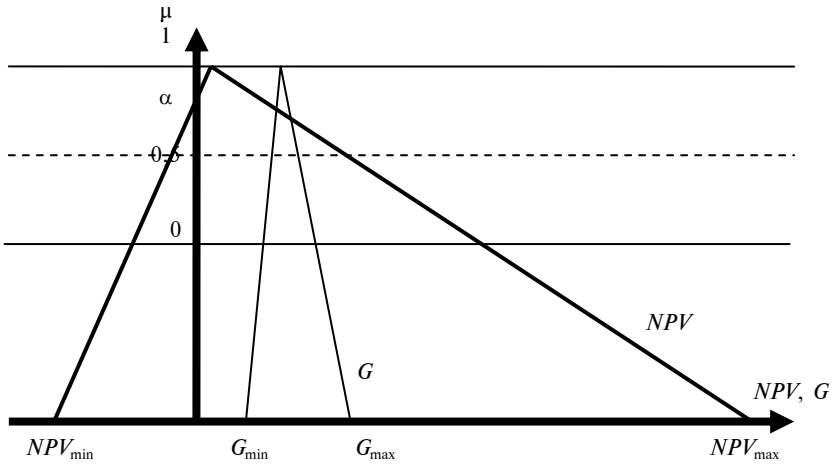

Fig. 3. NPV fuzzy evaluation

Innovation and investment projects are considered from the perspective of real options and are aimed at identifying their additional features and capabilities [8]: 1) varying the project parameters during its implementation; 2) quantitative assessment of the available options and their inclusion in the cost of the project.

According to the fuzzy interval approach, the basic parameters of the innovation project can be estimated in the form of triangular fuzzy numbers (minimum, maximum, and most expected values) and for each level of confidence (from 0 to 1) construct interval estimation of net present value **(***NPV***)** [9].

As the project goes from phases to phase, further information be comes available, ensuring further adjustment of NPV fuzzy evaluation (Fig. 3) [10]. The method allows constant critical analysis and a search for alternative ways within the internal and external environment; it allows not to assess the entire project at once, but to divide it into individual stages; it allows to evaluate the efficiency and make choices between alternatives without using other methods; it allows to consider the relationship between risk and opportunities for the organisation.

Thus, the environment is a source of both new business opportunities and potential threats for the organization. The effectiveness and efficiency of business organisations in a changing world will depend, first of all, on the choice of the behavioral strategy, which creates new opportunities, both currently and for the future of the organisation, and also eliminates the potential threats and the corresponding negative consequences. Therefore, a priority in choosing an organisational behavioral strategy in a changing world is the identification and evaluation of new aggregate environmental opportunities for the development of its business activities, as well as the prediction and assessment of potential threats impact.

Organisational strategies should be different in various conditions. Strategy formation should be a continuous process, which cither adapts to the enterprise changing environment or prevent undesirable effects. The suggested algorithm, the set of mechanisms of adaptation and pre-emptive actions, the method of estimating the efficiency of innovative projects proposed above, ensure appropriate management decisions and the evaluation of their effectiveness and efficiency.

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THE EVALUATION OF AN ACCOUNTS RECEIVABLE REDUCTION IMPACT ON THE FINANCIAL PERFORMANCE OF AN ENTERPRISE

А.Н. Левенцов, В.А. Левенцов

ОПРЕДЕЛЕНИЕ ВЛИЯНИЯ СНИЖЕНИЯ РАЗМЕРА ДЕБИТОРСКОЙ ЗАДОЛЖЕННОСТИ НА ФИНАНСОВЫЕ РЕЗУЛЬТАТЫ ПРЕДПРИЯТИЯ

The article discusses the major definitions of accounts receivable, the generation of an enterprise's accounts receivable management system, and the minimization of bad debts appearance risk. The main factors for assessment of the accounts receivable turnover are presented; an approach to evaluate the impact of accounts receivable reduction on the financial performance of an enterprise is proposed.

ACCOUNTS RECEIVABLE OF AN ENTERPRISE. REDUCTION OF ACCOUNTS RECEAVABLE. FINANCIAL PERFORMANCE. ACCOUNTS RECEIVABLE MANAGEMENT. ACCOUNTS RECEIVABLE RETURN.

Рассматриваются основные определения дебиторской задолженности, построение системы управления дебиторской задолженностью предприятия, минимизация риска возникновения у него безнадежных долгов. Представлены основные показатели оценки оборачиваемости дебиторской задолженности, предложен подход по определению влияния снижения размера дебиторской задолженности на финансовые результаты предприятия.

ДЕБИТОРСКАЯ ЗАДОЛЖЕННОСТЬ ПРЕДПРИЯТИЯ. СНИЖЕНИЕ РАЗМЕРА ДЕБИТОРСКОЙ ЗАДОЛЖЕННОСТИ. ФИНАНСОВЫЕ РЕЗУЛЬТАТЫ. УПРАВЛЕНИЕ ДЕБИТОРСКОЙ ЗАДОЛЖЕННОСТЬЮ. ОБОРАЧИВАЕМОСТЬ ДЕБИТОРСКОЙ ЗАДОЛЖЕННОСТИ.

When companies conduct their business and operations, dispatch products, execute work or provide services in a market, in most cases, they do not get money from their customers immediately. As a result, from the moment when the work is executed or the service is provided and until the moment when the money is obtained, the supplier ends up with the so called 'accounts receivable', and practically all enterprises, at some point, encounter problems in recovering them.

Nowadays, economists introduce a number of definitions for accounts receivable. Thus, to name just a fur, accounts receivable are 'total debt which results from sale of products (work, services) under conditions of payment deferment and which is to be returned to a company by its counteragents' [1], 'debts of various companies and individuals to an organization, which result from its business operations' [2], 'the right of an organization to demand financial and non-financial assets which emerge from liabilities of other companies and individuals due to agreements in business operations in order to assure an acceptable financial stability level [3], 'the amount of debts to be paid to an enterprise, firm, company on the part of other enterprises, firms, companies and individuals who are their debtors' [4]. To sum up, in general, amounts receivable are debts of companies and individuals (debtors) to an enterprise for the work of service the former has executed but has not been paid for. It corresponds with both international and Russian accounting standards.

In case debtors do not comply with the obligations they have accepted (i. e. they do not pay for the goods or services provided in due time), an enterprise deals with the so-called 'overdue' accounts receivable. Moreover, the funds they comprise are extracted from its business turnover, which affects the financial condition of the enterprise. Growing accounts

receivable cause an increase in the expenditures for the enterprise's borrowed capital and contribute to costs of the enterprise, which brings along a decrease in profitability and liquidity of the enterprise's working capital and, eventually, negatively influences its financial stability.

To manage the enterprise's accounts receivable means to regulate them using both quantitative and qualitative indicators. As for the optimization of the enterprise's business operations, it is essential to generate an effective system of recovering accounts receivable, because their growth entails a decrease in liquidity of the enterprise and in its economic results.

In the conditions of continuing recession of the world economy and, therefore, decline in the consumer's demand, Russian companies use deferment of payments for the goods supplied or services provided as one of the major ways to increase sales. If the payment discipline is not high enough, their credit risks go up. In addition, when a dispatch volume and a payment deferment increase, the sales turnover and warehouse stock volume grow and accounts receivable increase. Correspondingly, the increment of an enterprise's assets causes an increment of liabilities and increases the company's credits and loans servicing costs.

All these can contribute to a general decrease in an enterprise's financial stability.

At this point, an important issue is to evaluate the impact of a decrease in the amount of accounts receivable on the financial performance of an enterprise, as financial experts, asa rule, assess the accounts receivable turnover coefficient and the duration of its one turnover cycle.

Most common problems encountered by enterprises which credit their clients are:

1) the lack of comprehensive and reliable information about debtors;

2) insufficient control over overdue accounts receivable operations;

3) the fragmentation of data on current accounts receivable which is caused by the underdevelopment of the internal communication system between departments and divisions, branches and head offices, etc.

When generating an accounts receivable management system, the management of an enterprise has to sort out the following tasks:

– to organize up-to-date monitoring of accounts receivable and their analysis in the previous period;

– to develop rules for accounts receivable operations which are precise and clear for the company's employees and counteragents;

– to define possible amount of the working capital directed to accounts receivable due to the provision of deferment for the customers;

– to set a credit conditions system for the customers, including a system of discounts and penalties;

– to create standards for customers' assessment and differentiation of conditions for credit granting;

– to develop staff motivation schemes for employees engaged in the return of accounts receivable;

– to elaborate procedures for the collection of accounts receivable, including the ones related to the recovery of overdue payments both single-handedly and in court;

– to build an efficient control system for the flows and the timely collection of accounts receivable [5].

The efficient management of accounts receivable calls for a complex and systematic approach which cannot be narrowed down to sorting out particular problems (a search for an ideal customer, debt recovery in court, etc.). The purpose of the management system is to decrease the enterprise's risks, to optimize activities of all its employees, and to save time when it comes to management decisions.

To minimize risks of bad debts, T. Karimova and N. Plaskova suggest a three step algorithm, which, in our opinion, is of practical interest [6]:

Step 1. Elaboration of analytics for record keeping. At this stage, it is important to collect the necessary information about:

– distribution channels;

– types or categories of products to be sold;

– risks, related to certain counteragents.

Step 2. Preparation of report on accounts receivable status. In order to receive the information about overdue periods and expected dates of getting the money from counteragents, a management report on accounts receivable status should be prepared with due consideration of:

– the time when money is expected to arrive for the deferment payment delivery that has been executed;

– an overdue period of payment;
– the amount of overdue debt.

Step 3. Reconsideration of current delivery conditions. The main purpose of this step is to minimize risks, i. e. to understand the consistence of the terms of the previously made contracts with the enterprise's interests. This task can be solved through individual talks with wholesale companies by shifting operation conditions with small retailers to prepayment.

The research, which has been done by the journal '*Finansovy Director'(Financial Director)* and factoring company *NFK* in order to find ways to reduce risks related to a product delivery on deferment payment conditions, has revealed that the best option is to work with reliable customers. Thus, more than 70% of the companies in the survey grant deferment only to the trustworthy clients [7, 12]. These include the companies which have been involved in cooperation for a period of not less than 6-8 months.

An efficient accounts receivable management requires the creation of a continuous debt monitoring and analysis system, the elaboration of the precise rules to determine counteragents who can be given payment deferment as well as regulations when cooperating with 'problem' debtors.

The efficiency of an accounts receivable management system is evaluated by financial experts of enterprises by various criteria. Thus, K. Zharaspaev, *Rover Computers* Vice-President, believes that the key criterion when assessing the efficiency of the accounts receivable management system is accounts receivable return. For E. Ageeva, Financial Director of *OOO Golder-Electronics*, the key criterion is correspondence of actual accounts receivable turnover figures, their average payment period, and the share of problem debts in the total volume of debt to the planned indices. S. Vorobiev, Financial Director of *OOO Relief – Centre*, assesses the efficiency of the accounts receivable management system primarily by current overdue debt, its volume, the period of overdue payment, and the prospects of getting these amounts from the customers. Y. Lutsenko, Director of the financial department of *ZAO Mezhdunarodnaya Torgovaya Kompania 'Alisa'*, supposes that the accounts receivable management system is efficient if the volume and duration of the overdue debt and the turnover of the total accounts receivable are lower than the established standards, the customers' credit limits are not exceeded, and the debt return history is positive. M. Konovalova, Financial Director of the *laStyle* company thinks that one of the important factors is the balance between accounts receivable and the total sales volume. Furthermore, the company has established a limit which prevents funding accounts receivable when it becomes unprofitable and when sales promise losses [8, 13].

To determine how efficiently working assets are used (to evaluate accounts receivable turnover and their change dynamics), the following major indices, being general analysis tools, are traditionally calculated [9]:

1. Accounts receivable return coefficient (C_{ARR}):

$$C_{ARR} = \frac{S}{\overline{AR}}, \quad (1)$$

where S – sales return on goods, work, services and other property (excluding indirect taxes) for the period reviewed; AR– average amount of the accounts receivable balance.

This coefficient reflects the number of accounts receivable turnover cycles in the period reviewed, i. e. how many times they emerge and are paid within this period.

2. The coefficient of fund consolidation in accounts receivable (C_{CAR}), characterizes the amount of accounts receivable for 1 ruble of sales revenue and is the index opposite to the return coefficient:

$$C_{CAR} = \frac{\overline{AR}}{C}. \quad (2)$$

The lower the consolidation coefficient is, the more efficiently the funds that have been advanced into accounts receivable are used.

3. The average duration of one accounts receivable turnover cycle in days (recovery period) (D_{ART}):

$$D_{ART} = \frac{D \cdot \overline{AR}}{R}, \quad (3)$$

where D – number of days in the period reviewed (30, 90, 180, 270, 360).

This index demonstrates the average number of days needed for accounts receivable payment (recovery). The higher it is, the more mobile the structure of the enterprise's property is. Growth

of this index indicates a decrease in the liquidity of accounts receivable.

However, as A. Klementiev rightly believes, there is a problem with a correct evaluation of this index and, consequently, there is a risk of making wrong decisions [10]. The most common mistake is to use the net profit index from the profit and loss account in this formula, i. e. profit minus indirect taxes (VAT and excise taxes). Since accounts receivable comprise indirect taxes, there appears a problem related to the incomparability of the indices. In such a case, the period of turnover, calculated by the aforementioned formula (3) becomes worse than it really is, especially when the company pays excise taxes.

But even if the sales revenue figure is correct, this index can be significantly distorted as the revenue from sales of products is usually defined upon dispatch, whereas accounts receivable decrease at the moment the money is paid. The dispatch of products entails accounts receivable growth and, at the same time, increases its turnover, since it is the denominator in the formula. There can be no real decrease in the period of turnover, because there is no payment for the goods dispatched. This problem is common for enterprises which aggressively increase volumes of sales through payment deferment enlargement.

The problem can be avoided if we add to the formula (3) not the return 'on dispatch' but the amount of money actually paid for the products, goods or services that have been delivered or provided. In this case, the financial director can project cash flows and accounts receivable more precisely for the forthcoming periods and, eventually, increase the quality of planning.

Also, it is reasonable to apply the method which is often used when analyzing accounts receivable and which allows the evaluation of their 'real value' with due consideration of payment time and payment delay period. This method helps define the discounted cost of accounts receivable [11]:

$$PV = \sum_{k=1}^{N} (p_k FV_k e^{-it}), \qquad (4)$$

where PV – present value index of accounts receivable; p_k – possibility of k group accounts receivable payment (value 0-1), to be assessed in the expert way on the basis of payment guarantee which the customer provides or through the analysis of debt in the context of payment dates; FV_k – amount to be paid into account in future (corresponds to the balance cost of k group accounts receivable); e – constant ($e = 2{,}718282$); i – discount rate which characterizes the opportunity costs of assets ownership (for example, refinancing rate, bank crediting rate); t – expected period for accounts receivable payment (as a rule, one month).

The knowledge of accounts receivable discounted cost can also be used when calculating reductions offered to customers. For example, if it is 5% lower than its actual value with the payment period of one month, the enterprise can offer its customer 5% discount without damaging sufficiency of the working capital upon a condition of full prepayment for the goods delivered or service provided.

The results obtained from calculation should be used when identifying trends in accounts receivable change and when taking relevant management decisions.

It is recommended to carry out a general analysis of the enterprise's accounts receivable in the following directions [11].

Current condition analysis. At this stage, the current condition of accounts receivable is studied. The information is focused on the counteragents and the dates of the debt, which allows the enterprise to control the dates of payments for products, work, service and obtained advances in due time.

To simplify the count of inventory with counteragents and to reveal the overdue obligations of the customers, it is worth carrying out the *analysis by dates of accounts receivable.* When the data are provided in such a form, it becomes possible to control the quality of the enterprise's accounts receivable as a whole and with its groups. Moreover, if there are considerable debt amounts with more than three months' delay, it might be reasonable to initiate bankruptcy procedure in relation to particular counteragents or to use this argument as a leverage to influence the deliberate non-payers.

At the same time, it is not sufficient just to know the time when accounts receivable appear in order to understand their condition. The analysis has to be accompanied by the *analysis of accounts receivable by payment dates.*

Comparing data on volumes of dispatched products and payments, one can calculate the average payment rates by months and identify the average share of products which remains unpaid. In this case, dispatch should be understood as the volume of credit sales, i. e. it is only part of credit turnover in the 'Sales' account of the accounting records. Amounts of prepayment are not to be included in the calculation.

In addition to the suggested analysis, we recommend to conduct *a recovery coefficient analysis*. The calculation of this coefficient is one of the efficient methods which makes it possible to characterize the current condition of accounts receivable and forecast them. The essence of the method is to range accounts receivable (AR) as of certain dates by components according to the date when they appeared, for example: up to 1 month, from 1 to 2 month, from 2 to 3 months, etc.:

$$AR = AR_t + AR_{t-1} + ... + AR_{t-n}, \qquad (5)$$

where AR – amount of debt which appeared in the t period.

Then, *recovery coefficiencies* (C) will be calculated in the following way:

$$C_t = AR_t / S_t, \qquad (6)$$

where S – volume of sales with deferment in the t period.

The calculated *recovery coefficient* shows the percentage of debt which appeared in the corresponding month and remained unpaid by the end of the analyzed period.

Apart from the dates of payment and analysis of recovery coefficients, one can carry out an *ABC analysis*. It is based on the Pareto principle: a relatively small number of causes lead to the majority of possible effects. In practice, it is mostly used in the altered form as the '80 to 20 rule'. This means that 80% of amounts receivable is caused by 20 % of debtors.

In accordance with the *ABC method*, all debtors have to be classified as groups. Group A includes a small number of debtors with the highest level of specific weight in the accumulated amount of accounts receivable. Group B consists of an average number of counteragents with an average level of specific weight. Group C comprises of the majority of customers with insignificant amount of debt in relative terms. After debtors have been ranged by the degree they influence the liquidity of the company as a whole, the easiest way to follow is to analyze debt by date of appearance and payment, to calculate recovery coefficients, i. e. to use methods that have been described above.

When carrying out the analysis, it is worth considering that $\overline{AR}$ can be subordinated to the sales volume and average time period between sales of goods and receipt of revenue, which is defined by average duration of one accounts receivable turnover cycle in days:

$$\overline{AR} = \frac{R}{D}\frac{D \cdot \overline{AR}}{R} = R_{DA} D_{ART}, \qquad (7)$$

where R_{DA} – average daily revenue from sales of products, goods, work and service within the period analyzed.

After planning the average annual amount of accounts receivable for the year succeeding the financial one (for instance, after leaving it equal to the amount corresponding to the level at the end of the financial year) and after altering the formula (3) into the following one:

$$R_P = \frac{D \cdot \overline{AR}_P}{D_{ART_P}}, \qquad (8)$$

we, all other conditions being equal, get the volume of revenue for the next (planned) year.

In this formula $D = 360$ days;

$D_{ART\,P}$ – average duration of one accounts receivable turnover cycle in days in the planned year; $\overline{AR}_P$ – average annual amount of accounts receivable in the planned year.

Knowing the amount of sales revenue for the next year, it is possible to define the planned coefficient of amounts receivable turnover:

$$C_{ART_P} = \frac{R_P}{\overline{AR}_P}. \qquad (9)$$

The change in the coefficient of accounts receivable turnover in comparison with its value in the financial year can be calculated by the next formula:

$$\Delta C = C_{ART_P} - C_{ART} = \frac{R_P}{\overline{AR}_P} - \frac{R}{\overline{AR}}. \qquad (10)$$

After transforming this formula (10), we can define the increment of revenue ΔR in the planned year due to an increase of accounts receivable turnover:

$$\Delta R = R_P - R = \\ = C_{ART\,P} \cdot \Delta\overline{AR}_P - C_{ART} \cdot \Delta\overline{AR}_P. \quad (11)$$

Knowing this, we can use general methods to evaluate the enterprise's economic efficiency. Thus, in this case, the increment of revenue ΔR can be seen as an accounts receivable management economic effect. If we know costs C, related to the achievement of this effect, we can evaluate its management economic efficiency:

$$E = \frac{\Delta R}{C}. \quad (12)$$

To sumup, unlike traditional methods for the evaluation of the working assets employment efficiency, which are based, as a rule, on the assessment of accounts receivable turnover, the authors of the present paper propose an approach which makes it possible to evaluate the impact of decreasing accounts receivable amount on the financial performance of the enterprise and, finally, to calculate the economic effect and economic efficiency of accounts receivable management in a classical way.

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THE INTEGRATION OF THE PROJECT MANAGEMENT APPROACH INTO THE BUSINESS ARCHITECTURE MODEL OF THE COMPANY

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ИНТЕГРАЦИЯ ПРОЕКТНОГО ПОДХОДА В МОДЕЛЬ БИЗНЕС-АРХИТЕКТУРЫ ПРЕДПРИЯТИЯ

The effective business management should be provided by an appropriate management system which is based on the enterprise architecture. The latter provides the achievement of the strategic goals of a company by means of business processes and projects. Many representatives of the community emphasise society confess a great role of working with changes using a project approach. However, there is still no consensus about the place of project management system within the enterprise architecture.

The model of enterprise architecture developed in the paper defines the place of project management within the enterprise architecture. *This paper aims* to develop an approach to the enterprise business-architecture formation and to propose the means of modeling its all business components.

PROJECT MANAGEMENT. PROJECT MANAGEMENT STANDARDS. BUSINESS PROCESS. ENTERPRISE ARCHITECTURE.

Эффективное управление бизнесом должно обеспечиваться соответствующей системой управления, которая находит отражение в архитектуре компании. Последняя позволяет достигать стратегических целей бизнеса посредством реализации системы бизнес-процессов и проектов. Многие представители профессионального сообщества признают важность работы с изменениями в компаниях с использованием проектного подхода, однако в настоящее время до сих пор однозначно не определено место системы управления проектами в архитектуре предприятия.

Предлагаемая в статье модель архитектуры предприятия определяет место проектов в архитектуре предприятия. *Целью статьи* является развитие подхода к формированию бизнес-архитектуры компании и предложить средство моделирования всех компонентов бизнес-архитектуры в рамках единой модели.

УПРАВЛЕНИЕ ПРОЕКТАМИ. СТАНДАРТ УПРАВЛЕНИЯ ПРОЕКТАМИ. БИЗНЕС-ПРОЦЕССЫ. АРХИТЕКТУРА КОМПАНИИ.

Research problem. Dynamically changing conditions of modern business environment make companies face changes in everyday business life. Business in our days is run in the context of open markets and increasing competition. In such circumstances, companies need to build and maintain a flexible management system that would allow the company to operate efficiently and remain competitive. The management system of the company has to ensure the achievement of its strategic goals, to provide stability of operating activities and at the same time to allow the company to adapt easily to the rapidly changing business environment. The solution of the problem requires special approaches to deal with changes, in particular, approaches to planning, monitoring, resource allocation, allocation of the roles and responsibilities while implementing changes. In these circumstances, special attention is paid to project management activities.

A *project* is traditionally defined as «a temporary organization that is created for the purpose of delivering one or more business products» [1]. The project management approach has its own characteristics:

– consideration of the project as a unique combination of processes of project implementation;

– rights and responsibility for the project results achievement shared by the project manager and the project team;

– allocation of the project budget;

– use of the special design of the project organizational structure and the specific motivation of the project participants;

– the development and application of specific standards to the project processes [2].

The project approach is used in different fields: business, social, political, cultural, etc. – in those fields where there is a need to introduce changes and to address unique challenges. In many enterprises, each customer order is considered as a separate project. Such companies are called project-oriented; their projects are large enough, financial and/or resource-intensive and unique. For such enterprises it is critically important to have a systematic approach to project implementation. Typical project-oriented businesses are from such business fields as construction, real estate development business, engineering services, IT-consulting, development and implementation of IT-solutions, manufacturing on the order basis, etc.

But projects can be aimed not only at the realization of external orders, but also at the introduction of innovative initiatives within the company. Among the projects of this type, it is worth mentioning such widely implemented types of projects as business-processes re-engineering and process approach implementation, implementation of corporate information systems and company's website development, implementation of quality management standards, forming and reforming enterprise architecture, and other projects to address specific business challenges.

Project management is an area of management, covering the areas of industrial activity in which a product or a service is implemented as a unique set of interrelated activities restricted by certain requirements for time, budget and quality of the expected results. Taking into account increasing competition, the project management plays a significant role in companies; project-based approach to running business is becoming very popular in companies, a large number of companies in various fields of activity are faced with a need to solve business problems that can not be resolved through the standard routine business processes. It causes a need for the development and implementation of project-based solutions to solve business problems, which states the necessity of introducing the project approach to the enterprise management system. However, there is still no solution for the integration of process and project approaches so that to model and manage the business architecture effectively.

This paper aims to elaborate an approach to the enterprise business-architecture formation based on the principles of strategic, process and project management that would allow to resolve a lasting conflict between processes and projects within the management system of the company. The approach consists of a model of the business architecture that ensures interests of both process and project management and a model of project management processes that would provide a unified base for modeling process and project activities.

Methodology

Enterprise architecture – development of the concept.

So far, the term «enterprise architecture» was used mostly to define the structure of tools of IT system development and was considered to be the IT-area of knowledge. Now «enterprise architecture» is treated as a broader concept concerning the formation of the management system of a company from corporate strategic to IT hardware infrastructure – the initial definition became a part of the whole architecture concept.

The enterprise architecture traditionally means a series of different components of the management system and the relationship between them:

Corporate Enterprise Architecture is a system view of the key structural sections (certain key components and their relationships), applied to solve various practical problem of the organization [2, 3].

Enterprise Architecture is an interconnected set of principles, methods and models that are used in the design and building of organizational structure, business processes, information systems and infrastructure [4].

Enterprise Architecture is the process of translating business vision and strategy into the effective enterprise change by creating, communicating, and improving the key requirements, principles and models that describe the state of the enterprise and ensure its evolution [7].

These definitions allow us to conclude that enterprise architecture is a complex management

tool which is designed to provide effective enterprise management solutions in response to the challenges of the business environment. A heterogeneous structure of the enterprise architecture requires continuous alignment of the so called architecture layers. In the meantime, the need to follow the realities of today's business causes the need to reform and develop of enterprise architecture.

Currently, the management of many companies realizes the need for the development, formalization, and implementation of the management system, embodied in the form of a corporate enterprise architecture. The need for the implementation of projects (a system of interrelated projects) on the architectural restructuring is caused by the following reasons:

1. Absence of the precise strategy of management architecture development;
2. Absence of an integrated architecture adaptability to market conditions;
3. Discrepancy between the organizational structure and increased business demands;
4. Discrepancy between the organizational structure of companies and organizational structures of projects;
5. Absence of common corporate standards of project management;
6. Absence of precisely prescribed roles and responsibilities in the current organizational structure;
7. Absence of detailed and transparent business processes;
8. Need for the implementation of the enterprise information system [3];
9. The need for alignment of different architectural components – business architecture and system architecture.

The specific characteristic of the enterprise architecture is its heterogeneous composition. Traditionally, the components of the enterprise architecture can be represented as a set of layers comprising a set of structural components [5]:

– Corporate mission and vision, strategic goals and objectives;
– Business architecture: business processes, organizational staff structure, workflow system;
– System Architecture (IT architecture) applications, data, and hardware.

The paper [5] states: «Architecture (in accordance with the document «Federal Enterprise Architecture Framework. Dev. By: The Chief Information Officers Council (USA)») is a strategic information basis which supports the:

– structure of the business;
– information necessary to run business;
– technologies used to support business operations;
– transformation processes of development and transition necessary to implement new technologies in response to a change / the appearance of new business needs» [5].

The last point of the above list confirms that some researchers of the enterprise architecture recognize that dealing with change is the reality of today's enterprises. The enterprise architecture is a dynamic management tool, which requires a build-in mechanism for managing changes that is different from the routine operational processes. This fact, in particular, is emphasized in the enterprise architecture development approach of the TOGAF standards, known as the Architecture Development Method (ADM). This method claims, among other components, a phase named «Architecture realization», bringing together various aspects of the change activity performance related to enterprise architecture: «Architecture Realization artifacts capture change roadmaps showing transition between architecture states and binding statements that are used to steer and govern an implementation of the architecture» [6].

Hence, the need to address the unique challenges and achieve unique results determines feasibility of incorporating the project management technology into the overall management system of the company. Every modern company needs a project management as a mechanism ensuring the flexibility of and conformity with decision making in a rapidly changing business environment.

Business architecture – authors' approach. The definitions and the concepts of the resresentatives of the professional society mentioned above (for example, in [5]) prove the need to add the project viewpoint to the business architecture model. The authors propose to consider project management as one of the

subsystems of the enterprise management system which is presented in the enterprise architecture. This, updated, business architecture:

– provides a company with an effective tool to run projects;

– provides an integration between project management processes and processes of the whole company management;

– provides an effective mechanism of balancing the interests of the operating and innovation activities of the enterprise, i. e. coordination of the interests of process and project management approaches based on the unity of the strategic guidelines.

The authors propose the following development of common approaches to enterprise architecture (Fig. 1), reflecting the list of structural components of the enterprise architecture and the relationships between them. Proposed in this paper, the concept of enterprise architecture describes the structural representation of a set of inter-related and inter-determining logic levels of enterprise architecture which includes a project approach as a component of business architecture.

The structural elements of the enterprise architecture (see Fig. 1) are connected and determine each other as described below. The activity of any enterprise is focused on and determined by business objectives. Therefore, the starting point for the formation of an enterprise architecture is the definition of such categories as mission, vision, and strategy – these categories are on the top of the management pyramid (see Fig. 1). They define the desired image of the business and determine the direction of movement towards it. Mission, vision and strategy are specified by the set of strategic goals and objectives that define the key components of the desired image, and set the roadmap for business. Setting such a high level categories as mission, vision, strategy, goals and objectives is the responsibility of the owners and/or top-management of the enterprise.

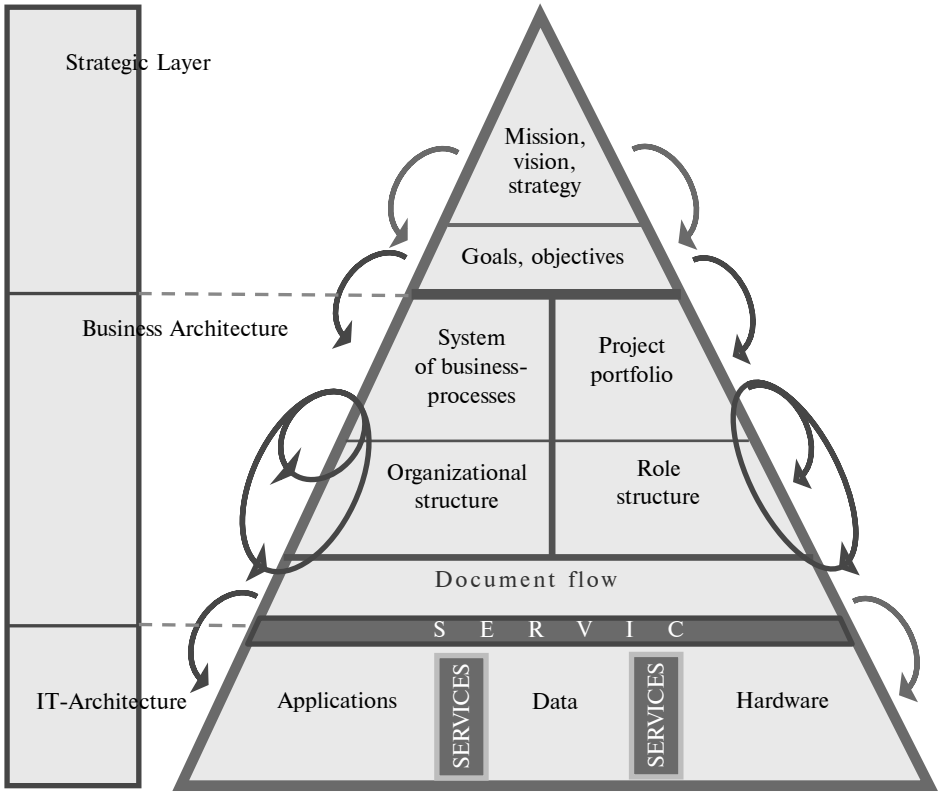

Fig. 1. Logic levels of enterprise architecture

Regardless of the specifics of a particular system, systems theory identifies two types of objectives for each system – the goals of stabilization and the goals of development. The goals of stabilization are aimed to preserve the achieved level of development and operation. The goals of development are aimed to create additional resources that the system does not have, or achieve some new states to which it aspires. It makes sense for the enterprise as a business system as well: the goals of stabilization serve to provide effective operations and stability in the present, while the goals of development are responsible for dealing with changes that allow the business to grow and be competitive in the long term. Different types of goals require different approaches to the organization of activities of their achievement: the system of business processes – to achieve the goals of stabilization, the portfolio of projects – to achieve the goals of development (see Fig. 2).

The business process is «a special process that aims at the implementation of the basic objectives of the enterprise (business objectives) and describes the central sphere of its activity» [9]. The business processes as «a stable (regularly repeated), targeted set of interrelated activities, which, according a certain technology, transforms inputs into outputs of value to the consumer (client)» [8]. The organizational structure is a stable set of interrelated and inter-subordinate organizational units to coordinate human resources of the company. «The process approach to management is a construction of a system of processes, control of these processes in order to achieve the best results by improving efficiency and customer satisfaction» [8]. In modern enterprises implementing process management involves description, regulation, and reforming of business processes system and the organizational structure, which ensures business processes performance. The purpose of the implementation of the process approach is to ensure the stability and reproducibility of the results.

Projects, as well as business processes, are aimed at creating a certain result, but, in contrast to the business processes, projects create unique results; and after achieving them, the project structure has no more reasons for existing. Despite the fact that the implementation of various projects involves the implementation of a typical set of business processes, the managed objects, the owners and the performers of these business processes will vary from project to project. That is why, the implementation of each project requires a clear framework of roles and responsibilities – the so called role structure, roles being performed by different individuals in different projects. The purpose of the implementation of the project approach is to provide effective solutions to the unique challenges, which occur in the company due to the need to respond to changes in the business environment.

Business architecture forms certain demands for the IT architecture that are transferred and are met through a set of services. The same service interaction takes place between application architecture, data architecture and technical architecture. (A detailed analysis of the IT architecture is beyond the scope of this paper.)

Modeling of business architecture. The creation of the management system of the company starts with the modeling of its architecture . Currently, there are a lot of enterprise architecture modeling tools, such as ARIS, Business Studio, Atchi2 and others. Concerning business architecture modeling, these tools offer a means of modeling business processes, organizational structure, and document flow. Within the framework of project approach, the business architecture requires appropriate tools for modeling project activities. It is reasonable to provide a unified framework for modeling of all the management subsystems.

As for the business processes, the official history of their modeling began in the 1970s with the establishment of a methodology for functional modeling called IDEF0. Thus, the business processes modeling has more than 40-years history and many modern business model tools (such as ARIS, Business Studio) are equipped with a full range of functional languages (notations) for business process modeling (IDEX , EPC, BPMN, etc.).

Currently, there is a number of international and national project management standards. The analysis of the most common project management approaches (standards) aims to identify a common basis for modeling project activities.

The most recognesed approaches within the world professional society are those developed by such organizations as the Cabinet Office (United Kingdom), PMI (USA), IPMA (Switzerland), Microsoft (USA), etc. The methodology of each organization is documented in the form of a guidelines – Managing Successful Projects Using PRINCE2 (Cabinet Office), PMBoK (PMI), ICB (IPMA), MSF (Microsoft) correspondingly – and is associated with a certain system of professional certification. These methodologies are developed by leading professional associations and organizations, and are the result of analysis, synthesis and formalizing of best practices in project management.

Most of the standards in the field of project management cover all major areas of project management, including cost, risk, quality, personnel management. Each standard addresses this subsystem from different points of view.

For the effective implementation of project management activities, it seems appropriate to introduce a single enterprise corporate standard. Its implementation is intended to provide a general understanding of the goals and procedures of project management by all project participants due to a common methodology and uniform terminology to guarantee more effective communications within and outside the project team. As a basis for the corporate standard of project management in a particular company it is possible to implement one of the well-known methodologies adopting it to the company environment.

This paper includes a brief review of the structure of the standards of project management, mentioned above. For project management model within a business architecture model of a particular enterprise it is acceptable to use any of the recognized standard methodologies mentioned above or a own corporate project management standards developed in a company.

PRINCE2 (Projects in a Controlled Environment) is a structured project management method developed by the Cabinet of Ministers of the United Kingdom of Great Britain and Northern Ireland (Cabinet Office), which is a de - facto standard for project management of the Government of the United Kingdom and some European countries. The structure of PRINCE2 method includes the following elements:

– 7 principles – the basic rules that underpin the management of the project and require to constantly follow them throughout the project life cycle;

– 7 themes – the dynamic objects of project management having a particular relationship between each other;

– 7 processes – a structured list of activities aimed at achieving the project objectives [1].

The main features of the standard PRINCE2 are: product-focused planning, division of the project into manageable and controllable stages, flexibility with regard to the scale of the project, prescribed organizational structure of the project management team, which allows to clearly separate the responsibility for decision-making between different management levels. The method focuses on how to operate the project at various stages, and provides a clear algorithm for the organization of the management of the project, which makes it possible to tailor a project for any size and business field.

The disadvantage of the method often points to the lack of specific techniques of implementation of certain activities in the project (eg, budgeting, scheduling, etc.). Other experts note that as a degree of freedom: each manager chooses his/her own (or adopted by the company) methods and approaches to performing certain activities. In addition, PRINCE2 is positioned as the standard applicable to projects of all sizes and areas of activity.

PMBoK (Project Management Body of Knowledge) a national standard in the USA has become popular among professionals in many other countries. It is the body of knowledge on project management developed by Project Management Institute (PMI). The structure of the standard includes:

– 5 groups of processes covering project management throughout the project's life cycle: the processes of initiation, planning, executing, process monitoring and controlling, closing;

– 10 knowledge areas that must be managed in each project: project integration management, project scope management, project time management, project cost management, project quality management,

project human resource management, project communications management, project risk management, project procurement management, project stakeholders management [10].

Generally PMBoK interprets project as a set of structured processes. The standard names the actions to be taken in the management of each area of knowledge, prescribes the tools and methods for their implementation in sufficient detail. PMBoK provides specialists with unique knowledge for project management and knowledge related to other management disciplines as well. However , while the PMBoK contains the principles managing project in general, the standard does not provide a clear holistic project management algorithm: when, how often, what processes should be applied. Often, the difficulty of using PMBoK for small projects is also mentioned.

It is worth mentioning that in September 2012 the International Organization for Standardization adopted a project management standard ISO 21500, based at the PMBoK, and this standard was approved as a project management standard by the Rosstandart (Russia).

The methodology of IPMA, known from the guidelines called ICB (IPMA Competence Baseline), describes the requirements for the competence of the expert in the field of project management. ICB identifies 46 elements of competence, which are divided into 3 groups:

– technical competence (20 competencies) – project management techniques;

– behavioral (15) – the professional behaviour of personnel engaged in project management;

– contextual (11) – dealing with the project in the context of programs and portfolios.

ICB mostly addresses individual managers, focusing on the acquisition and implementation of professional competences in the field of project management, rather than on companies planning to implement a corporate project management standard. The ICB manual does not describe the full-scale project management process.

The basis of the MSF approach (Microsoft Solution Frameworks) by Microsoft is a typical practice used by the software development methodology. MSF technology consists of the following elements:

– 2 models: MSF team model and MSF governance model;

– 3 disciplines: project management discipline, risk management discipline, training management discipline.

Regarding the organization of the project team, MSF offers an original approach to integrate members of the team in the role clusters, typical of IT-projects. The process model also suggests splitting the project into phases, following the logic of the implementation of projects in the field of IT-solutions, and is characterized by a certain flexibility by eliminating strictly prescribed procedures.

The proposed review of project management standards allows us to conclude that the basics of project management standards are:

– guideline;

– set of aspects that describe some certain sections of project management;

– the system of business processes.

As each project management standard requires the implementation of certain system processes, the current paper's methodology is based on the fact that the project is implemented as a set of specific actions related in some way to achieve your business goals, which determines the unique solution of the problem faced by the project management team. This set of actions determines the system of business processes of the project. Therefore, consideration of the project as a temporary process-oriented organization provides the possibility of modeling the project activities on the basis of the process approach [6, 9–11].

As a methodological basis for a demonstration model of project management processes was chosen the PRINCE2 methodology (Fig. 2) because this standard, according to the authors, reflects a structured approach to project management. This conclusion is based on the following characteristics of PRINCE2:

– systematic understanding of the project management process model with prescribed inputs, outputs, events that initiate the process;

– decomposition of the main processes (up to the third sub-level of decomposition), representing a clear algorithm of project management at various management levels;

– a clear definition of process owners («roles and responsibilities» in terms of process management) for all project management processes;

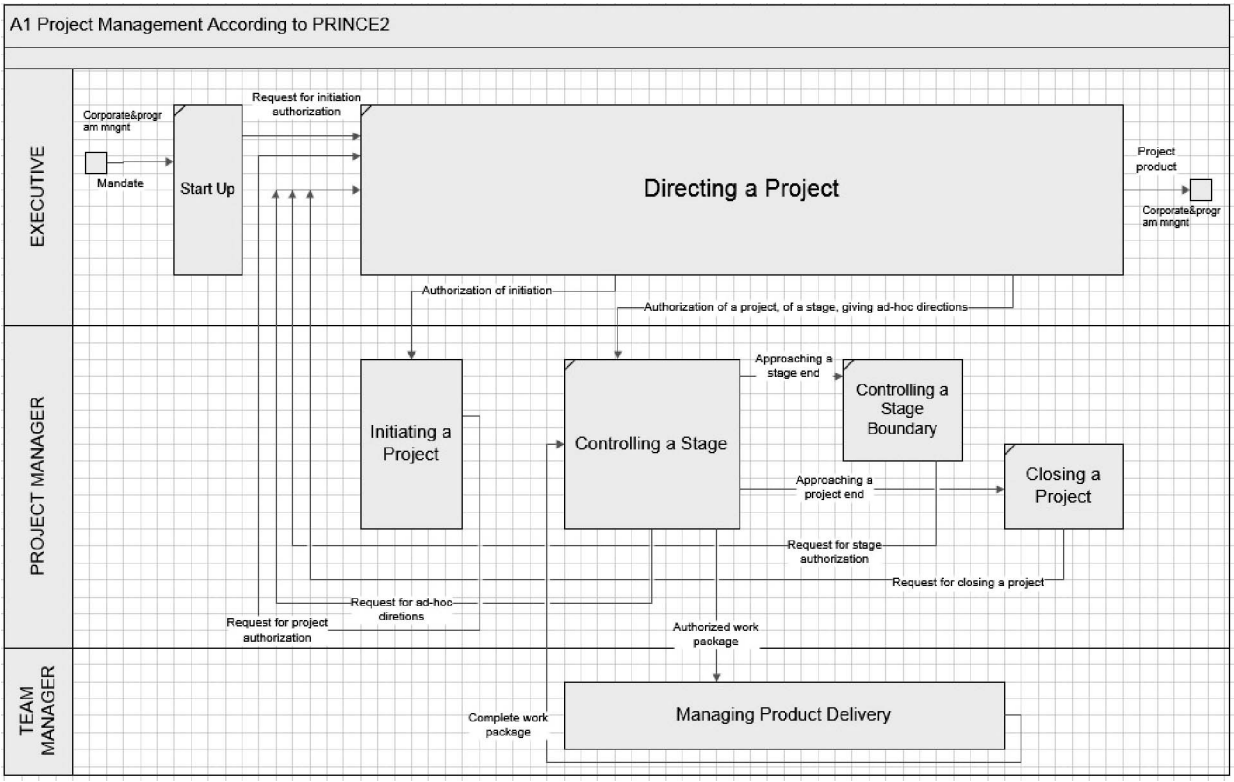

Fig. 2. Landscape of business processes of PRINCE2 project management standard

– document flow system, which accompanies all processes of project management, and the availability of typical document templates.

Fig. 2 shows a model of 7 processes of PRINCE2 which form the landscape of business processes (processes of the first level of decomposition) of project management (using the process modeling notation «Procedure»): Starting Up, Directing a Project, Initiating a Project, Controlling a Stage, Managing Product Delivery, Controlling a Stage Boundary, Closing a Project. Modeling was performed in the business modeling tool Business Studio 4.0.

A detailed description of the sub-processes (which is provided in the PRINCE2 manual) allows to decompose each of the processes and create a model of all processes in any notation corresponding to the rules of decomposition. Modeling of project processes using process modeling tools creates a unified basis for modeling the company enterprise architecture in order to provide effective business performance.

Conclusions. The necessity to meet challenges of everyday business life forces companies to implement approaches of dealing with changes into its management system. It is the reason to add the project viewpoint to the traditional business architecture models. Project management approach together with corresponding role structure of the project management team is supposed to provide a company with an effective tool of introducing innovations while a process approach intends to fulfill operational activities. Such a model of the business architecture allows to fully realize the strategic objectives of the company, to provide sustainable development of the company in the present and in the future. The business architecture formed according to this approach will create the preconditions for the further business growth.

The authors' vision of enterprise architecture and, in particular, a layer of business architecture, is reflected in the model of logical levels (Fig. 1) and in the process model of project management (Fig. 2). The models developed are intended:

– to provide effective communication of process and project activities within the same management system,

– to ensure integration of project management processes with general management processes,

– to give an effective instrument for modeling processes and projects within a single enterprise architecture model to practitioners.

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PRICING IN THE WIRELESS TELECOMMUNICATION COMPANY

Т.П. Некрасова, Е.Е. Аксенова

ЦЕНООБРАЗОВАНИЕ В ТЕЛЕКОММУНИКАЦИОННОЙ КОМПАНИИ СОТОВОЙ СВЯЗИ

The methodical basics of pricing of wireless communication services are considered. As a result of the performed calculations, a monthly fee and a time rate payment are determined.

TELECOMMUNICATION. WIRELESS SERVICES. PRICING. SERVICE FEE. TIME RATE PAYMENT.

Рассмотрены методические основы формирования цены услуг сотовой связи. В результате проведенных расчетов определены величины абонентской и повременной плат за эти услуги.

ТЕЛЕКОММУНИКАЦИИ. УСЛУГИ СОТОВОЙ СВЯЗИ. ЦЕНООБРАЗОВАНИЕ. АБОНЕНТСКАЯ ПЛАТА. ПОВРЕМЕННАЯ ПЛАТА.

A rapid development of information and communication technologies has molded the most perspective ways on the market of information services. In the order of significance, they are: mobile wireless telecommunications, internet, broadband communications (stationary and mobile), stationary telecommunications. It should be pointed out that stationary telecommunications is in downtrend now. Taking into account that wireless telecommunications has become the major service provided, pricing in this sphere seems to be of importance.

The principles of pricing in telecommunication services are:

- orientation on the market situation while maintaining a competitive level;
- affordability (attracting new clients);
- clients' loyalty;
- flexibility in various stages of the services' lifecycle.

While pricing, the main pricing factors that influence the costs of a service, should be taken into account. They can be divided into technologic, economical (both external and internal) and sectoral factors. The set of factors, influencing the price of wireless communication services is represented in Fig. 1.

The well-known pricing model consists of the following stages:

- determination of the firm's goals;
- demand analysis;
- costs analysis;
- competitors' prices and products analysis;
- methods of pricing analysis;
- the final price determination.

This pricing method has been adjusted for a wireless telecom operator on the Fig. 2.

The first stage – requirements and goals of pricing

In the worldwide practice one can point out three main goals of pricing that are applicable to a telecom company:

- profit maximization;
- sales maximization;
- market stability.

In a case when managers of a telecom company are primarily concerned with boosting up sales, building up a reputable brand name, increasing the market share, a policy of price penetration seems to be applicable. The policy suggests setting up of reduced prices during the initial period, i. e. pursuing pricing competition. For profit maximization, one can set up prices with a high-level profit margin provided that the market condition and the services quality gives an opportunity of sustaining such a price. This may not be used any time as many factors may appear obstacles – new competitors on the market, when maintaining the sales volume is of importance. If the telecom company is not a monopoly or oligopoly and operates as a price-taker, it will maximize profits through varying sales volumes.

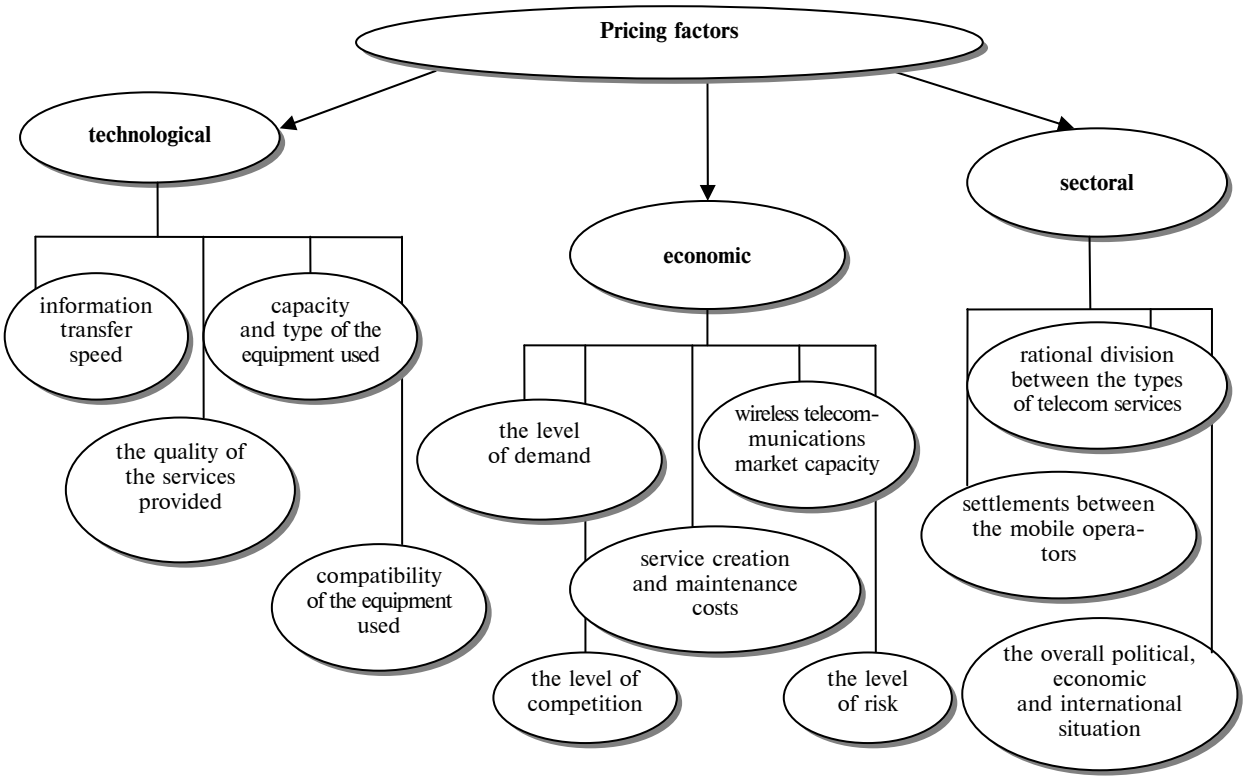

Fig. 1. The major pricing factors concerning the wireless telecommunication market

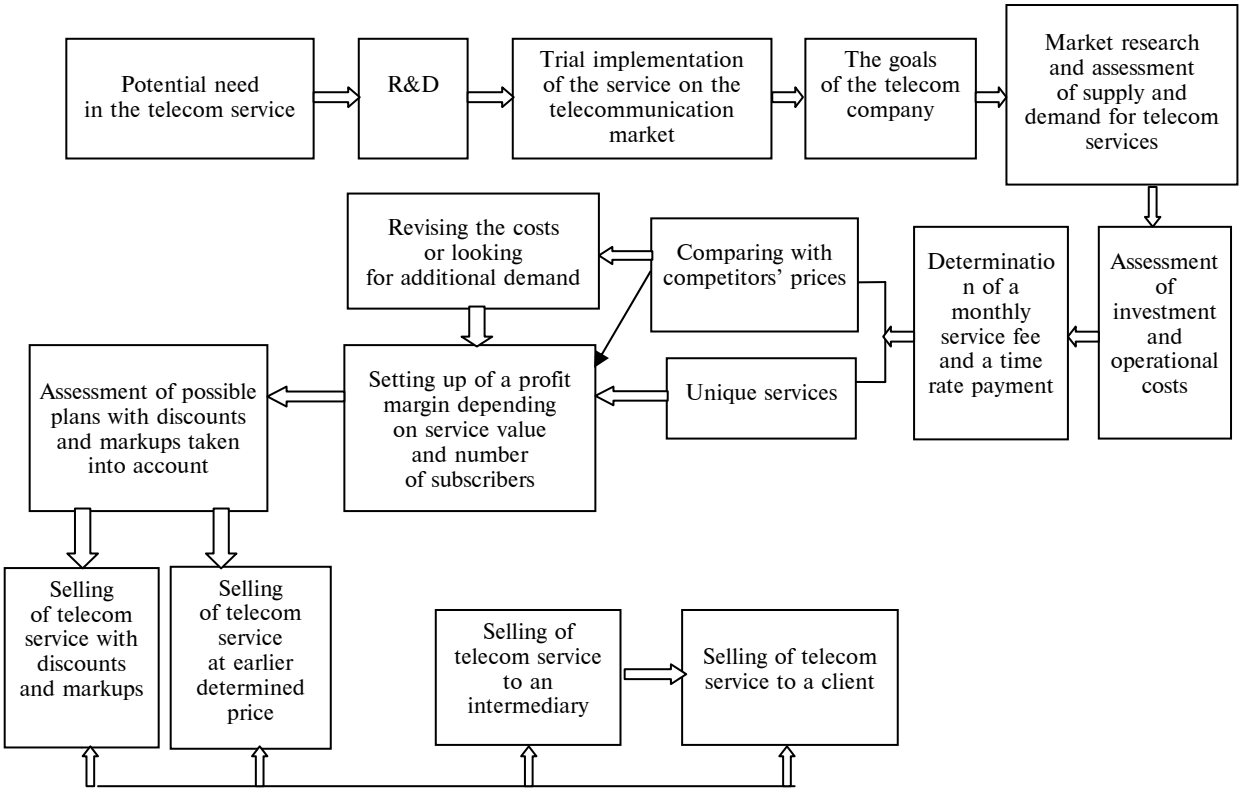

Fig. 2. The diagram of wireless telecom pricing

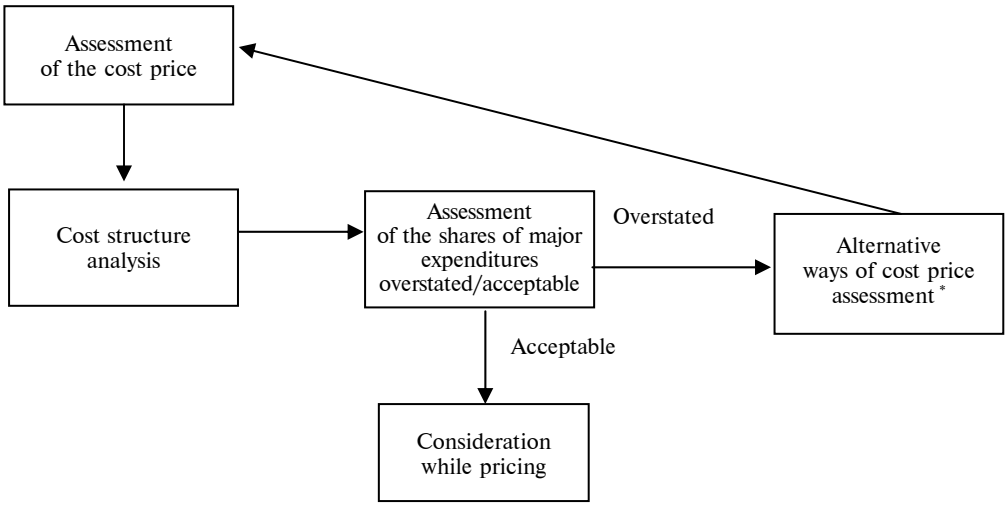

Fig. 3. The stages of telecom services cost analysis
* Selection of other suppliers of equipment and accessories is carried out

The pricing policy focused on stability, say, of assortment of the provided telecom services, is very widespread. The introduction of new services increases the level of risk for a telecom company and requires large-scale investments. Consequently, sometimes it is much more reasonable to extend the lifecycle of the existing services by using a discount system.

The second stage – demand analysis

Demand means the volume of services that can be purchased during a certain time period at a certain price provided all other factors stay unchanged. The demand dependence of external and internal factors can be expressed in the following way:

$$Q_d = f(P, Ps, Y, A, D, R, T);$$

$$Q_d = b_1P + b_2Ps + b_3Y + b_4A + b_5D + b_6R + b_7T,$$

where P – the price of the telecom service; Ps – the price for a substitute service; Y – customers' income; A – advertising of this telecom service; D – number and age structure of the customers; R – interest rate on consumer credit; T – characteristics of consumer tastes; b_1–b_7 – the coefficients of demand elasticity of consistent factor.

The demand analysis determines the needed production volumes for the provided telecom services.

The third stage – costs assessment and looking for the ways of their reduction

The reduction of the cost price leads to higher profits from each telecom service traded and facilitates the choice of financing schedule, while minimizing debt service.

Cost analysis for telecom services production and selling could be fulfilled according to the diagram in Fig. 3.

The analysis of the telecom services cost structure allows to estimate a share of each cost type in total. It becomes evident which elements determine the cost price, and which can be cut. It should be mentioned that fixed costs constitute approx. 92 % in the telecom services cost structure.

Having assessed the costs that determine the lower price boundary, one can estimate the initial price for the telecom service. This price affects the overall profit, economic efficiency of the production and, finally, the living standards of the society. The price for the telecom services depends on demand and supply, the volume and assortment of services provided, the costs of production and circulation and the number of intermediaries. For each participant of the producer-customer chain, the price includes the costs of service itself, the costs of marketing and the added value at every stage. The price, the costs and the profit are related in an equation:

$$W_p = \sum_{i=1}^{N} q_i z_i - \sum_{i=1}^{N} q_i p_i,$$

where W_p – profit from the telecom services traded; q_i – quantity of type i telecom service; z_i – price of type i telecom service; p_i – cost price of 1 unit of type i telecom service.

Pricing strategies

Competitive	Differentiated pricing	Assortment pricing
Market penetration strategy	Discount on the second market strategy	«Set»-strategy
«Cream skimming» strategy	Periodical discount strategy	«Kit»-strategy
Neutral strategy	Random discount strategy	Cost-plus strategy
Pricing strategy according to the implementation curve		«Image»-strategy
Pricing strategy of signalizing		
Geographical pricing strategy		

While pricing the breakeven sales volume is taken into consideration, where the total revenue equals the total costs. To determine the breakeven sales volume, we can use the breakeven production point method (BEP).

The minimal price can be calculated based on the costs with the following formula:

$$P_{\min} = C/(1 - R),$$

where C – the cost price of the service; R – the minimal acceptable profit margin in the price.

The calculated initial price specifies a possible market entry strategy. The pricing strategies known in the international practice are presented in Table.

The initial price on the telecom services' market is usually set at a relatively high level, i. e. these companies follow the «cream skimming» strategy. This price is stipulated by high expenditures. As the demand on the service expands and the number of clients grows, the price usually goes down because of decreasing marginal costs.

The choice of the strategy can't be made without fulfilling ***the fourth stage of pricing – analysis of competitors' products and prices.***

The level of competition on the wireless telecom market depends on many factors. Among them is the number of mobile operators in the region, their characteristics (supported wireless technology, federal or regional operator), their marketing strategies (entry to the market, preserving of the market share, redivision of the market, etc.), the progress the wireless communication market has made so far in the region (inception, upsurge, maturity, etc.) and a general economic situation in the region. The level of competition on the wireless communications market has direct influence on the penetration degree in each region.

The fifth stage – the pricing method

One of the most popular pricing method is called cost-plus pricing. According to it, the price consists of three elements:

- variable costs per unit;
- average fixed costs (overheads);
- marginal profit.

The application of the method implies the use of the most appropriate profit margin and the justification of the profit margin within the selling price, which should reflect the influence of all major factors on the telecom company. One of the methods used in the cost-plus pricing is the determination of the price using a profit-cost ratio standard.

$$P_t = C_{1t}\,(1 + R),$$

where C_{1t} – expenses of the production and selling of telecom services in period t; R – profit margin.

Because of shorter pay-back times for the investments, it is recommended to use a unified profit margin, calculated in relation to the total costs of production.

The calculation of the price according to the cost-plus method is only the first step of the price determination. The type of the service provided can lead to some price corrections reflecting political, social and economic factors. As a result, a mutual subsidizing system appears. One can talk not only of mutual subsidizing between separate services, but also between groups of clients. As a rule, this process goes at the expense of the so called business segment.

The system of mutual subsidizing is needed at some stage, where the wireless communications' development level doesn't match the socio-economic requirements, where economic interests of mobile operators and social interests go apart, while the state plays an important regulatory role on the market.

The economic approach to pricing of the telecom services is primarily concentrated on the price as a function supply meds demand. The needed amount of services will be determined by multiple variables, including price, a possibility of making choice, consumers' income, prices of other goods and services (including the service substitutes), future expectations, taxes, advertising and affordability of credit. A research shows that, nowadays, consumers (especially from the business segment) pose even higher requirements on the quality and versatility of possibilities offered by the telecom services than on the price.

The optimal combination of market forces is when supply meets demand. The equilibrium price gives some certain information to the producers. A change in the equilibrium price is a sign to change output volume and to look for better technology. The demand curve can shift to the right due to the increase in consumers' income, or inflation expectations as well as changing fashion or political circumstances, or even due to population changes.

It means that, under this approach, the main thing is to find the equilibrium price. Under real market conditions, pricing is based not on optimizing methods, but primarily on gradual search (with a lot of unknown data) of the acceptable price. The market approach to pricing of services may depend on the type of market competition or on market segmentation (different clients may pay different prices for the same service). The calculation of the consumer-oriented price could be based on expert estimations and customers' survey.

In practice, wireless telecom companies set a price which secures economic viability, i. e. the price that covers all the expenses of the company both in the short and in the long run, and maximizes the profits. In order to increase the price competitiveness, the price which customers are ready to accept is also taken into consideration. In other words, the cost-plus pricing is combined with demand-oriented pricing.

The sixth stage – final price determination

While determining the final price, one important price-correcting factor is to be analyzed. That is the system of discounts and markups.

Trading discount – a certain percentage of the selling price.

$$P_c = P_p / (1 - M_{sp}),$$

where P_c – the selling price of the service traded; P_p – the price actually paid for the service; M_{sp} – trading discount in decimal points.

Trading discounts can be used not only by mobile operator, but also by its subsidiaries in order to attract new clients. Discounts on the wireless telecom market may also be caused by growing competition. The discount level shouldn't affect the gross profit indicator negatively (the latter can be even larger because of the increased number of services sold).

Service quality accounting

One of the possible ways of service quality accounting is the use of a quality coefficient? That can be defined as a percentage of the service selling price or a percentage of service fee.

$$P_1 = PK_{к,}$$

where P_1 – the final price; P – the initial price; $K_к$ – quality coefficient, percentage of the price.

This approach is however subjective and approximate because the same quality improvement can be estimated differently in telecom companies, so this quality coefficient, calculated through expert estimations, can vary.

If the company is unable to provide the service with the quality stipulated by the contract (equipment failure or unstable connection, failure of information transfer), the service price is to be lower. The percentage of this price corrections is set by the contract.

Price elements in wireless communications

The base price for wireless communications is the sum the client must pay for the first month. It can be defined as a single payment for the network access and a monthly service fee. This sum is not affected by the call duration:

$$P_2 = P_I + P_A + P_P,$$

where P_I – single payment for network access; P_A – the service fee; P_P – payment for the calls made or for the information downloaded (time rate payment).

The payment for the next month is simply the service fee plus the time rate payment.

$$P_3 = P_I + P_A .$$

Here the service fee can be calculated as a ratio of the total cost for producing and selling of the telecom services that constitutes the service fee to the number of clients.

$$P_A = C_2 / Q,$$

where C_2 – the total cost for producing and selling of the telecom services that constitutes the service fee; Q – the number of clients.

The time rate payment is determined as a ratio of the total cost that constitutes the time rate costs including profit margin to the total duration of the calls for the period

$$P_{\min} = \frac{C_1 R + C_3}{Q_{\min}},$$

where C_1 – the cost of producing and selling telecom services; C_3 – the total cost of the telecom services in terms of duration of the services provided; $Q_{\min}$ – total duration of the calls for the period; R – the profit margin.

Increasing the capacity of the equipment needed by the expanding telecom market leads to an increase in service production and selling expenditures because of an increase in depreciation, maintenance and service costs. The latter means peak wise increase in the service fee. Thus, the service fee tends to decrease during the initial period t where the number of clients is at a certain level (say, 1000). Later on, the expansion of additional capacities makes the service fee larger, but the increase is not as high as in period $t - 1$ because of a larger customer base.

It means that the service fee decreases not gradually, but in spurts. Managers of a telecom company may modify the level of a service fee and a time rate payment, whereas a redistribution of costs between the payments is also possible. Finally, the managers' choice determines the profit margin and is dependent on the overall market situation. While determining the service fee, the operator may use at least 4 variants with each additional 1000 clients: maximal service fee level, intermediate service fee level (the mean level), minimal service fee level, and the real service fee level which fluctuates constantly.

The research shows that the telecom services pricing can involve well-known methods supplemented by the stage approach typical of this branch. This concerns the distribution of the price between two major elements – the monthly service fee and the time rate payment. It also involves the dynamics of these elements under the influence of pricing factors, the number of clients (the level of demand), and the technical level of the provided service. The service fee has certain peak values that are stipulated by the growing scale of production. However, the monthly service fee increase seems to be insignificant with a large number of clients. The service fee reflects expenditures (in per client terms) of a telecom company that ensure the normal functioning of the whole wireless communication system. These expenditures contain depreciation, maintenance, energy casts, payment of wages and overheads. The time rate payment reflects other costs not included in the monthly service fee.

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THE IMPACT OF THE KEY QUALITY OF A SYSTEM ON THE SHAPING OF STRATEGIC METHODS OF CONTROLLING

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О ВЛИЯНИИ ОСНОВНОГО КАЧЕСТВА СИСТЕМЫ НА ФОРМИРОВАНИЕ СТРАТЕГИЧЕСКИХ ТЕХНОЛОГИЙ КОНТРОЛЛИНГА

The paper deals with the nature and role of the key quality of a system as the element of the systemic concept of controlling; we consider the impact that the key system quality may have on how a company chooses its strategic activity areas.

SYSTEM APPROACH, CONTROLLING, KEY SYSTEM QUALITY, ENVIRONMENTALLY RESPONSIBLE BUSINESS, QUALITY MANAGEMENT STRATEGY.

Обсуждается содержание и роль основного качества системы как элемента системной концепции контроллинга, рассмотрено влияние основного качества системы на выбор фирмой стратегического направления деятельности

СИСТЕМНЫЙ ПОДХОД, КОНТРОЛЛИНГ, ОСНОВНОЕ КАЧЕСТВО СИСТЕМЫ, ЭКОЛОГИЧЕСКИ ОТВЕТСТВЕННОЕ ПОВЕДЕНИЕ ФИРМЫ, СТРАТЕГИЯ УПРАВЛЕНИЯ КАЧЕСТВОМ.

The processes going on in various business areas (a necessity to consider market turbulences, the increasingly important role of intellectual resources, more focus on social and environmental responsibility of businesses, etc.) make us consider the fact that a system approach to the nature of an enterprise, to the forms and methods of controlling it have to be revised.

An enterprise (company, firm, organization) has been traditionally regarded as a system. However, existing views on the nature of such a system are undergoing a substantial change. For a long time, an enterprise has been looked upon as a complicated or even an extremely complicated system; on the other hand, the approach used to analyze such systems has been similar to that applied to engineering systems. However, thanks to the works of several biologists both Russian and Western (P.K. Anokhin [1], U. Maturana and F. Varela [2]) who have revealed a resemblance between functions of biological and social objects, a company began to be viewed as something similar to a living organism. In the recent decades, we have witnessed the shaping of a new approach of considering to an enterprise is a social-cultural system [3–5].

The evolution of ideas concerning how we understand the nature of an enterprise requires an adequate interpretation of what the term «to control a company» means. In social economic systems, processes of control proceed in a conscious, intention-based way, i. e. they takes the form of controlling. It should be noted that the concept «controlling» has not been widely accepted in its uniform, standardized meaning. Currently, we can talk about several co-existent schools of «scientific controlling», most authoritative of which are the Anglo-American school and the Continental school (German language).[1] The research of various aspects of controlling done by Russian scholars, demonstratesa heterogeneity of approaches among which we can single our the *instrumental*, the *vector-based* and the *systemic* ones. The most promising of them, from the point of view of

[1] A review of different definitions of «controlling» reflecting the approaches of the mentioned schools of science can be found, for intance, in [6].

how the nature of controlling is revealed, we believe to be the systemic approach.[2] One of the essential features of the system-based concept of controlling is the notion of the «key system quality» that largely defines the behaviour of a system (in this case – of a company).

Regardless of the fact that, there are different approaches to the interpretation of the nature of controlling, all theoretical and practical schools of controlling focus currently on the development of strategic methods for the intra-company control.

The purpose of this paper is to consider and analyze the notion «key system quality» applied to a commercial enterprise, and to characterize how this key quality of a company impacts its strategic line of activity.

Key System Quality

The term «key system quality» is used in the system theory to explain the nature of a control process. Thus, in [11] we read: «control is a function of a system focused either on the maintenance of the key system quality, i. e. the combination of features the loss of which leads to the destruction of the system in a changing environment, or on the implementation of a plan aimed at ensuring stable work, homeostasis and attainment of a certain goal».

For a long time, however, as applied to social economic systems, the term «control», in a systemic sense,[3] has been considered in the context of the so-called teleological approach [5, 12, 16] that implies primarily the goal-oriented function of a company. There is an opinion that control without a goal is impossible. This approach is typical of the mechanistic description model of the nature of an enterprise (the first phase of the evolution of views on the nature of a company).

At the same time, the systems theory discriminates between the notions [11, p. 774] of «the goal of activity» (an actual specific goal) and the «goal – aspiration» (the goal = the ideal, a potential goal). This stance has been recently supported, for instance, in the works of G.B. Kleiner who writes [13]: «In the systemic paradigm, the goal of setting up a company can be specified in independent terms, while the goal of the work of a company (its day-to-day activity) can be formulated only as the creation of conditions for carrying on and improving this process».

The evolution of views on the nature of a company and the development of the systemic paradigm has led to the shift in views on the role of a *goal*. Thus, for instance, following the ideas of Ya. Kornai [14], B.G. Kleiner draws attention to the neutrality of the systemic paradigm in relation to the teleological approach to the analysis of an enterprise [13]. The concept of living systems (the second phase of the evolution) and the social cultural approach (the third phase of the evolution) do not place so much importance on a goal, as is the case within the framework of the mechanistic approach. Today new aspects are coming to the foreground [3], as follows: the goal of existence of a «living system» is regarded to be survival; social cultural approach entails focusing on the matching of the interests of goal-seeking elements between each other and with the whole of the system.

In relation to the above, in order to explain the meaning of the process of controlling a company (enterprise/organization) it seems to be quite reasonable to use the term «key system quality» (KSQ), that is, as we remember, a combination of features and properties the loss of which brings about the end of a system. In the light of today's views on the nature of an enterprise, it is the revealing of the combination of such features which becomes one of the most essential problems to be solved on the way towards ensuring a company's success in its day-to-day business activities: it means that we have to know what needs to be protected and preserved.

Taking into consideration the fact that a company is an economic system, the necessity to follow economic principles is to be naturally reckoned among these qualities and features, that is, to ensure a combination of production factors: following an economic principle reflecting the fact that resources a company has at hand are limited, following the principle of financial balance, following the principle of profitability of commercial enterprises. On the other hand, the above principles can not be used for characterization of a

[2] Various aspects of this concept have been worked out by the author of the paper in [7–10, 25].

[3] As is well known, «control» is often fully identified with «management». See criticism of this approach in [9]. «Controlling» as the implementation of a control cycle in social economic systems implies directing («pushing») a company's management along the channel of a control cycle in its systemic meaning.

specific given company as they are to be followed and complied with by all and everybody.

At the same time, a company is a system that can be classified as a social one. Recently several colleagues have paid special attention to this fact: see [4, 5, 15, 16]. In our view, it is this that exerts a substantial influence on the shaping of the KSQ. There are grounds to believe that within the paradigm of a living system this process is defined by the personality who runs a company (see, for instance, [17]) and builds around him/herself a «club» of co-workers. To reveal the specific features of the process of shaping the KSQ of a «multi-mind system» means to carry out additional research. On the other hand, as J.Garaedagi maintains [3], it is the common corporate values that keep the organization members together.

In theoretical perspective, the problem of defining KSQ is similar to defining a system's identity. In his papers and books, U. Maturana stresses that «identity», when used to characterize, in particular, a human being as a system, is the «only stable element in all transformations throughout his/her personal history»[19].

Apparently, the key quality of a system should be reasonably interpreted as the identifiable image of a system that can be formulated as a combination of the principles of its functioning, among which the common corporate values have a special place. The setting of functional (local) goals is defined by the particularities of the key system quality, naturally enough, with regard to the existing specific context.

The problem of defining the KSQ of a system can not be recognized as sufficiently meaningful, unless we trace its impact upon the behaviour of the system. In our opinion, this impact, or influence, can be revealed, for instance, by means of analyzing the motives a company is guided by when it chooses between strategic methods of intra-company control it wants to adopt.

The Influence of the Key System Quality upon the Choice of Strategic Methods of Intra-company Control

We shall examine the manifestations of the influence of KSQ upon strategic company management decisions by the example of various types of company behaviour in relation to the problem of environmental responsibility of business entities.

The fact that companies begin developing and implementing their own environmental policies should be first and foremost linked to the specific nature of today's institutional environment which is more than rich in requirements to and limitations on business activities impacting their ecological setting. In this situation, each company responds to existing institutional limitations in its own particular way, showing various degrees of voluntariness to obey. At the same time, such enterprises still have to meet their economic challenges. But in this case, as in each and every other one, the problem of voluntariness is of no small importance. As is widely known, some companies opt for a total disregard for the problem of environment and pay fines, while others try to avoid such situations. We can say more than that: it often happens nowadays that implementation of socially and environmentally responsible policies is viewed by businesses as another way of commercializing. Alongside with this, as we know, there are other companies that provide support for various environmental measures on charity grounds. In our view, these differences are the manifestation of the forms of the «key quality» specific to each particular company, i. e. of the set of principles by which the management of a company is guided in its decisions.

The differing degree of voluntariness in choosing a strategy towards institutional and traditionally economic aspects of doing business helps us rubricate enterprises with the aim of subsequently characterizing the particular features of the functional methods of controlling adopted by each of the below groups.

First of all, in respect of the voluntariness of compliance with institutional requirements, all companies can be divided in two groups. The first group comprises the enterprises for which a commitment to comply with institutional environmental norms is not an element of their key quality but is caused by other factors; the second group comprises companies which view the socially and environmentally responsible behaviour as one of the basic principles of their business. In connection with this, one may expect that entities in the first group will carry out their business always looking back at environmental problems but in a forced, involuntary way; companies belonging to the second group, on the contrary, will opt for environmental policies willingly.

<table>
<tr><td rowspan="2">Degree of voluntariness of complying with institutional requirements</td><td>High</td><td>Businesses supporting environmental measures by way of philanthropy (IV)</td><td>Businesses using environmental measures as an instrument of economic effect (III)</td></tr>
<tr><td>Low</td><td>Companies for which environmental measures are a side-work required by law (I)</td><td>Companies whose economic performance relies on whether the environmental characteristics of the control object are ensured and maintained (II)</td></tr>
<tr><td colspan="2" rowspan="2"></td><td>No</td><td>Yes</td></tr>
<tr><td colspan="2">Taking account of how the fulfillment of a company's' environmental commitments impacts its performance</td></tr>
</table>

Fig. 1. Company positioning in relation to the degree of voluntariness of their commitment to take account of the institutional and traditionally economic aspects of business activity during implementation of environmentally responsible policies

Next, each of the two groups, in its turn, can be further broken down into two sub-groups depending on how important it is for a company that its compliance with environmental requirements might potentially improve its economic performance.

With regard to the circumstances mentioned above, we can, eventually, single out four categories of business enterprises. It seems to be obvious that each of the company categories has an intrinsic specificity related to how control problems are solved, and, consequently, which functionally particular methods of controlling are used. Thus, for instance, companies in group I, for which environmental measures are a forced choice, are usually engaged in mineral resource extraction and processing. Their business activity is done in circumstances that involve serious institutional limitations. For them the most important controlling instruments shall be as follows: collection and taking account of environmentally significant data; monitoring and evaluation of environmental conditions; environmental risk insurance, along with carrying out research in the field of environmental protection and implementation of state-of-the-art green technologies [26].

Companies in group II are enterprises relying on use of natural resources, i. e. viewing such resources as the object of control (agriculture, recreational woodland management, etc.). A necessity to pay attention to environmental problems in this case proceeds from not institutional requirements but the properties (nature) of the object of control. If often happens in such companies that for them the most significant management problem is to find and apply appropriate instruments and tools in the area of «production» management. Solution of such problems in international practice is often linked to the concept of «adaptive management» (see, for instance, [20, 21]).

For business entities that make their commitments to environmental protection with the aim of attaining better economic results (group III), this type of behaviour is coupled with the necessity to take into account the concept of the strategic cost-generating factors (see, for instance, [22]).

For companies that view environmental protection activity as their corporate charity (group IV), the analysis of a company's business goal pattern with regard not only to traditional goals (growth, development and profit) seems to be more important, but also to such a goal as implementation of social environmental policies.

Obviously, the above typification can not and should not be too «strict». We understand, for instance, that companies in groups I and IV may have certain economic interests linked to environmental protection measures. At the same time, some companies in group II may quite as well disregard the requirements of environmental friendliness towards the controlled ecosystem, not caring about their own future but only formally complying with legislation and paying fines and penalties if necessary, thus shifting towards group I or even altogether leaving the boundaries of the proposed classification[1].

[1] See more on the issues of positioning (classifying) companies by the degree of voluntariness of their compliance with institutional and traditionally economic requirements while choosing a responsible environmental policy in [23].

A similar approach can also be applied to the analysis of how KSQ impacts the choice of certain quality control policies by companies. It is well known that the actual quality level is determined by measures generating two types of cost [24]: *quality assurance costs*, aimed at eliminating the possibility of faulty products, and *quality non-compliance costs* generated if faulty products occur. Depending on what stance a company's management take, as determined by the chosen company mission and the degree of responsibility on the part of the management and the personnel (which reflects the KSQ of the business), different types of enterprises may be found which view the problem of quality assurance and, accordingly, the control schemes to be used for this purpose, in their own way. In Fig.2 we show a diagram of company grouping that reflects how the KSQ manifests itself in relation to the product quality control concept.

Focus on measures generating «quality assurance» costs			
	–	IV	III
	+	I	II
		+	–
		Focus on measures generating «quality non-compliance» costs	

Fig. 2. Company positioning by the degree of focus on quality assurance or quality non-compliance costs

Companies in group I strive to minimize costs related to both «quality assurance» and «quality non-compliance» measures, which may not lead to the elimination of faulty product. Group II companies try to minimize «quality non-compliance» costs by investing more resources in «quality assurance»; ideally this leads to the 100% quality of product. Group IV companies minimize costs linked to «quality assurance», which, accordingly, increase the possibility of faulty products and «non-compliance» costs. Obviously, these companies can not be called client-oriented. And, finally, group III: apparently, such businesses are inexistent. If no attention is paid to the problem of quality, such companies will most probably get into group IV.

Conclusion. The evolution of views on the nature of an enterprise and on the idea of a control process as a system draws out attention to the concept of the «key system quality».

The key quality of a system should be interpreted as the identifiable image of a system that can be formulated as a combination of the principles of its function, among which the common corporate values have a special place.

The setting of functional (local) goals is defined by the particularities of the key system quality with regard to the existing specific context.

The impact the KSQ on how a company chooses certain forms and methods of environmentally responsible behaviour (policies) manifests itself in the appearance of several types of enterprises depending on which specific tools and technologies of strategic intra-company control they apply.

The analysis of the KSQ impact on the choice of certain quality control policies by companies helps us define a range of enterprises which view the tasks of product quality assurance in their own specific way.

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MANAGEMENT AND MODELS OF QUALITY COSTS

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УПРАВЛЕНИЕ И МОДЕЛИ ЗАТРАТ НА КАЧЕСТВО*

The concept of quality cost is defined by standard ISO9004. Optimization of quality costs is understood by the enterprises in different ways and always in a practical sense. There is possibility to consider optimization of quality cost as a distributive problem of optimum enterprise costs planning. Anality control cost and failure cost are interrelated and interdependent. Perfection of control processes can lead to a decrease in quality control expenses. Losses from failure cost can also be reduced due to the realization of relevant projects in manufacturing. The implementation of all similar projects demands additional expenses in manufacturing. There are expenses for preventive maintenance and failure costs. The limited resources of prevention cost can be distributed between failure costs and quality control cost. Optimum distribution of prevention cost is presented as a model of optimum planning and distribution of resources in manufacturing. A method for taking the optimum decision is presented.

QUALITY MANAGEMENT. ECONOMIC THEORY. QUANTITY AND QUALITY OF CONSUMED PRODUCTS. PREVENTION COSTS. CONTROL COSTS. FAILURE COSTS. OPTIMIZATION MODEL.

Концепция управления затратами на качество определяется стандартами ISO9004. Существует возможность рассмотрения оптимизации затрат на качество как проблему оптимального распределения расходов предприятия при внутрикорпоративном планировании. При этом затраты на контроль качества и потери на брак взаимосвязаны и влияют друг на друга. Совершенствование процессов управления может привести к снижению расходов контроля качества. Потери от брака также могут быть сокращены за счет внедрения соответствующих проектов в производстве. Однако осуществление всех аналогичных проектов требует дополнительного финансирования в производство. Кроме того, существуют профилактические расходы на обслуживание процесса и предотвращения брака. Оптимальное распределение затрат на качество представлено в виде модели оптимального планирования и распределения ресурсов в производстве.

МЕНЕДЖМЕНТ КАЧЕСТВО. ЭКОНОМИЧЕСКАЯ ТЕОРИЯ. КОЛИЧЕСТВО И КАЧЕСТВО ПРОИЗВОДИМОЙ ПРОДУКЦИИ. ЗАТРАТЫ НА КОНТРОЛЬ И ПРЕДОТВРАЩЕНИЕ БРАКА. ОПТИМИЗАЦИОННАЯ МОДЕЛЬ.

Quality management problems have been widely covered in the domestic scientific and practical fields while quality economic issues and corresponding models have not been developed. There has been a gap between the economic theory (economic models of quality) and practice (quality management). Basic economic concepts and models used in decision-making by economic subjects are, as a rule, based on the interrelation of quantitative and financial (price) variables, whereas quality is usually considered ceteris paribus (invariable). Possible approaches to quantify quality classes and corresponding models of decision-making by the manufacturer concerning quality and a commodity price will be considered in the article.

Management and models of quality costs

At present, experts have started viewing quality as one of the fundamental economic variables, such as demand / supply of products, market prices of products and «the quality price», economic growth and quality. Scientists rarely take into consideration the following questions:

1. Does quality as one of the fundamental economic variables define contents of economic models?

2. How does quality influences rates of economic growth and economic equilibrium?

3. What are features of the investment analysis in the context of quality problems?

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4. How does quality influence project's investment appeal and investment and operating risks?

Problems of the economic theory are not generally considered in such a «coordinate system». In the economic theory there are neoclassical models of quality by Jean-Jacques Laffont. However, necessity of such an approach is becoming more and more obvious.

Models of quality costs optimisation

According to the fundamental concepts of the economic theory, a utility function of the customer is determined by two variable parameters – by the quantity of consumed products (q) and by their quality (k). Integrated utility under these conditions is expressed analytically: $U(q, k)$. Differential utility function or marginal utility function (MUF) depends on limiting (increment) values of variables ($u(\Delta q, \Delta k)$). Marginal utility function is assumed to have an additive and linear character. The given assumption is in contradiction with the fundamental neoclassical statements about the utility function (decreasing marginal utility as basically it does not agree with the linear character of utility function).

However, in our opinion, the assumption of linearity of utility function with little changes of variables is still acceptable. With these assumptions, the marginal utility function can be represented as:

$$u(\Delta q, \Delta k) = a_k \Delta q + a_k \Delta k, \qquad (1)$$

where $u(\Delta q, \Delta k)$ is the differential utility function; a_q, a_k – are marginal utility of a unit of quality and unit of quality; Δq, Δk – variation in the quantity of consumed products (q) and their quality (k).

To define marginal utility function, marginal utilities of units of quality and units of quantity should be known and expressed in the identical measurement. A company strives for marginal utility function maximization under the existing resource restrictions and restrictions on the minimum admissible degree of quality and quantity of the products.

The problem of marginal utility optimization can be presented as following:

$$\begin{aligned} & u(\Delta q, \Delta k) \to \max \\ & r_q q + r_k k \le R \\ & q \ge \bar{q} \\ & k \ge \bar{k} \\ & q, k \ge 0 \end{aligned} \qquad (2)$$

or after its transformation according to maximization requirements:

$$\begin{aligned} & u(\Delta q, \Delta k) \to \max \\ & r_q q + r_k k \le R \\ & -q \le -\bar{q} \\ & -k \le -\bar{k} \\ & q, k \ge 0. \end{aligned} \qquad (3)$$

Here R – available resources; $\bar{q}$ – minimal requirements for the quantity of products; $\bar{k}$ – minimal requirements for the quality of products; r_q, r_k – norms of consumption of some generalized limited resource on production of a unit of quantity and a unit of quality.

The formulated optimization problem is, in its essence, an optimum plan of consumption for a company at existing limitations. As it has a linear character, a dual problem can be formulated and its substantial interpretation can be given:

$$\begin{aligned} & -P_k \bar{k} - P_q \bar{q} + Re \to \min, \\ & -P_k + r_k e \ge a_k, \\ & -P_q + r_q e \ge a_q, \end{aligned} \qquad (4)$$

here P_k, P_q, e – dual variables – the prices of products and resources.

Once again we reformulate the problem, now presenting it as a maximization condition:

$$\begin{aligned} & P_k \bar{k} + P_q \bar{q} - Re \to \max, \\ & P_k - r_k e \le -a_k, \\ & P_q - r_q e \le -a_q. \end{aligned} \qquad (5)$$

The dual problem represents conditions for manufacturing products. The criterion function, in this case, characterizes the criterion of the production efficiency – the added economic value. If the solution of a «direct» problem allows defining the optimum consumer plan, the solution of the «dual» problem allows defining the objective estimations of this plan, i. e. the prices. Dual variables express quantitative estimations of variables of «the quantity prices», «the quality prices» and the prices of resources in an optimum consumption plan. These are the prices of products and resources in the optimum plan. In this particular case, «products» are the quantity and the quality of manufactured goods.

The solution of the dual problem results in notional prices according to which the

«exchange» is made, i. e. the quantity and the quality of manufactured goods are coordinated in a comparable way. The substantial meaning of the dual problem restrictions implies that neither quality of production, nor its quantity are given to a company «free of charge». The manufacturer pays for the «production» of the quantity and the quality of products with the reduction of its utility. Thus, the added economic value should not exceed decrease in utility – otherwise quantity and quality reproduction would make no sense. The obtained conditional calculative prices are coefficients for the recalculation of quantity and quality in a comparable way. The solution to the dual problem results in the prices according to which the quantity and quality are «exchanged».

One of the problems connected with the formation of a quality economic model directly depends on the nature of a quality category which, by definition, is difficult to quantify, as well as it duality from the point of view of the manufacturer and consumer as participants in the deal. On the one hand, the buyer sees the quantitative expression of quality as a bid price. At the same time, the buyer makes a decision concerning quality, namely, the decision to buy a product at a determined price, being based on incomplete information.

Since the consumer cannot define categorically all quality components when buying the product, his decision-making is based on «an adverse selection» principle, i. e. he understates «expected» evaluation concerning implicated quality parameters. A priori, it is possible to name this buyer's quality evaluation as consumer quality evaluation. After the product has been consumed, the consumer can generate the final quality evaluation a posteriori which can be either above, and below the initial price. On the other hand, the direct quantitative function of quality of the goods for the manufacturer is the amount of production costs. It is obvious that the basic stimulus for the manufacturer in decision-making on quality is to minimize costs.

Therefore the manufacturer, in general, will not be interested to improve quality of goods over aprioristic «skeptical» quality evaluation by the consumer. It concerns, first of all, «implicit» factors of quality which cannot be evaluated by the consumer when buying, for example, the reliability of durable goods.

Quality costs. Nowadays, difficulties in the development and the application of economic quality models are caused by deficiency of some fundamental economic concepts. The development of market processes leads to the reconsideration of the existing approaches to the economic problems one of which is the so-called «problem of quality costs». It has been formulated in the 1970s when quality management methods were rapidly developing all over the world, including Russia. The formulation of the economic model of quality costs is attributed to A. Fejgenbaum, a famous American expert in the field of quality systems. In its essence, it was a management model, based on the use of economic criteria. Quality costs in quality management system, according to this approach, should be considered as an element of this system and as a corresponding tool of economic management for the manufacturer. This tool of economic management, under market conditions, is aimed at achieving an internal balance by the manufacturer and gaining maximum profit. The model assumed that there was a separate group of production costs in the company which was caused by the level of quality of manufactured goods and necessity to maintain the determined quality in production. This group of costs has been named «quality costs». An approximate structure of costs and prospective influence of some expenses on the other ones were identified in the model. So the interrelation between the elements of costs in the quality management process has been formulated. The ways to minimize quality costs based on the effect of mutual influence of costs have been considered. Since economic management methods were not developed enough in our country in those years, scientists and experts did not find it interesting to study the interrelation and the mutual influence of elements of quality costs.

At the same time, much attention was paid to the issue of the cost structure and classification, as well as to philosophical aspects (what is interrelationship between quantity and quality; what are the expenses for quantity, if expenses for quality exist etc.). The economic side of the problem was definitely underestimated, manipulations with the classification and the definition of cost structure deformed its economic contents and true criterion function of management – quality cost reduction or achievement of the required quality with least

costs. The market conditions epmhasised the hopelessness of the strategy «quality at any cost» both from the point of view of achievement of required quality (this approach cannot ensure quality anyway), and of production efficiency (there must be more effective areas to use operating resources at such approach). We include here the main provisions of the model of industrial quality costs just for historical information.

Quality costs (QC) are the total costs of the three above-named groups of expenses (prevention costs, control costs, failure costs) and criterion function of quality maintenance economic model is profit maximization of the company from minimization (economy) of quality costs which is ensured by the mechanism of mutual influence of expenses (Fig.1).

Fig. 1 shows that preventive expenses of the 1st group (quality preventive costs (QC_p)) are «managing directors» in management process and influence other costs. In the economic model, these expenses play a role of external variable, constant in relation to other variables and, consequently, they are not included into criterion function of model of management.

The traditional costs classification, included into existing the standards of the quality management system, comprises the following groupings of costs:

1. Prevention costs (QC_p) – expenses of quality preventive maintenance (revealing and eliminating causes of poor quality of producing) and also on perfection of production quality monitoring and quality evaluation of the product and production process.

2. Control costs (QC_c) – expenses of revealing inappropriate quality or on the control and quality evaluation of goods and production process.

3. Failure costs (QC_f) – expenses (costs, losses) of the production of inappropriate quality. These expenses can be divided into two groups: internal production costs (losses) of the manufacturer from inappropriate quality of the product and external expenses (losses) of both the manufacturer and the consumer because of inappropriate quality. In practice, when the system of the quality assuarance is developed and losses are compensated, consumer's expenses (losses) because of goods of inappropriate quality become internal expenses of the manufacturer, i. e. expenses of this group are mutually converted.

Under the influence of the preventive costs, the quality control costs will diminish provided:

1. The amount of the preventive costs is fixed according to the production plan of appropriate goods quality;

2. Production quality control is one hundred percent, including the goods of inappropriate quality;

3. Goods of inappropriate quality are not subject to correction or processing, according to the accepted definition of the target use of quality costs.

This decrease is caused by the direct reduction of controlled goods quantity due to the measures taken to eradicate the causes of poor quality. Consequently, the quantity of poor-quality goods decreases and the output of good quality goods increases. As a result, the total quantity of input decreases to produce the required amount of the good quality goods. This quantity of suitable goods is exposed to quality assurance, which, accordingly, leads to the reduction of quality assurance costs. Therefore there is a direct influence on the amount of specific expenses on quality assurance of goods which decrease due to the corresponding preventive measures directed, in a broad sense, at an in increase on the productivity of quality assurance processes. Under the influence of the preventive costs the quantity of poor-quality goods also diminishes as actions to eliminate the causes of discrepancy of quality to the established standards are taken. As a result, quality costs shrink since cost of poor-quality goods is part of it.

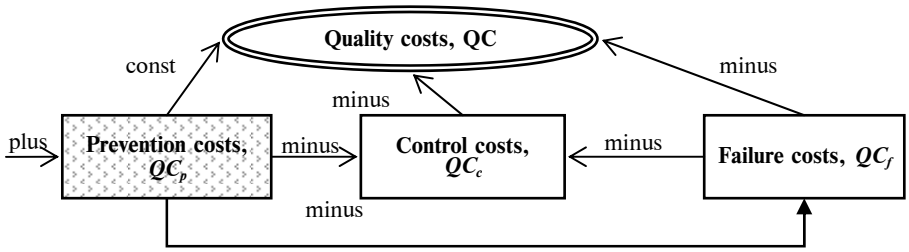

Fig. 1 The mechanism of mutual influence of expenses on quality

In a more comprehensive sense, the formulation of a problem of quality expenses is not anything else but an attempt to find application for the classical problem of optimum economic management in the field of quality management. It means that the quality management is considered as an economic problem and corresponding approaches and methods should be used to solve it. From this point of view, the minimization of quality costs can be allocated limiting (additional) expenses (costs) of the company for production perfection in directions: to increase quantity of manufactured products; to decrease direct industrial costs on manufacturing of a unit of goods (except quality costs); to take measures to decrease or indemnify factors of discrepancy of quality of goods to the established standards or direct industrial costs of an increase in the output of suitable goods (hereinafter these are expenses of production process improvement); to take measures to decrease current production costs of control and quality evaluation processes. Expenses are expressed in shares of the allocated limit of resources. Let us review control and quality evaluation expenses. The assumption (not quite realistic) is that the direction of all allocated resources can ensure zero level of these expenses.

Let's assume that the transformation of additional production costs of production into perfection into required results is described by a number of production functions. Production function reflects the transformation of additional production costs of production perfection into required result in the form of reduced quantity of goods which do not correspond to the established quality standards (increase in the output suitable). It is obvious, that if funds for process perfection are not allocated, quality of the process remains at the same level and, if all funds of the allocated limit are spent in the given direction, production improvement quality will be the greatest possible.

The following formulas are suggested to calculate actual quality expenses:

$$QC_f = Q\left(\frac{1}{y + kx} - 1\right),$$

$$QC_c = \frac{Q}{y + kx} a(1 - x),$$

$$QC = QC_f + QC_c. \qquad (6)$$

$Q(X)$ – production function (in its classical understanding), reflects the quantity of manufactured goods depending on expenses of production factors, at the set planned output should be $X = 0$, $Q(X) = Q = \text{const}$. – it is set by the plan, a – reduction in expenditure marginal level on the control and quality evaluation at allocation of one additional unit of resources.

Abbreviations and numerical values for a considered settlement example are given in the Tab. 1.

Table 1

Real quality costs

Indicator, amendment unit	The Designation.	Numerical significance
Quantity of goods according to plan (unit)	Q	1
Output suitable without improvements (a share unit)	y	0,7
Expenses of the control of a unit of goods (a share monetary unit)	a	0,4
The multiplicator of an output suitable (unit shares / additional monetary unit)	k	0,3

Here the allocated size of expenses of improvements (x) «runs» all values with the accepted numerical interval from 0 to the size of the allocated limit. The optimizing problem of minimization of quality costs is reduced to optimum distribution of the restricted limit of the allocated resources of expenses of production improvement among all quality expenses.

The definition of the minimum size of total quality costs ($QC = QC_f + QC_c$). With numerical values of parameters $QC_f = f_1(x)$ and $QC_c = f_2(x)$, we receive:

$$f_1(x) = \frac{3(1 - x)}{7 + 3x};$$

$$f_2(x) = \frac{4(1 - x)}{7 + 3x} = \frac{4}{3} f_1(x). \qquad (7)$$

Thus, we come to the following statement of the problem. Entering function $f(x) = \frac{3(1 - x)}{7 + 3x}$, it is required to find the least value of function of two variables: $F(x, y) = f(x) + \frac{4}{3} f(y)$ in the area: $0 \le x \le 1$, $0 \le y \le 1 - x$.

Table 2

Calculation of real components of quality costs.

x		0,000	0,100	0,200	0,300	0,400	0,500	0,600	0,700	0,800	0,900	1,000
	3k/3б	0,571	0,493	0,421	0,354	0,293	0,235	0,182	0,132	0,085	0,041	0,000
0,000	0,429	1,000	0,922	0,850	0,783	0,722	0,664	0,611	0,561	0,514	0,470	0,429
0,100	0,370	0,941	0,863	0,791	0,724	0,663	0,605	0,552	0,502	0,455	0,411	
0,200	0,316	0,887	0,809	0,737	0,670	0,609	0,551	0,498	0,448	0,401		
0,300	0,266	0,837	0,759	0,687	0,620	0,559	0,501	0,448	0,398			
0,400	0,220	0,791	0,713	0,641	0,574	0,513	0,455	0,402				
0,500	0,176	0,747	0,669	0,597	0,530	0,469	0,411					
0,600	0,136	0,707	0,629	0,557	0,490	0,429						
0,700	0,099	0,670	0,592	0,520	0,453							
0,800	0,064	0,635	0,557	0,485								
0,900	0,031	0,602	0,524									
1,000	0,000	0,571										
QC optimum		1,000	0,922	0,850	0,783	0,722	0,663	0,597	0,551	0,498	0,448	0,398

Thus $f'(x) = \dfrac{30}{(7+3x)^2} < 0$. This function $f(x)$ monotonously decreases. It means that it reaches the least value on the right end of an interval. Therefore the least value of function $F(x, y)$ cannot be reached in a triangle or on its legs of a triangle. It will be reached on its hypotenuse $y = 1 - x$.

Hence, it is required to find a function minimum: $g(x) = f(x) + \dfrac{4}{3} f(1-x)$, $0 \le x \le 1$. Write the equation to find a minimum point:

$$g'(x) = f'(x) - \frac{4}{3} f'(1-x) = \\ = \frac{40}{(10-3x)^2} - \frac{30}{(7-3x)^2} = 0.$$

This equation is reduced to a quadratic and also has a positive root $x \approx 0{,}2966$. Thus, the least value required $9x^2 + 348x - 104 = 0$ and $F_{\min} = g(0{,}2966) \approx 0{,}3977$.

The given size is expressed in cost units.

The solution is presented in the calculation Tab. 2.

In the given example, quality cost optimization, i. e. the minimum size of accumulated costs of the control and losses from poor quality is considered at various (allocated) values of expenses of prevention of defects that have been set in advance, as the table shows (the minimum value on each of diagonals). The total minimum value of quality costs corresponds to the minimum value on that diagonal of the calculation table which corresponds to a certain value of the allocated resources in the realization of preventive maintenance of quality (prevention cost). The size of preventive costs run all values from 0 to 1 with the chosen interval of change. Minimum costs corresponding to these values on quality are shown in the bottom line of the calculation table. From it, it is obvious that the more resources are allocated for preventive maintenance, the lower are accumulated quality costs. Economy has to be paid for! Note. Direct quality costs, i. e. direct costs of operating resources or production factors on manufacturing, according to the norms and in correspondence with the requirements to the applied engineering procedures are hereinafter considered. Costs or expenses of resources which, at the same time, constitute a significant share of quality costs are not considered, being indirect or constant in relation to the production volume. The reason is that economic models of

production optimization are developing by neoclassical principles of marginal economic analysis which does not consider fixed costs when analyzing current production costs (marginal fixed costs are equal to 0). Fixed costs can be considered in the investment analysis at performance evaluation of the capital investment projects used to improve managerial processes in quality systems. However, the problem of quality costs minimalization is traditionally considered as a problem of current production costs management. Here we stick to this rule.

Conclusions. Quality costs are the total sum of prevention costs, control costs, failure costs and criterion function of economic model of quality maintenance which is profit maximization of the company from minimization (economy) of quality costs. There is a possibility to consider the optimization of quality cost as a distributive problem of optimum enterprise costs planning. Cost control and failure cost are interconnected and influence each other. Optimum distribution of prevention cost is presented as a model of optimum planning and distribution of resources in manufacturing. Financial management methods (formation of an additional profit through costs reduction owing to efficient management through investments and disinvestments into company's assets and quality management model which is self-balanced) are used to describe the influence of quality costs in the enterprise management system.

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THE DETERMINATION OF CONTRIBUTORY COSTS FOR THE VALUATION OF INTANGIBLE ASSETS

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ОПРЕДЕЛЕНИЕ ЗАТРАТ НА УЧАСТВУЮЩИЕ АКТИВЫ В ОЦЕНКЕ НЕМАТЕРИАЛЬНЫХ АКТИВОВ

Theory and practice suggest several approaches and methods for thethe valuation of intangible assets. In absence of comparable asset prices, the appraiser may apply a methodology of the income approach to value intangible asset. However, the methodology requires several subjective assumptions and produces questionable results. The author considers peculiarities of the application of the income approach, in particular, multi-period excess earning method in the valuation of such intangible assets.

VALUATION, INTANGIBLE ASSETS, IMPAIRMENT OF ASSETS, FIXED ASSETS, GOODWILL, DISCOUNT RATE

В теории и практике известны различные подходы и методы оценки нематериальных активов. При отсутствии объектов-аналогов, оценщик может использовать методологию доходного подхода в оценке нематериальных активов, при которой принимается множество субъективных предположений, а результат обычно вызывает множество вопросов. В данной статье рассматриваются особенности применения доходного подхода, построения модели по методу многопериодных избыточных доходов и варианты расчета доходностей на материальные и нематериальные участвующие активы при оценке нематериальных активов.

ОЦЕНКА БИЗНЕСА, ОЦЕНКА НМА, ОЦЕНКА АКТИВОВ, ОСНОВНЫЕ СРЕДСТВА, ГУДВИЛЛ, СТАВКА ДИСКОНТИРОВАНИЯ.

In the area of multiple assets and businesses, there are three traditional approaches to the determination of the fair value of intangible assets: the income approach, the cost approach and the market (comparative) approach.

Obviously, the most reliable estimate of fair value gives the current market price of an intangible asset in an active market. If there is no active market for an intangible asset, the fair value may be measured on the basis of recent transactions with similar assets.

In absence of such information, the companies that are regularly engaged in the acquisition and sale of unique intangible assets commonly use alternative methods of estimating the fair value of intangible assets, such as discounting of estimated future net cash flows. Within the income approach, there are several methods to value intangible assets [the brief summary of all three approaches and methods are presented in 1, p. 6]. Relief from royalty method is the simplest and most often applicable to trademarks. For its application it is necessary to forecast revenues or operating profits of the business, and to find a reasonable royalty rate for the asset. However, the use of relief from royalty method is complicated by several facts. The first difficulty is the lack of, or a wide range of royalty rates, for discussions of different rates see e. g. [2, pp. 2–3]. The second factor is the presence of several identified intangible assets, together generating the cash flow, which requires the valuation of the combined intangible asset, followed by a breakdown into several intangible assets, or developing an alternative methodology.

If there are several intangible assets, it may be needed to stratify them into those that can be valued by a comparable approach, or the relief from royalty method, and the asset or a group of assets, together generating income, which are the most specific to the business and which will be valued by the method of excessive earnings. As described above, this method is used mainly in the valuation of well-established relationships with customers, as well as manufacturing technology. We will consider the method in detail.

The method of excess earnings is one of the methods of the income approach. To apply this method, you must select a group of assets that includes this intangible asset and other current and non-current assets, and generates revenue in the future. The valuation of this asset is conducted by the allocation of returns attributable to other current and non-current assets of the total revenues or flows of the group of assets, and subsequent discounting of residual returns attributable to the intangible asset. We will call these required returns of assets involved contributory asset charges of other (contributing) assets.

Therefore, for the correct application of the method, you must define the contributing assets of the group and their profitability and return on them.

The most common assets are working capital items (cash, receivables, inventories, net of accounts payable and provisions), fixed assets (land, buildings, machinery, equipment, etc.) and some intangible assets (trademarks, technology, software, qualified staff).

In determining these participating assets, we should note that they cannot (or are not supposed to) generate revenue on their own, and their presence is necessary for the operation of the business and the use of the intangible asset. For example, an excessive land plot or non-operating fixed assets should not be counted as assets involved in the calculation of the required yield.

We should note that the use of an intangible asset as the contributory asset is not directly related to the possibility of its recognition as an intangible asset in the financial statements. For example, a qualified personnel does not meet the criteria for the recognition of intangible assets in the financial statements in IFRS, but is involved in the flows of the assets, e. g. in a 'technology' intangible asset. Therefore, to value the technology by excess earnings method it is necessary to estimate the value of qualified personnel participating as an asset and to determine its required return. Note that in practice, some of such participating assets may not be valued under the assumption that their values are not significant, or their effect will be not significant. In this case, intangible asset valued under excess earnings method will have 'conditional' fair value, which may be slightly higher than its fair value.

It should be noted that the method of excess earnings has several drawbacks, among which are many subjective factors, the use of which may produce a result that is different from the fair value of the asset, as well as the assumption that all residual income relate to the intangible asset valued (and, therefore, the value of the asset may be overstated).

This method involves accounting for returns on different assets, but does not take into account the synergy of these assets and other effects that are not directly associated with the intangible asset. These non-identified assets may be needed to be presented separately, or they should be included in goodwill, e. g. [see 3, pp. 2–3]:

- established systems, processes and procedures;
- access to capital;
- policies in the management of expenses;
- systems of quality control, etc.

These factors are not valued separately and are not recognised on the balance sheet as assets, therefore, in case they could have significant impact on the company, you need to be cautious in applying the method of excess earnings for the identified assets, such as customer relationships. Let us discuss these participating assets and their costs in detail.

Contributory costs of working capital. It is obvious that working capital is one of the major participating assets because its components are directly related to the ability of the business to generate cash flow. Traditionally, working capital includes minimum cash at a level necessary to support operations, inventories and accounts receivable less accounts payable. Therefore, net working capital is used, which does not include excess cash and debt financing.

The value of the net working capital used needs to be normalised from two perspectives:

- at the date of the analysis – to include only those components and in the amounts that are required for functioning of an intangible asset valued,
- later in the forecast – in case that at the date of the analysis, the value of the working capital was not optimal for the business (it is then normalised based on history, approved policies, comparable companies, etc.).

This forecast of the optimal level can be achieved in different ways: through the turnover rates for components (accounts receivable, inventories, accounts payable) in days, or the

ratio of the total net working capital value as a percentage of the revenue. The optimal values can be taken based on historical ratios (for example, for the previous 3-5 years), ratios for similar companies, industry average data.

The value of working capital can be positive or negative, if appropriate for business models, such as in the case of significant prepayments (in construction industry). It is obvious that the assumption of a negative working capital or working capital lower than the current level will have a positive impact on the forecast flow and increase the value of an intangible asset being valued; the higher required return on working capital, the greater the positive effect on the value.

Therefore, normalisation implies a forecast of optimal levels for an asset or business, not only disregarding non-recurring items or transaction. In case of a significant difference between working capital of the company and a target industry average or average historical level, it is necessary to analyse the possibility of such a transition and normalisation. The ability to reach optimal values of net working capital may be achievable in some, perhaps, medium-term period.

Return on working capital is generally the lowest yield compared with other assets (fixed assets, other intangible assets). To determine the yield, different sources of information may be used. The most common approach is to use the company's short-term borrowing rates. It is also possible to use the average yield on all short-term loans, or rate of the latest loan, the closest to the date of the analysis. In absence of short-term loans, the company can use the available market information, including Bulletin of Banking Statistics (issued by the Central Bank of Russia), rates on short-term (30–90 days) government bonds. In case of different risks of components of working capital it is possible to analyse the components separately: for example, to make adjustment (additional premium) to the required rate of return for dubious receivables. However, in our view, it is more reasonable, in practice, to write off such receivable and to apply an average rate of return to the total adjusted amount of working capital.

According to the comments of the working group of Appraisal foundation [see 4, p. 4 and 5], an exclusive use of borrowing rate is incorrect, because in most cases working capital is financed not only by debt; it may require a determination of the weighted average cost of capital (debt and equity). In our opinion, this approach introduces additional complexity and is unlikely to lead to a significant increase in the quality of the estimates in case of not significant differences between the cost of equity and debt, and the assumption that the greater part of the working capital may still be financed by borrowings. In case of significant balances of working capital, an additional analysis of sources of finance should be done, which again may require (e. g. in construction industry) the use of cost of debt, not weighted cost.

When calculating the required costs of working capital, average working capital for the period or balance at the end of the period should be taken into account. Changes in the value of working capital itself affect the flow (free cash flow to shareholders, investors), so accounted for separately.

Contributory costs of fixed assets. Fixed assets also play a significant role in ensuring the future flows from the use of the intangible asset valued. Property, plant and equipment, in this case, include land, buildings, machinery, equipment, construction in progress and equipment for installation, plus assets under finance lease, prepayments for property and equipment, investment property, despite the fact that there is no clear guidance in the standards of reporting and valuation of these assets.

Since most of the groups of fixed assets are subject to depreciation (physical, moral, economic), the forecast may need to include expenses for their replenishment through capital investments. The value of fixed assets should also be normalised – for example, by projecting to achieve the necessary fixed asset base and production capacity within the forecast period. A particular company may have an excess or lack of fixed assets, which will be taken into account in the forecast of capital expenditures and flows from use of assets. When analysing them we need to keep track of changes in the value of the assets to analyse the impact of the turnover or assets, and to compare them with historical data of the company or peers.

In the analysis, in addition to the separation of operating and non-operating assets, it may be needed to separate the value of land. Firstly, such

asset as land is not subject to obsolescence and therefore not depreciated, therefore its separation may increase the quality of the projection of depreciation and the value of assets. Secondly, the land is significantly less risky and less profitable asset: for example, based on our experience in valuation of several real estate properties, the level of capitalisation rates for office real estate can reach 8–12 %, whereas the capitalisation rate on commercial or agriculture land plots, obtained by the extraction method could be 2–5 %.

To determine the return on fixed assets, a variety of approaches and sources of information can also be used as was a case with working capital costs: the rate of medium- or long-term borrowings of the company, the borrowing rate for a particular asset if it can be determined, weighted average cost of capital is also often used. A number of companies, including international and Russian companies, use the so-called mini-WACC approach, i. e. weighted average cost of capital conditionally applying ratio of debt to equity of 60/40, assuming this ratio to be optimal for financing fixed assets. Another possible approach is the use of interest rates on long-term loans with a premium for the risk of investments in fixed assets.

The forecast of the required rate of return on fixed assets as participating assets, according to the analysis of Appraisal foundation, can be produced by different methods.

Contributory costs of intangibles. Intangible assets, as well as working capital and fixed assets, may be involved in the generation of estimated future cash flows of the intangible asset valued. In addition to intangible assets recognised in the financial statements, such as trademarks, software and other non-identified intangible assets that do not meet the criteria for the recognition in the financial statements may also participate in producing cash flows. In particular, this applies to the qualified personnel. Goodwill cannot be treated as an asset involved, since it is a residual asset and its inclusion in the assets involved would lead to a paradox – reducing the value of other identifiable assets at the expense of high returns on goodwill. This is also one of the drawbacks of the approach.

An international consulting company Ernst & Young analysed more than 700 transactions of business acquisitions in 2009 to review the intangible assets recognised as a result of transactions. As a result, they found the following distribution of the value of the acquired businesses: 30 % was attributable to the property, plant and equipment, financial and other current and non-current assets, 23 % – to the value of intangible assets, 47 % – was recognised as goodwill [see 6, p. 1]. Currently, goodwill is not normally depreciated and therefore tested for impairment at the end of reporting periods. However, in accordance with new discussions, it may be depreciated in certain cases, e. g. amortized on a straight-line basis over the useful life of the primary asset of the acquired entity, not to exceed 10 years for certain private companies statements [see 7, p. 3 and 12, 13].

In case of significant amount of goodwill and understanding that goodwill includes some intangible assets that do not meet the criteria for recognition, or cannot be reliably measured, it is nevertheless useful to separate them from goodwill, including them as contributory assets or presenting sensitivity analysis of the final value of the intangible asset valued to the value of such intangible asset. If, however, a reliable valuation of the asset involved is impossible, another method to determine expenses for the participation of the asset may be considered – e. g. a distribution of the flow on such asset and therefore reducing the value of the intangible asset valued. There are a lot of research papers on the analysis of goodwill and intangibles, however, the analysis is sometimes too theoretical with overcomplicated models difficult to apply and to prove statistical data [e. g. see 8].

For example, when the participating asset was valued by the relief from royalty method, the forecast flows for an estimated intangible asset can simply include royalty payments.

A case when the company does not assume long-term use of the intangible asset involved may be considered separately. For example, the company plans to stop using the trademark of the acquired company and extrapolate its trademark on the acquired assets. In the case of such a change, it is necessary to use the purchaser's trademark, as it is supposed to be used. With this new trademark, the business and assets can be even stronger than previously, and this will lead to increased flows and ensure a greater rate of return, for example, through the royalty rate.

To predict the flows in such a case, it is necessary not only to project the yield of the asset, but also the compensation for the asset, e. g. marketing, advertising and other expenses, depending on the asset, other costs and expenses.

In the case where the participating asset is valued by the relief from royalty method, royalty rates may be used as the rate of return, and the analyst may pay attention to the type of royalty rates (gross or net rate) and include marketing expenses when needed.

The biggest problem might be in case of several intangible assets to be valued by the method of excess return, for example, production technology and customer relationships. It is obvious that, in this case, circular references for returns on assets at each other will arise. Despite the fact that these calculations may be implemented in practice, it is advisable to avoid such situations and try to separate flows and models, i. e. build models independently of each other, or to evaluate any of these assets using other methods (relief from royalty, the cost approach, etc), leaving only one asset to be valued by the method of excess earnings.

The rate of return on intangible assets is generally higher than the rate on working capital and fixed assets as intangible assets are more risky and more specific to the business, i. e. less liquid assets. Since intangible assets are often financed from one's own funds or a combination of equity and debt, in most cases it is advisable to use the cost of equity and weighted average cost of capital with a premium for the risk. There are also other approaches to determine rates to be used in the models [e. g. see 9], however, in most cases they are of theoretical nature and do not produce significantly higher precision level.

Changes in value of the contributory assets. As shown above, the costs of assets involved – working capital, fixed assets, intangible assets can vary significantly among themselves. During the forecast period, you can observe changes in the value of assets as a result of two factors:

- Firstly, assets are subject to depreciation and amortisation, at different rates and with different levels of reimbursement, which can affect the combination of the assets involved, and hence the overall costs of the assets involved;
- Secondly, the required rate of return itself may also change over time, such as with floating weighted average cost of capital rate.

To check the reasonableness of costs of intangible assets (as well as of other assets), their trend can be analysed. In case of a mature business, costs could be fairly stable. In case of a start-up business, a gradual reduction in the costs of assets involved, as the business matures, is probable.

Final checks and conclusions. In the allocation of the purchase price and checking the reliability of the results obtained, a comparison of WACC, WARA and IRR could be done. In this case, IRR is the most general concept that reflects the expected internal rate of return on investment but usually neglected. The comparison of WACC and WARA is done to compare weighted average cost of capital (from the liabilities side of the balance sheet) with the weighted average return on assets (assets side of the balance sheet) [for details see 10, p. 12, for the analysis of WACC rates and the determination of WACC for financial reporting see 11].

Therefore, in case the transaction was done under non-market conditions, there is no need to perform this analysis. If the difference is not significant, no investigations are required. However, a significant difference between WACC and WARA, as a result of the analysis, can show that there are some non-identified intangible assets, costs of the assets or fair value of the assets identified are not reasonable and need reconsideration and recalculation, including the analysis of the goodwill impairment.

As discussed in the article, the methodology of the income approach for the valuation of intangible assets could be applied in some cases, but the results will be very sensitive to values of other assets and contributory costs. If it is still necessary to value the intangibles, one must bear in mind that this valuation and a split of the group of assets' value among different assets is a theoretical exercise, and due consideration should be given by the appraiser not to overstate the value of the intangible assets.

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FEATURES AND CHALLENGES OF THE PROCESS APPROACH APPLICATION AT ENTERPRISES

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ОСОБЕННОСТИ ПРИМЕНЕНИЯ ПРОЦЕССНОГО ПОДХОДА В УПРАВЛЕНИИ ПРЕДПРИЯТИЕМ

The process approach and the question of how to use it at an enterprise is still topical because, so far, there is no straightforward answer about its usefulness in all the business cases. In this article, the authors attempt to analyze the typical situations when it is necessary to use the process approach and when it is absolutely unacceptable.

PROCESS APPROACH. ENTERPRISE. BUSINESS PROCESS. FUNCTIONAL APPROACH. MANAGEMENT.

Вопрос о том, как применить процессный подход на предприятии по-прежнему актуален и регулярно поднимается при управлении предприятием. Это связано с отсутствием конкретного ответа на вопрос о повсеместной применимости данного подхода. В данной статье авторы пытаются проанализировать типичные ситуации, когда применение процессного подхода необходимо и когда оно недопустимо.

ПРОЦЕССНЫЙ ПОДХОД. ПРЕДПРИЯТИЕ. БИЗНЕС-ПРОЦЕСС. ФУНКЦИОНАЛЬНЫЙ ПОДХОД. УПРАВЛЕНИЕ.

Concept of managerial efficiency evaluation: subject, main issues

The analysis of the efficiency of the company's management is one of the most important everyday issues for corporate executives and external consultants worldwide. The need to evaluate the efficiency is faced in a variety of situations. The objective pursued while evaluating efficiency is very simple: each owner or a third-party investor tends to make all the settings of the enterprise (resources, technology, finance, personnel, etc.) promote хлебозаготовthe achievement of the main goal. The highest level of this goal is to increase the company's profit. Difficulty in evaluating the *managerial efficiency* often includes a variety of factors, like the following: a possibility of only expert evaluation of any business processes; volatile market conditions; an excess – or vice versa – a lack of sufficient information for evaluation.

For the operational and strategic management, the tools to evaluate the company's performance should be applied regularly, using examples of many companies. Methods for efficiency evaluation must be constantly improved and adapted to the industry in which the company operates, as well as for specific business processes under investigation.

In order to give a clear definition of 'efficiency evaluation' and, accordingly, to propose options for evaluating the efficiency using the process approach in management, the key terms of the issue shall be considered.

Efficiency is defined as an achievement of any specific results at the lowest possible cost and the achievement of the maximum possible production volume using a given amount of resources [1]. The concept of efficiency is often associated with the principle of Pareto optimality, which states that the optimality is a state in which it is impossible to make any one indicator characterizing the system better off without making at least one indicator worse off [2]. In the words of V. Pareto, «Any change which brings no loss to anybody, and benefit to some people (by their own estimation), is an improvement» [3]. Efficiency indicator (relative) is defined as the quotient of the potential impact by the resource intensity of any operation, project, and process [4].

Having defined the efficiency concept, it is necessary to clarify the question: what is the subject of the analysis? What kind of efficiency are we talking about?

In English, the concept of efficiency in the management is expressed by two key terms:

managerial effectiveness ('system' efficiency) and management efficiency ('operational' efficiency). Managerial effectiveness depends on the efficiency of the organization of the management, i. e. the composition and quantity of links, their subordination, and distribution of functions. In other words, effectiveness of the management system depends on the quality of the organizational structure, management processes, but does not depend on the qualities of any managers. Management efficiency, i. e. ratio of performance of management and overall effort, in contrast, is primarily determined by business qualities of managers, as well as by rational use of their potential [5]. Both parts of the study are important for the evaluation of efficiency within the process approach. However, it is managerial effectiveness which is the major subject of this study.

An efficiency indicator is a key element in making managerial decisions based not only on the specific numbers, but also on the expert method. Consequently, the main challenges of the matter are as follows: what data should be correctly reflected in the formulas to derive this indicator, how can the error of the indicator be reduced, and what administrative levers are required for the growth of this indicator. But the most important question is how to derive this indicator.

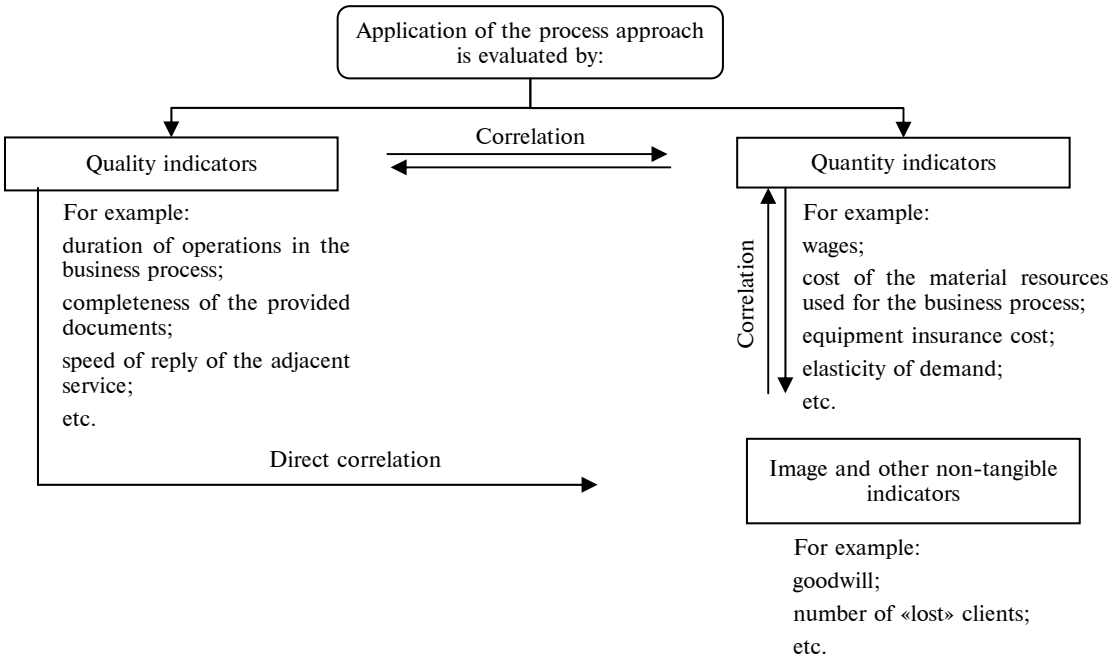
An aim of any company's activities is to maximize profits and reduce costs. These indicators are quantitative, and can be expressed in monetary terms. The achievement of these indicators relates to the operational management, and constitutes an important part of management. However, quantitative indicators are inseparable from quality indicators. It is worth giving a simple example: if a product is not in accordance with ISO or any other standards, obtaining marginal profit is impossible. The same approach can be applied to the business process of creating this product. That is, the concept of quality can refer both to a specific product and the system of processes of its manufacturing. The process approach, being analyzed in this study, aims at improving the performance of certain business processes or the whole system. The application of the process approach is known to be recommended in various series of ISO international standards. So, it is assumed that quality improvement through the use of the process approach affects the quantitative indicators of the company, as well as various intangible assets, such as goodwill.

As it was mentioned before, efficiency is the ratio of the effect (including profit) from any activities, and the cost of such activities, thus, it is necessary to emphasize the importance of the latter in this formula. Costs are expenses of enterprises, entrepreneurs, and private producers of production, sales and marketing expressed in monetary terms [6].In other words, costs are the volume of the resources used in the process of economic activity during a certain time period. Management decisions are characterized by both costs of quantity and quality of the manufactured products; an improvement of production chains; reengineering activities of business directions of the company. Consequently, making a management decision does not require an aggregated efficiency indicator but an indicator, derived with maximum clarity, showing quantity and justifying costs, both qualitative and quantitative; and this is an important issue of this study.

The issue of quality costs has always caused a lot of argument. A process of figuring out, whether there are costs of quality and how they can be separated from the quantity costs, is still on. ISO 9000:2000 standards specify mandatory activities to improve the efficiency and performance of the processes and the whole quality management system. However, a practical implementation of such activities is more complicated, multifaceted, and laborious.

Effectiveness is determined by ISO 9000:2000 as a degree of the implementation of planned activities and the achievement of the planned results [7]. Furthermore, effectiveness can include enforcement, achievement (completeness degree),and accomplishment, conduction (degree of execution) of a command, responsibility (obligation),assignment (objective), and promise. According to ISO 9000:2000, efficiency is the ratio of the results achieved and the resources used. Therefore, defining the efficiency indicator is not possible without using quality costs, quantity and cost of the process. Hence we obtain the isolated task: we need to evaluate the efficiency of the process approach, for which we need to know criteria of economic efficiency and effectiveness (in monetary terms), but, first, we need to calculate quality costs of the process.

Graphically, the above can be reflected as follows:



Thus, the evaluation of the process approach efficiency, in general, is the analysis of three main areas: economic effect of the process approach application expressed as an aggregate in monetary terms; the quality of the internal organization of business processes; goodwill.

Significance of key performance indicators for the process approach evaluation in management

In each of these three areas, in order to assess the process approach efficiency, the key metrics should be defined, which are used for the calculation of general efficiency indicator.

In this study, the metric refers to a criterion of a process, stage, state which gives a qualitative characteristic in clear quantitative terms. The definition of the metric, in most cases, does not require a complex formula because the logic of the process approach implies the understanding that each stage in the process has its own input and output. Input includes resources and requirements to the stage. Output is a result used by the following link, and compliance of the result obtained with previously stated requirements.

In a broader sense, the process approach application requires the development of a system of key performance indicators (KPI). KPI is an evaluation system that helps organizations to determine the achievement of strategic and tactical (operational) objectives [8].

The translation of the words *key* (main, characterizing a degree of achievement of a goal, essential for the work of one of activity directions of the company) and *indicator* (indicator) in to Russian is easy, but the word *performance* can not be interpreted unambiguously. ISO 9000:2008 provides the right interpretation of this word. It divides *performance* into two terms: effectiveness and efficiency, as it has been said before. Once again, effectiveness is a degree of achievement of the planned results (the company's ability to focus on results), and efficiency is a ratio of the results achieved and the resources invested (the company's ability to achieve their goals and plans with a specified quality level, expressed specific requirements – time, cost, a degree of achievement). Thus, the correct translation of the KPI in Russian is «ключевой показатель результата деятельности» (key indicator of the activity's result), as the activity's result includes both the degree of achievement, and the costs of achievement of the result.

What is the difference between KPI and the stages' metrics then? In this study, similar to the common practice in Western companies, metric refers to a smaller criterion unit, located at the junction of the stages within one process. KPI, in its turn, covers either the whole process or the network of processes, being a measuring instrument for the set goals.

The most important rules for creating a KPI in the process approach are as follows [9]:

1. 10/80/10 Rule: The company must have about 10 key performance indicators, up to 80 operational indicators, and 10 key efficiency indicators.

Stages' metrics	KPI
Set of documents provided from unit A and unit B, must contain document no. 1, document no. 2, document no. 3. Written report shall be provided by the Department A to the Directorate B in two days. Approval of project documentation by unit A and unit B shall be made within a week. Waiting time to apply for the conclusion of a power supply agreement in the Customer Center A shall not take more than 5 minutes. After the first phase of the investment program the Directorate A shall select and provide to the Directorate B not less than 100 agreements with the most favorable construction works	Preparation and approval of technical conditions within 10 days. Responding to the applicants not later than 3 days after the application's registration. Technological losses during transmission in Lodejnopolsk region shall be not more than 1MVA per 1 year

2. Management ability and control ability principle: The persons responsible for any KPI have all required resources for its enforcement, it can be controlled.

3. Integration of the process of evaluating of indicators, accountability and productivity improvement: it is necessary to create and constantly improve integrated circuit of efficiency evaluation, reporting, etc.

Large Western companies and domestic corporations with a wide geography, large market, two or more core directions can provide a lot of good examples of KPI and metrics. In this study, we take a network distribution company X, specializing in electric power. The examples are taken from all three groups of indicators.

In summary, in order to find out, whether the process approach is effective:

1. Evaluation of three main groups of indicators (qualitative, quantitative, goodwill)

1.1. availability and optimality of KPI of the processes as a whole,

1.2. availability and optimality of the stages' metrics,

1.3. definition of costs of applying the concept of the process approach for the conditional period of time;

2. Comparison of economic indicators before and after the implementation of the process approach, in the main business directions of the company (where the approach has been implemented)

3.The conclusion, based on the above, about the possibility of the calculation of an integral indicator of the efficiency of the process approach application

It should be noted that the result of this analysis provides the answers to two questions: *What was the efficiency of the process approach application*? And *Is the process approach application efficient for a particular direction of the company under study?*

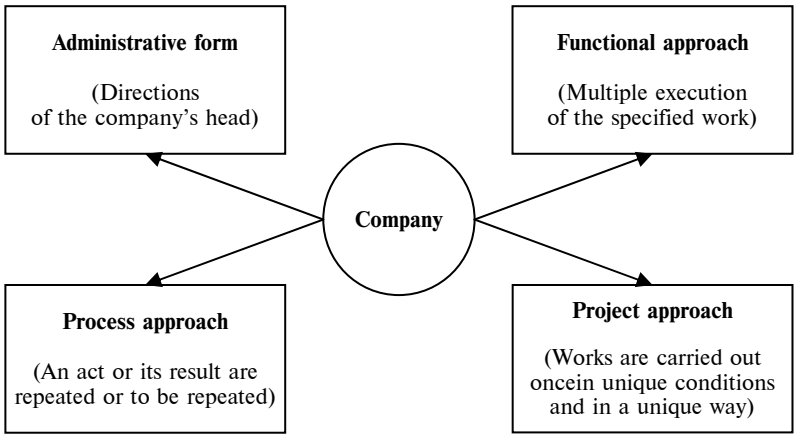
Definition of areas where the process approach application can be considered ineffective

Modern management in a market economy aims to react as flexibly as possible to all changes that are dictated by the market or carried out by the organization itself. Depending on the specific industry of a company, and its functions in the market, the question of the appropriateness of the process approach application should be raised.

When choosing an approach for the management of the organization's activities, it should be assumed that one organization may have multiple management approaches. In both theory and practice of management three major approaches to management have dominated: in 1960–1980 entrepreneurs sought to establish a clear organizational structure, in which each division and a separate unit understood the limits of their liability. A proper distinction of functions and persons responsible for them became a key success factor for many organizations. The apex of this approach was the development of the international standards ISO 9000 version 1994.

Further, the process approach was developed, resulting in the creation of ISO 9000 version 2000 [10, 11, 13]. However, despite the widespread desire to apply the process approach with its clearly structured inputs and outputs, there were organizations engaged in the construction of unique objects, or producing a limited number of units for special requirements[11]. In such organizations, the project approach is dominant when the project has a beginning and an end, resources are limited, and each project is done once, using a given sequence of actions in unique environments. The developers of ISO 9000 tried to solve this problem and include the project activity in the standards of quality management by calling the project a special case of the process. In this study, it is implied that the project is a completely different activity.

Thus, the overall structure of various management approaches might look as follows [12]:



These types of management approaches are used most frequently. Administrative approach is characterized by direct instructions given by a person in authority to other persons in the form of commands, directions and demands. But in any case, the scope of application of this form is a relatively short-term task, with a more or less clear solution. For example, the instruction 'to connect to a representative of the supplier'.

The functional approach is applicable and effective when people need to repeatedly perform a specific job, but the way of work execution is not defined or not known in advance. Moreover, there may be different ways to do this work in different situations (subject to variable conditions), and none of them is preferred in advance. In such cases, the personnel is said to be entrusted with a function. For example, function 'to connect to the representatives of the suppliers'. In cases where the actions and their results are repeated or should be repeated (especially if it concerns the product's or service's characteristics, etc.), i. e. must be reproducible, for example, if it concerns the part's characteristics, conduction of internal audits, etc., activities should be organized as a process.

For the process approach reproducibility is a key distinctive feature. It is its expectation that requires the reproducibility of the process of input, as well as actions in the process and the conditions of its occurrence (execution). For example, we want to receive quarterly information on our customers, which we contact on many issues. We regularly want to know their opinion about our products and services. This kind of activity can and should be organized as a process. In this case, it is necessary to identify the owner of the process who is to call the same people with a list of questions each quarter in order to get a report of a definite structure, which will be submitted for the analysis.

The project approach is for such activities which are performed once in unique circumstances and in a unique way. A good example is the management of the current construction of a nuclear power plant. A nuclear power plant construction elsewhere will be fulfilled according to a completely different project. It may have processes inside, say, supply of bricks for the construction of the administrative building. But in general it will be a project.

The foregoing description can be presented in a table [12].

Forms of management of different activities in organizations and relevant types of relationships		
Classification criteria	Activities not suggesting specific planning	Activities involving special planning
Single activity (has a start date and an end date)	Management form – administrative Relationship form – superior–subordinate	Management form – project Relationship form – customer – contractor
Continuous activity (repeated on a constant basis)	Management form – functional Relationship form – periodic reporting	Management form – process Relationship form – customer – supplier

It should be concluded that the application of any single approach for the whole enterprise is impossible. The more diversified the company is, the more it is likely to use two or more management approach. It should be noted that it is the number of different internal and external areas of work which is significant in this case, not the number of the company's personnel.

Example of mixing management approaches at the enterprise

Let's consider an energy company which core business is to work with consumers in the sphere of energy consumption data monitoring; to enter these data in the specialized information systems for the subsequent listing of energy consumption balances by consumer groups and by regions; to define the level of electricity losses in transmission.

The following general company information is available:

Number of personnel working in the office	43
Number of personnel involved in the «field» work	50
Organizational structure	Director-General, 5 Deputy General Directors, 8 heads of departments/sectors, line personnel
Activity 1	Conduction of energy audits in order to create programs for energy conservation and efficiency
Activity 2	Preparation and implementation of programs for energy conservation and energy efficiency
Activity 3	Installation/maintenance/replacement of meters at the balance borders of the networks' owner and the consumer
Activity 4	Carrying out checks of the performance control of measurement systems used
Activity 5	Surveys and preparation of control readings certificates
Activity 6	Regular tripping of the objects belonging to the consumers illegally connected to the grids
Supporting activities	Accounting, legal, administrative and economic activity

In order to decide which form of organization of activities should be chosen according to the objectives set within the activity, it is necessary to carry out decomposition steps in order to achieve these objectives.

For example, let's consider the form of activities involving making up the balance of electrical energy. The electrical energy balance is inextricably linked to the electric power balance – balance of the consumers' maximum load and generating capacity subject to the rational amount of the reserve, MW. The purpose of this area of work is to ensure balancing through the following basic steps:

1. Installation of intelligence metering systems;

2. Reading of the measurement systems of the consumers not yet equipped with intelligence systems;

3. Settlements on consumption standards depending on the seasonality of the consumers not included in the group mentioned in paragraphs 1 and 2;

4. Entering the data obtained in the information system;

5. Consideration of issues of legal validity of the meters replacement, procedure of reflection of updated information of the meters in the information system;

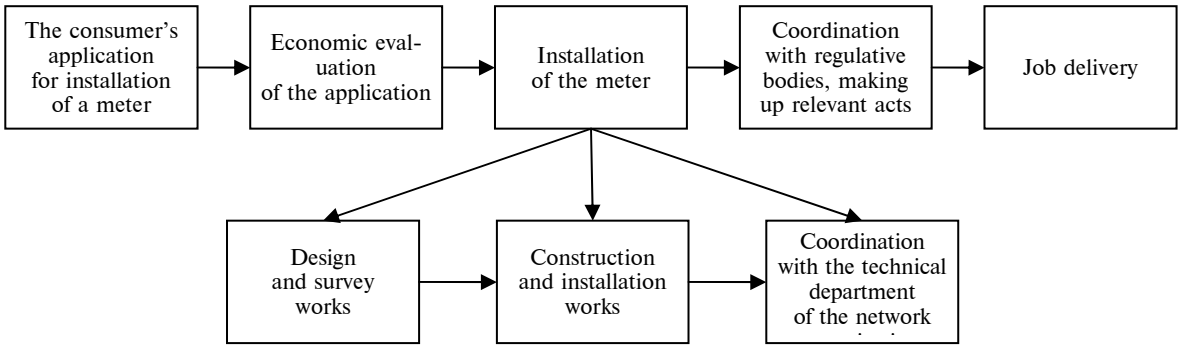
6. Planning of repeated survey of the same facilities once in a month;

Preparation of financial and other reports, providing information to the network organization for the subsequent separation of data on the circuit of electric power balance.

Among the above sub-steps, even at first glance, sub-steps of paragraphs 1, 2, 4 look like processes. Let's consider, for example, the top level of paragraph 1.

In general, the sub-process is as follows (see Fig.).

Each of these blocks can be decomposed several times and described. This scheme shows that, in general, activity associated with the installation of metering units, is a process in its nature: each separate unit is localized, input and output parameters are well-defined. The result is also obvious – the sealed meter at the consumer's. However, despite the process approach and the KPI system applied to this sub-process, there are some blocks which are associated with functional features. They include



primarily all kinds of activities connected with the consideration and coordination with the legal services – within the company and upon coordination with the network organization, due to the fact that legal departments often perceive the problem beyond the process and its features, including rigid time limits under which similar work is usually conducted. The same approach can be applied to the making up of the accounts, which is the final stage of the work with the consumer.

The mixing of approaches in the organization of work cannot be unambiguously considered only negative. Hypothetically, the integration of all participants in the process is possible. However, for persons working only with meters and conducting planning of this activity, it is easier to carry out their activity as a mechanical automatic operation rather than by diversified units supporting functions of the processes.

Thus, the more specified are the tasks of the unit, the faster and more efficient is the implementation of the process approach in management. It should also be noted that the units responsible for the compliance of the company's activities with all required standards, in most cases, remain in the zone of functional organization, since the issues considered can be addressed deep enough down the internal hierarchy of the units.

The mixing of management approaches is the most common phenomenon in management nowadays. There is no thesis which would uniquely state that there is a universal approach or tool. The mixing of approaches may not apply only to the task itself and to the process of solving certain issue but also in cases when on the contrary, inside a unit, certain tasks are carried out using the project approach, and some of the tasks are carried out by the rules of the functional organization of activities. That is why, when choosing a particular approach and setting goals, inputs, outputs and key performance indicators, a thorough audit of the current work order is to be conducted.

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METHODS FOR THE COMPENSATION OF A PRODUCTION RESERVES DEFICIT

Е.С. Балашова

МЕТОДЫ, КОМПЕНСИРУЮЩИЕ ДЕФИЦИТ РЕЗЕРВОВ ПРОИЗВОДСТВА

The article focuses on the urgent problems of resource management; a classification of the production reserves is provided. Special attention is devoted to the modern methods of resource management, allowing to identify and optimize production reserves.

RESOURCES. MANAGEMENT. PRODUCTION RESERVES. ORGANIZATIONAL TECHNOLOGY. LEAN PRODUCTION. KAIZEN.

Рассматривается проблематика ресурсного менеджмента, его актуальность, дана классификация резервов производства. Особое внимание уделяется современным методам ресурсного менеджмента, позволяющим выявить и оптимизировать производственные резервы.

РЕСУРСЫ. МЕНЕДЖМЕНТ. РЕЗЕРВЫ ПРОИЗВОДСТВА. ОРГАНИЗАЦИОННЫЕ ТЕХНОЛОГИИ. БЕРЕЖЛИВОЕ ПРОИЗВОДСТВО. КАЙДЗЕН.

The global economy is constantly and continuously changing, thus establishing the new requirements of successful operation of businesses. Industrial enterprises are in a particularly difficult situation because the basic criterion for the efficiency of the production systems is currently formulated as «manufacturing of products of the highest quality at the lowest cost» [5]. Such a statement of the problem is based on a high and ever-increasing level of competition among manufacturers, openness of the markets at the macroeconomic level, availability of substitutes of the manufactured products, from the consumers' point of view, in terms of satisfaction of the emerging basic needs.

The unused and constantly emerging opportunities for growth and perfection of production, improvement of its ultimate results (increased production and sales of products, reduction of production costs, growth of profits are the internal production reserves of industrial enterprises (Fig. 1) [4, 9, 11, 12]. Production reserves are characterized by the inconsistency between a current use of the production resources and a much higher potential of production resources in case losses and wasteful expenditure are eliminated, and scientific achievements and technical progress are applied.

The formation of the production reserves is a continuous process, as it is related to scientific and technical progress, and the improvement of the organization of labor and management [7]. Production reserves must be distinguished from the losses resulting from malfunctions, deviation from the established operating practices, and violation of technological discipline. While analyzing and identifying the reserves, the researchers should primarily clarify the analyzed level or the basis of comparison.

The goal of the reserves selection is to increase production and sales rates, achieving the level of profitability that is high enough to hold the competitive positions and to increase the company value. Search and evaluation of the reserves implies quantitative modification of the potential production growth as a result of more efficient use of the resources and optimal combination thereof, as well as increased market presence of the organization.

Use of the lean production model as a tool for identifying the production reserves and for related optimization of the operational activity, represents a breakthrough approach to management and administration of the industrial enterprises, maintenance of its long-term competitiveness without significant capital investment.

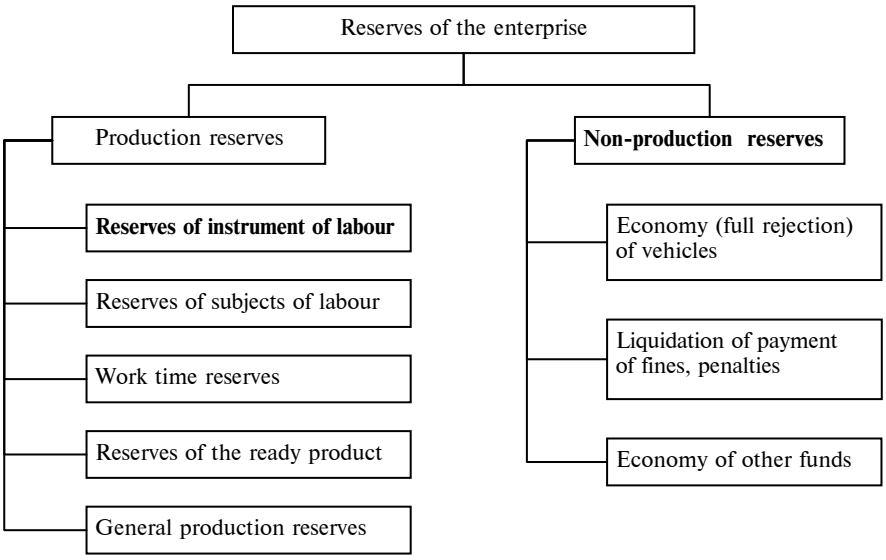

Fig. 1. Typology of enterprise' reserves

According to the results of statistical studies and sociological opinion polls, penetration of the elements of Japanese lean production system into the Russian industry is rather sound – about 30 % [3]. The concept of lean production includes optimization of the production processes, in order to achieve simultaneous cost reduction of the company's basic products, and to improve their quality. Dependence between the product cost and its quality has been traditionally considered as direct dependence, i. e. high quality product, as it was assumed above, cannot be cheap for the manufacturer. The concept of lean production represents the product price/quality dependence rather differently. Quality product is a product during the manufacture of which the production loss level as low as possible. Thus, the set goal becomes quite attainable. However, introduction of such a basic and simple, at first glance, concept is actually a complex managerial, organizational, and communication process. The problem is that the Lean production concept has been developed and initially applied in the automotive business. The basic models and methods of lean production must be established in view of specificity of the business operation and should be adapted to the latest demands. For the major sectors of public economy, the adaptation of lean production model has only just begun.

The relevance of the application of the lean production model in Russia has been appreciated at the governmental level. At a meeting of the Modernization Commission, President of the Russian Federation noted that, in order to improve the competitiveness of the national enterprises and their performance efficiency, it is essential to be engaged in the **development of production systems**. In this sense, he seemed to have much concern in the concept of «**lean production and economic thinking**», and he believes that Kaizen philosophy of continuous improvement is just a «godsend»:.. *total exclusion of losses – all that does not add value to the end product – is the top issue now. These losses are at the bottom of actual reasons for the low productivity and low efficiency of the domestic enterprises... «*

The Government of the Russian Federation has ordered to consider, in the nearest future, the possibility of the domestic enterprises to apply advanced production organization methods. The lean technologies and ideas of operational excellence themselves are important enough to be included in the compulsory curriculums of the universities and post-secondary educational institutions.

The concept of lean production is gaining much popularity in Russia. Many manufacturers are committed to cost reduction, increase in productivity and the improvement of quality. Lean production corresponds to the process model of management of an industrial enterprise, so that it is traditionally represented as a process that consists of the following five stages of implementation [6]:

– definition of the consumer value,
– making the consistent value stream,

– ensuring the stream continuity,
– ensuring it to be customer-oriented,
– constant commitment to excellence,

The concept of lean production was changing historically, gradually transforming into the idea of a lean enterprise. This is quite natural, since production is directly related to non-productive service agencies and, if production is in good order, but the rest of the organization lies in total anarchy, lean production will be of no use at all.

The functional goal of each component of lean production is to achieve its own target, while an interaction of components facilitates the main purpose of the production system: maximizing the product quality and minimizing the production costs.

The functional goals of the components of lean production are based on the essence of the major tasks thereof.

The process of continuous improvement (kaizen) represents one of the basic organizational techniques in modern business. The basic purpose of kaizen is improving performance through the company's internal resources.

The set goal is conventionally divided into the three main components:
– Improvement of the finished product quality;
– Cost reduction of each product;
– Delivery on «just-in-time» basis.

The 5S System represents the technology of work space organization aimed at in improvement of labor productivity. The purpose of 5S is the formation and maintenance of the working order in the process of added value creation. The 5S system implies achievement of the following production goals:
– Strategic: increase in labor productivity: reduction of spoilage rate;
– Tactical: identification and elimination of deviations from the normal operation, elimination and exclusion of malfunctions, improved labor safety.

Detecting the sources of manufacturing defects Global 8D is the process of systematic problem solving, which consists of 8 stages (tasks) functioning at the same time and determining the key reasons behind the problem, thus preventing its reoccurrence [10]. The main purpose of G8D is to find the place and the reason dehind the production problem (failure, malfunction, defect, non-conformity), its elimination and preventive improvement of the production system, in order to exclude its reoccurrence in the future operations.

An important facility for production processes improvement is the Statistical Process Control (SPC). Statistical process control implies monitoring the condition of the processes through measuring some of the parameters of the manufactured products or manufacturing processes. The purpose of SPC is a gradual relinquishment of production quality control to be replaced by process quality control, which may ensure the elimination the systemic failures of the production system until the occurrence thereof, and ensure stability and reproducibility of the production behavior.

FMEA (Failure Mode and Effects Analysis) represents analysis of the types and post-effects of failures. FMEA is a methodology for the analysis and identification of the most critical steps, for the purpose of quality control. The purpose of FMEA is to analyze all possible system errors and determine their results or effects on the system, in order to classify all the errors in terms of their criticality for the system's operation.

TPM (Total Productive Maintenance) is servicing of the equipment, allowing for achievement of its maximum efficiency over the entire life cycle involving all the staff. The purpose of TPM is to create an enterprise which will be constantly striving to the utmost and comprehensive improvement of the production system efficiency. To achieve the above goal, a system focused on the prevention of any types of losses must be introduced («no accidents», «no damages», «no defects») throughout the entire life cycle of the production system.

JIT (Just In Time) represents a method of company inventory management, which has been designed to improve return on investments, efficiency and quality of work through drastic reduction of the inventory level [1]. A consistent application of JIT allows to achieve the following main objectives of an enterprise: simplification of warehouse material flows, synchronization thereof with the production schedule, reduction of inventory storage-related costs.

Kanban (Smart Card) represents a planning system which allows to determine what, when and how much shall be produced. This is an appropriate element of the JIT concept introduction. Kanban is used as an indicator of demand, immediately transmitting the signal over

the entire supply chain. It represents the «pulling» system which is guided by demand in the extreme right point of the supply chain. The main goal is to produce just the necessary volume of products within strictly defined period of time, in order to reduce the time of keeping the product at each production site and in a warehouse, thus using the time of production and delivery to the consumer as a competitive advantage. The application of the Kanban system regulates the quantity of goods produced at an enterprise [2]. Kanban is called a signaling system of lean production, because it controls the production as skillfully as the brain and the nervous system (the first signaling system) do to the human body. The main advantage of Kanban is to prevent overproduction. The purpose of Kanban system is to produce only the desired products in the required quantity and at the right time. In Japanese, the word «kanban» means «tag» or «mark».

The application of the WG Model (Working Group) – Model of Working Groups (WG) implies a permanent creation of the cross-functional teams of company employees, to achieve fast implementation of the internal corporate goals. Such goals can be either of scientific-research nature and imply development or introduction of the new intracompany projects. Workgroups operate within the predetermined time interval from few weeks to several years. Upon the termination of the specified time or achievement of the set goal, they are dissolved. The objectives of the working groups are:

– creation of the reference document, technique;
– establishing the intracompany standards;
– solving the system or network related problems;
– continuous improvement of the production processes.

TQM – Total quality management is the philosophy of comprehensive quality management, which has been successfully launched many years ago in Japan and the USA, upon the introduction of the initiative of giving awards to the companies that have achieved the highest product quality [8]. The main idea of TQM is that the company must focus not only on product quality, but also on quality of the organization of work, including the work of the staff. TQM implies permanent parallel improvement of the 3 components thereof:

– product quality;
– quality of processes organization;
– staff qualification level.

Quality is defined by the following categories:

– meeting the customers' requirements
– growth of the company's financial effectiveness
– increase in the company's employees' job satisfaction

The compensation of the internal production reserves is achieved through the implementation of the functional goals of lean production, thus it should be taken into account that the utmost efficiency of the production system can be achieved subject to simultaneous implementation thereof.

Reserves of labor instruments are formed due to application of the policy of saving fixed production assets (Fig. 2). The classical concept of such a strategy would inevitably lead to the decline in the quality or productivity of the main production processes; the application of the lean production instruments allows to minimize the potential adverse effects while achieving clear competitive advantages. Similar trends are observed in the identification and compensation of the subjects of labor and the finished product.

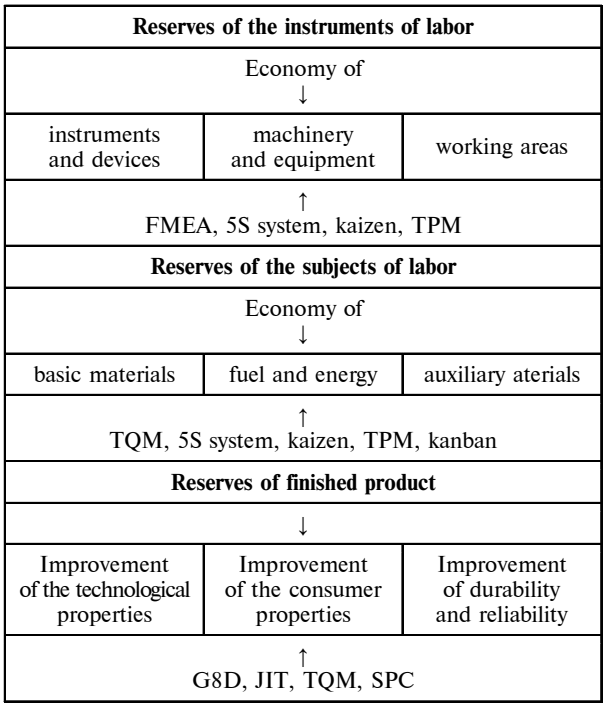

Fig. 2. Management of the reserves of labor instruments, subjects of labor and finished product

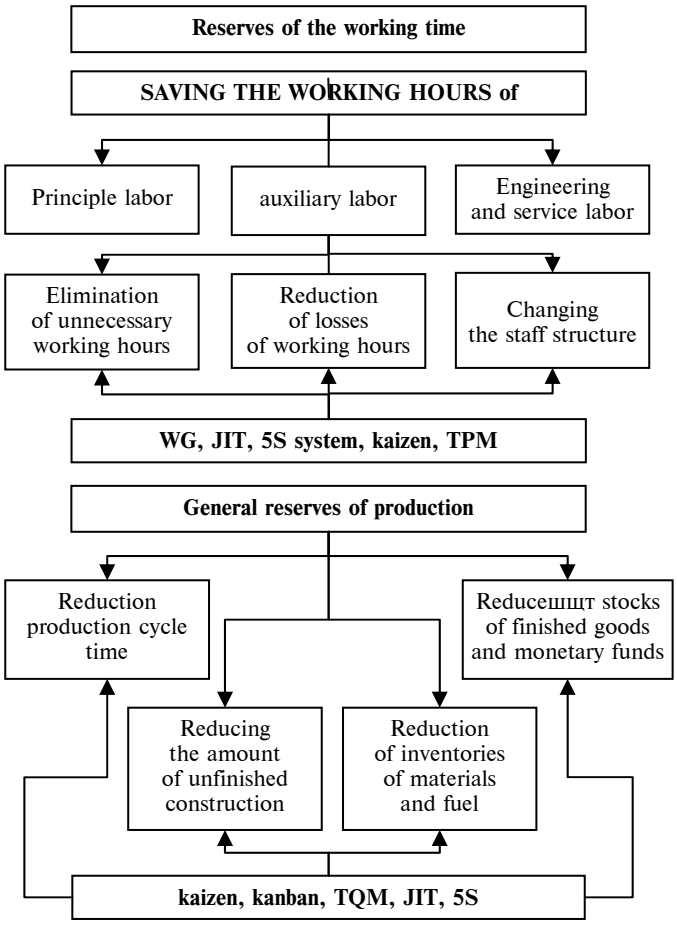

Fig. 3. Management of the working time reserves, general production reserves

General production reserves (Fig. 3) which are understood as the reserves related to the organization of the production process, are formed on the basis of applied organizational and production technologies. Their identification and compensation constitute a component of corporate strategy based on the introduction of such models as kaizen, kanban, TQM, JIT, and 5S.

The mobilization of reserves allows to increase production considerably with minimal investments involved (capital investment) and minimal additional consumption of materials, fuel and energy. It ensures significant savings of public labor, improvement of its productivity, decreasein production, and growth of internal production savings. The mobilization of production reserves is the most economical source of industrial production growth.

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INFLATION AS UNCERTAINTY FACTOR IN STRATEGIC FINANCIAL PLANNING SYSTEM OF INDUSTRIAL ENTERPRISES

В.В. Пшеничников

ИНФЛЯЦИЯ КАК ФАКТОР НЕОПРЕДЕЛЕННОСТИ В СИСТЕМЕ СТРАТЕГИЧЕСКОГО ФИНАНСОВОГО ПЛАНИРОВАНИЯ ПРОМЫШЛЕННОГО ПРЕДПРИЯТИЯ

The article discusses the importance of financial planning in the strategic planning of an industrial enterprise; observes the causes of inflation in the Russian economy, forms of its manifestation, and their mutual influence. The article proposes to complement the discounted cash flow method by moving average indicators that would take into account the inflation rate in the development and implementation process of strategic financial planning of an industrial enterprise.

INFLATION. STRATEGIC PLANNING. FINANCIAL PLANNING. CASH FLOW DISCOUNTING. MOVING AVERAGE.

Раскрывается значимость финансового планирования в системе стратегического планирования промышленного предприятия. Рассматриваются причины инфляции в экономике России, формы ее проявления и их взаимное влияние. Предлагается дополнить метод дисконтирования денежных потоков применением показателей скользящих средних, которые учитывали бы темпы инфляции в процессе разработки и реализации стратегических финансовых планов промышленного предприятия.

ИНФЛЯЦИЯ. СТРАТЕГИЧЕСКОЕ ПЛАНИРОВАНИЕ. ФИНАНСОВОЕ ПЛАНИРОВАНИЕ. ДИСКОНТИРОВАНИЕ ДЕНЕЖНЫХ ПОТОКОВ, СКОЛЬЗЯЩИЕ СРЕДНИЕ.

Planning financial resources and sources of their coverage is one of the essential elements of the strategic planning of an industrial enterprise. The value of financial planning for businesses is as follows: it realizes strategic goals in the form of specific financial indicators, provides financial resources for the input in production plan, provides the possibility of determining the viability of the company in a competitive environment, and serves as an instrument of financial support from external investors.

On the one hand, planning prevents erroneous actions in the areas of finance, on the other hand, it reduces unused opportunities.

The main objectives of financial planning at the enterprise are:

– providing production, investment and financing activities with the necessary financial resources;

– identifying ways of effective capital investment and the assessment of its rational use;

– finding internal reserves to increase profits by means of economic use of funds;

– establishing rational financial relations with budget, banks and counterparties;

– safeguarding the interests of shareholders and other investors;

– controlling the financial condition, paying capacity and creditworthiness of the company.

The financial plan is intended to provide financial resources for the entrepreneurial plan of the business unit; it has a big impact on the economics of the enterprise. This is due to several circumstances.

Firstly, the financial plan compares the planned expenditure with the implementation of the real opportunities, and, as a result, is achieved by adjusting the material and financial balance.

Secondly, the articles of the financial plan are associated with all the economic indicators of the enterprise and linked to the main sections of the business plan: production of goods and services, research and technology development, production and management improvement, production efficiency, capital construction, logistics, labor and personnel, revenue and profitability, economic incentives, etc.

Kolbachev E.B. stresses the importance of the financial condition of the company and the indicators characterizing it in the modern production system. «The financial condition of the company is the result, on the one hand, of its production and economic activity, on the other hand, of the external environment (to which the production and business activities of the enterprise should be adequate). In addition, the financial figures are, in essence, one of the many information resources available to the enterprise, and should be considered as part of the overall resource system. This approach does not contradict the fundamentals of the modern market economy» [4].

Thus, financial planning influences all the aspects of activities of a business unit by selecting the objects of financing, transferring funds and promotes the rational use of manpower, material and financial resources.

Financial planning is inextricably linked with the use of indicators of monetary value. In terms of money circulation when the monetary unit is a unit of account and measurement of commodity prices and subject to inflationary depreciation, plan figures can acquire a high degree of conventionality.

Inflation is a complex multifactorial socio-economic process determined by the interaction of the sphere of production and the sphere of circulation, disproportion between different spheres of the national economy: accumulation and consumption, supply and demand, revenues and expenditures of the state, money supply in circulation and money needs of the economy.

Typical manifestations of modern inflation are a general rise in commodity prices and the depreciation of the national currency against major foreign currencies. In a market economy, the crisis of monetary circulation can be judged only by the dynamics of prices, so inflation is both a monetary and price phenomenon.

Modern inflation may be caused by both internal and external factors, the most important of which are:

– excessive emission of currency;
– loss of confidence in the national currency;
– off-balance country pay balance.

Excessive emission of currency is determined by a number of factors:

– imbalance of public expenditure and revenue, budget deficit, widespread use of domestic borrowing to cover the budget deficit which increases the money supply, and therefore leads to higher prices;
– increasing the mass circulation of credit instruments which result in the expansion of the credit system;
– releasing into circulation means of payment which are not completely state-controlled (e.g. finance bills);
– excessive investment which leads to the overproduction of some goods and, at the same time, to a deficit of others, which increases the imbalance in the economy and monetary system;
– faster growth of wages in comparison with an increase in labor productivity (this phenomenon can take place in the public sector as a result of populist policies to increase the incomes of the population), etc.

Non-monetary causes of inflation define it indirectly, but ultimately lead to higher prices and the depreciation of money. Therefore, it is advisable to allocate the following non-monetary causes of inflation:

1. The deformation of the structure of the economy. In the case of excessive development of heavy industry and mining, their employees come to the consumer market with a high level of income without producing non-production goods. In this case, excessive demand is formed alongside the gap in supply of necessary consumer products. In addition, it provides the basis for cost-push of the latter. Adverse effects are also observed in the case of growth of the service industry which unjustifiably exceeds reasonable limits. The fact is that the service industry is characterized, on the

one hand, by the slower growth of labor productivity compared to the sectors of material production, and on the other hand, by a large proportion of wages in total production costs.

2. The militarization of the economy. State funding of military spending will inevitably lead to an increase in money supply at relative impoverishment of the market of consumer goods and services.

3. Monopolism in economy. Natural, economic, artificial monopolies are able to raise their prices without corresponding increase in consumer qualities. The prices are usually set by the principle of «allocable costs of production plus guaranteed profit». This leads to a lack of interest in reducing costs and cost based management. As a result, in particular, new technology which leads to reducing costs is scarcely used in a natural monopoly. In contrast, capital-intensive technologies are actively implemented.

4. The extraordinary circumstances of socio-political and economic nature (union demands for wage growth, strikes, growth of political and economic instability).

5. Errors in the conduct of monetary, fiscal and pricing policies of the state. In particular, in the Russian Federation the taxation is emphasized on indirect taxes. But indirect taxes are directly included in the price structure. Thus, the Russian practice of taxation leads to higher prices and requires corresponding growth in the money supply.

Among the external causes of inflation we should highlight the following:

– the inflow of foreign currency into the country in exchange for domestic currency, which demands additional issue of national means of payment;

– the falling rate of the national currency leads to an increase in import prices and promotes the growth of the general price level in the country;

– high demand for imported goods which are more expensive in comparison with similar national products, which promotes the rise in price of the latter through the mechanism of «pulling» the price level.

As a complex, multifaceted phenomenon, inflation can be classified from different perspectives. The factors determining inflation can be classified into two types.

The first group includes the factors that cause excess demand (for money supply) over supply (commodity weight), which results in the violation of the laws of monetary circulation. Eventually, demand pull occurs. The logic circuit is as follows. Excess of demand over supply causes an increase in price. Higher prices at fixed costs provide profit growth and growth of workers' income. This growth leads to the next round of increase in demand, a new level of pricing up. Typically, this type of inflation is most often seen at full employment.

The second group consists of the factors that lead to the initial increase in costs (the costs of salaries, materials, energy, etc.) and the prices of commodities, supported by further pulling of the money supply to a higher level. There is cost-push inflation. The logic circuit: the growth of the prices of factors of production (production costs) determines the reduction in supply of goods and, therefore, increases in commodity prices. An increase in nominal wages, however, does not mean an increase in real wages, as prices rise faster. The increase in wages, increasing costs of raw materials, components, fuel, energy, etc. gives a new impetus to the growth of production costs, which leads to a new rise in prices. If the money supply does not increase quickly, does not adapt to the increased level of prices, a cash flow problem arises. There is a danger of business interruption, reducing community weight.

Cost inflation can induce the so-called inflationary spiral of prices and wages. Wage growth in the revision of the tariff agreement between employers and employees under certain conditions is a source of aggravation of cost inflation. Originally, a new level of wages is established in the relevant segment of the labor market, then a change in the general level of wages in the whole country. If this process is not balanced by countervailing factors, such as labor productivity growth, the increase in unit costs of production leads to a reduction in production. With the increasing demand, reduction in the supply leads to higher prices. Rising prices, in turn, give impetus to the beginning of the next negotiation of workers and employers about the changes in earnings. Thus, the situation is repeated at a new level, the next turn of the spiral «wages – price».

Proposal inflation is a variety of cost-push inflation. This type of inflation is associated with underutilization of production capacities, for example, in connection with the technical

reconstruction and modernization of fixed capital. Underutilization of the available capital leads to a reduction in output, and hence to a decrease in the economies of scale. This is expressed in the growth of unit costs. A higher cost per unit of output reduces profits and volume of production, which the firm is willing to offer at the current price level. If the degree of price elasticity of demand can shift the increased costs to the consumer, it may lead to a decrease in supply of goods and an increase in prices.

Demand pull and cost-push inflation are linked. Excessive money supply in the economy creates increased demand, in response to which prices growth occurs. Being a product of unbalanced monetary circulation, demand inflation spreads further, increasing irregularity and disproportionate development in various areas of management, ultimately leading to cost-push inflation.

In modern Russia, the fight against inflation is the prerogative of the Bank of Russia (Russia is no different from other countries in the formulation of the key objectives of the Central Bank), in line with global trends following the ideas of monetarist concept of state economic regulation. However, unlike in developed countries, the causes of inflation in Russia are not so much determined by monetary factors as by the tariff policy of the natural monopolies. So it's hard to expect the desired result of inflation targeting only by the Bank of Russia.

In connection to this, the subjects of economic relations that are not directly related to the monetary authorities should contribute to the reduction of the rate of inflation and forecast of its level in the future. This approach to the problem of inflation fits into the concept of shared values of business and society.

Here we vindicate the position of Akmaeva R.I. «Like in Western companies that have adopted the idea of shared values, the leaders and managers of Russian companies will also require new knowledge and skills for better identification the pressing needs of society, the understanding that business and society need to reunite and business should take the initiative, and government agencies must learn to work so that common values came in the foreground in their activities» [1].

Thus, the rate of inflation not only should be taken into account when planning internal indicators of individual industrial enterprises, but also when assessing the innovative potential of the industrial cluster.

Babkin A.V. identifies the following groups of parameters of estimation of innovative potential of enterprises of the industrial cluster [2]:

- financials indicators;
- indicators of workforce potential ;
- indicators of inventory and logistics management;
- information resources indicators;
- organizational and managerial indicators;
- indicators of market position;
- innovation indicators of the company.

Each of the above groups of indicators involves the prices of inputs or finished products, which in the course of time are subject to adjustments that take into account inflation rate.

The amount of money in different time periods are brought to the desired point in time now and in future by means of two basic methods – the method of compounding interest rates and interest discount. At that, the interest rate (interest rate – r) is a standard. In our case, the interest rate represents the rate of inflation.

Accretion is understood as the process of increasing the initial amount as a result of interest increase. Economic meaning of the accretion method consists in determining the quantity which is or may be obtained from an initial (current) sum as a result of conducting the operation. In other words, the method allows determining the future value (future value – FV) of the current amount (present value – PV) after a certain period of time based on the given interest rate r.

Operations of money accretion at an interest rate are more simple and fairly well understood, since we have to face them quite often when borrowing or lending money. However, discounting of cash flows is not less important, as well as bringing their future value to the current time point to ensure the comparability of time–phased payments.

Discounting is the process of computing the value at a given time by its known or perceived value in the future.

In economic rationale, the discounted value of PV shows contemporary (from the current time point) value of the future value FV.

It is obvious that discounting, in its essence, is a mirror image of accretion. The interest rate r used is called the discount rate.

Depending on the conditions of financial transactions both accretion and discounting may be carried out with simple and complex interest.

As a rule, simple interest is used for short-term financial transactions that last less than a year. In this case, the basis for interest calculation for each period is the original (initial) amount of the transaction.

In general, accretion and discounting at the rate of simple interest is carried out according to the following formulas:

$$FV = PV(1 + rn),$$

$$PV = \frac{FV}{(1 + rn)},$$

where n is the number of periods; r is interest rate.

Compound interest is widely used in the long-term financial operations which last over one year. However, they can be used in short-term financial transactions, if specified by the terms of the transaction or due to objective necessity (for example, high levels of inflation, risk, etc.). Here the basis for interest calculation for the period includes both the original amount of the transaction and the amount of interest already accumulated by that time.

$$FV = PV(1 + r)^n,$$

$$PV = \frac{FV}{(1 + r)^n}.$$

In effect, depending on the terms of a financial transaction, interest may be charged several times a year, for example, monthly, quarterly, etc. In this case, the ratio to calculate the future value will be:

$$FV = PV\left(1 + \frac{r}{m}\right)^{mn},$$

where m is the number of interest periods per year.

There is often a need to compare the conditions of financial transactions that involve different interest periods. In this case, interest rates should be reduced to their annual equivalent:

$$EPR = \left(1 + \frac{r}{m}\right)^n - 1.$$

The resulting value is called an effective interest rate (effective interest rate – EPR), or the rate of comparison.

There are several different ways to identify the main trends and forecast financial growth within the method of discounted interest rates: moving average, analytical graduation, mechanical evening out and others.

Moving average is a fairly simple tool to graduate price ranges, which makes any trends more visible. The simple moving average is defined as the average price in several periods, ending with the current one.

In order to identify the main trends by the moving average method, we should first of all define its units. The units of the moving average shall be composed of the number of periods corresponding to the yearly cycle of activity in the studied phenomenon. When applying the method of moving average to monthly dynamics, 12-termed moving averages are calculated, followed by centering the values obtained. The term «moving average» means that a set of averaged values is continuously moving in time.

This method allows detecting a trend to describe it, but it is impossible to get a generalized statistical evaluation of the dynamics by this method. The solution to this problem is achieved by analytical alignment.

The main content of the analytical method of graduation is that the main development trend of yt is calculated as a function of time:

$$\dot{Y}t = f(\mathrm{t}).$$

The determination of the theoretical (calculated) levels yt_i is based on the so-called adequate mathematical function that best reflects the basic time series trend.

The most important problem to be solved in the application of the analytical method of graduation is the selection of the mathematical function used to calculate the theoretical trend levels. The conclusions about trend patterns of the phenomena depend on the solution of this problem. If the selected math function is adequate to the main trend of temporal development of the phenomenon, the trend model synthesized on this basis may have useful application in the study of the dynamics of commercial activity on the basis of key financial indicators, forecasting and other practical purposes.

There are different types of temporal development of statistical indicators: even development, uniformly accelerated (uniformly decelerated) development, development with variable acceleration (deceleration), exponential development, and development with a slowdown at the end of the period.

The selection of appropriate function is performed by the least square method – the minimum deviation of the sum of squares between the theoretical yt_i and empirical y_i levels:

$$\Sigma(\dot{Y}t - \dot{Y}i)^2 \rightarrow \min.$$

The essence of this method is to find the first and second successive difference.

To describe the main trend of the time series we use the following equation:

$$y_t = a_0 + a_1 t,$$

where a_0, a_1 are the parameters of the equation; t is time.

Thus, power functions are used when modeling the main trend of financial performance. This is due to the fact that the parabola and linear functions describe the increase or decrease trend more accurately. When additional properties appear, more sophisticated methods are necessary.

Identified trends of indicators of the financial activity may extend to their future development. The theoretical basis for this is the property of the socio -economic phenomenon – inertia. That is, it allows identifying the relationship between the dynamic equations. Extrapolation gives the opportunity to get the point wise value of financial performance indicators forecast.

But in any case, the method of extrapolation cannot be the only method to confine to. Adapted forecasting methods, the Brown's method, in particular, and a harmonic balance method are necessary.

The essence of the Brown's method is that the number of time series is smoothed using a weighted moving average where the weights are subject to exponential law. This average is called exponential and is denoted $S_t(y)$. It allows on the basis of information on the economic dynamics of the process to trace patterns on the most important, i. e. the last levels. The influence on the early levels is not very high, as they are given the least weight. Exponential moving average is calculated by the formula:

$$S_t = ay_t + (1 - a)S_{t-1},$$

where S_t is exponential average value at the time t; y_t is the value of the economic process in time t; a is the weight of t^{th} value of time series (or smoothing parameter); S_{t-1} is exponential average value at the time $t - 1$.

The formula shows that in calculating the exponential average $S_t(y)$ only the previous exponential moving average S_{t-1} and the last observation are used, and all the previous observations are neglected. A consistent application of the formula makes it possible to calculate the exponential moving average $S_t(y)$ of the values of all the levels of time series.

The most important characteristic of a model of exponential smoothing is the one on which the forecast is actually calculated. The closer to 1 the value of the parameters is, the higher is its value for the forecast. That is, the forecast takes into account mainly the impact of recent levels of time series. If the parameter value is close to zero, the time series weights dynamics decrease slowly, which means that the forecast takes into account all previous series levels. Typically, the value is selected based on the careful analysis of the raw data, but in some cases this value is determined based on the smoothing interval formula:

$$a = \frac{2}{n+1},$$

where n is the number of initial data in the time series.

However, it should be kept in mind that in this case the parameters are totally dependent on the number of observations n. Most often, to solve practical problems and is assumed to be 0.1, 0.15, 0.2, 0.25, 0.3.

Exponential smoothing method has its advantages and disadvantages. Among the advantages of the method it is necessary to note its accuracy, which increases with the number of levels of the series. Economic series tend to be short so the study of economic time series method of exponential smoothing does not have time to reflect all the changes that occur in a number of speakers. There is no method for selecting the optimal value of the smoothing

parameter. The accuracy of this method projections decreases with an increase in a forecast interval. It is effective for short-term forecasting.

An important element is the accuracy and reliability of the forecast. The accuracy of the forecast is usually judged by the value of the forecast error, which is defined as the difference between the predicted value and the actual value of the variable.

In determining the forecast error, we often calculate a relative error – the ratio of the absolute prediction error for the expected (or actual) value of the attribute. It should be noted that the verification of accuracy of the forecast unit indicates a small degree of accuracy, since a large number of different factors affect the formation of the phenomenon investigated.

H. Theil proposed to use mismatch factor for measuring the quality of forecasts. The proposed ratio is calculated as the quotient of the square root of the sum of squares of the absolute prediction error divided by the sum of the squares of the actual change in the variable.

In case the mismatch factor Kn = 0, all the values are the same (with perfect forecast). If Kn = 1, the forecast has an error [5].

In summary, it should be noted that at present in the Russian Federation direct state and regional regulation of prices is carried out by means of:

- fixing prices and tariffs;
- fixing maximum prices and tariffs;
- fixing growth rates of prices limits;
- fixing profitability limits;
- -fixing maximum supply and sales and margins;
- declaring prices;
- fixing recommendation prices for key products;
- fixing parity prices.

The specific nature of Russian inflation requires special techniques and methods of regulation. The purpose of this regulation is to establish control over inflation and achieve growth rates acceptable for the national economy. The improvement of anti-inflation policy in Russia should be aimed, in our opinion, at the following objectives. The first goal is the revival of real investment and sustainable growth of the national economy. Another compelling issue is restructuring of the economy and adapting it to the needs of the market at the expense of de-monopolization and regulation of existing monopolies, promotion of competition, conversion of the military-industrial complex, government promotion of industries and high-tech enterprises and high-tech industry.

One of the pressing problems in modern Russia is the reorganization and restructuring of the banking system, the shift of banks from speculative operations and lending operations to serve the real sector of the economy, development of means to hedge risks of banks and depositors, strengthening banking supervision. In order to ensure availability of the required financial resources to the real economy enterprises, recovery of the stock market and control over its activities should be ensured; protecting the interests of Russian producers by protectionist trade policies, effective regulation of exchange rate, reducing the dependence on foreign loans by generation resources; restraining «capital flight» and its repatriation; overcoming inflationary expectations by achieving political, economic, and legal stability in the country.

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PROBLEMS OF EVALUATION OF INNOVATIVE BANK ACTIVITY

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ПРОБЛЕМЫ ОЦЕНКИ ЭФФЕКТИВНОСТИ ИННОВАЦИОННОЙ ДЕЯТЕЛЬНОСТИ БАНКА

This article describes the key principles of the effective management of innovation activity. Reasons for the use of the system of indicators of efficiency of innovative bank activity are revealed. Requirements to the corporate system of KPI of innovative activity are justified. Balanced scorecard as the most appropriate method to evaluate the efficiency of innovative bank activity is proposed.

BANK. INNOVATIVE BANK ACTIVITY. EFFICIENCY. EVALUATION.

Сформулированы ключевые принципы эффективного управления инновационной деятельностью. Выявлены причины использования системы показателей эффективности инновационной деятельности банка. Обоснованы требования к корпоративной системе показателей эффективности инновационной деятельности. Предложена сбалансированная система показателей как наиболее приемлемый метод оценки эффективности инновационной деятельности банка.

БАНК. ИННОВАЦИОННАЯ ДЕЯТЕЛЬНОСТЬ БАНКА. ЭФФЕКТИВНОСТЬ. ОЦЕНКА.

A lot of banks have recently begun to regard their ability to evaluate products and services, to offer customers technology-based banking services and to promptly modify their market behavior as a major success factor. Ultimately, it all comes down to the execution of a bank's development strategy which greatly depends upon innovative services, products and technologies. Thus, innovation in banking is gaining significance and will become even more important in the new economy.

Innovative processes must be manageable. When applied to banking, the key principles of efficient innovation management have been formulated as follows.

1. *The principle 'scale of novelty'* determines how novel the innovation is.

2. *The principle of potential* asserts that the innovation should conform with the bank's strategic plans and be implementable.

3. *The principle of client-centeredness* manifests that innovations in banking are to be primarily aimed at customers.

6. *The principle of outdistancing* states that with banking innovations it is essential to anticipate your clients' needs and keep up with your innovative customers.

5. *The principle of feasibility (or the principle of resource endowment)* means that the innovation is theoretically feasible, i. e., physical, financial and human resources required for putting the innovation into practice are readily available.

6. *The principle of institutional clusters of innovative ideas* implies that efficient innovation management in a bank requires setting up specialized departments of research and development in charge of innovative projects.

7. *The principle of time limitation* emphasizes the importance of establishing the project execution timeframe, from the time an application is received until the innovation is a part of banking practices.

8. *The principle of measurability* assumes that there must be an innovative performance measurement system using both quantitative and qualitative indicators.

9. *The principle of efficiency* means that the above-mentioned measurement system of quantitative and qualitative indicators can help to assess the practicality of the implemented innovations and the efficiency of innovation management.

As the principles of measurability and efficiency manifest themselves in the banking

context in many ways and are of vital importance, the problem of evaluating bank performance amid vigorous innovative activity requires detailed consideration.

The application of the measurability and efficiency principles calls for the creation of a balanced scorecard system that would assist in determining a company's aptitude for innovative decisions.

The need for a scorecard system of the innovation performance measurement in banking arises due to the following reasons.

1. The system of innovation performance measurement indicators is based on objective numerical data that allows for quantitative performance assessment of innovation and calculation of innovation-related costs; in the end, it is the data that leads to purposeful managerial decisions.

2. Utilizing a scorecard system of innovation performance is in the company's strategic interests. An innovation process should be an integral part of the core business processes. Banking activities should constitute a coherent whole aimed at achieving stated objectives.

3. Exploiting innovation performance indicators can facilitate the equitable allocation of resources to 'traditional' and innovative business activities. Thanks to innovation performance indicators it is possible to find out if the innovation performance lived up to expectations by comparing the actual indicators with the target ones.

4. Innovation performance indicators can be used to encourage employees to take the initiative.

A corporate balanced scorecard system of innovation performance evaluation should meet the following requirements.

1. There should not be too many indicators, as the evidence provided by successfully operating systems shows that, at the executive level, it is best to have no more than eight to ten indicators to work with.

2. When establishing a system, one should select those indicators that are, firstly, independent and, secondly, are focused on different aspects of innovation processes.

3. A scorecard system should comprise both quantitative and qualitative data.

4. A system of innovation performance measurement indicators has to be integrated into a corporate bank performance evaluation system.

5. Creating autonomous scorecard systems of innovation performance for each structural department of the bank is unacceptable. In case an autonomous innovation performance system is allocated to a separate department, it should conform to the whole bank system, i. e., the general-to-specific approach is to be followed.

6. First and foremost, a system of innovation performance measurement indicators should satisfy the requirements of a customer-centric approach adopted by a bank. If a bank's policy is driven by profit-and-loss reports, it is bound to put increased emphasis on cost saving. Should this happen, there will not be much of a chance for competitive growth. Innovation performance indicators are intended to show customer satisfaction with innovative products, services and technologies supplied by the bank. In this instance, it is advisable to consider the following indicators:

– the ratio of customers using banking innovation to the total number of the bank's customers;

– the ratio of customers regarding the bank as innovative to the total number of the bank's customers.

7. Continuous assessment of the utilized innovation performance indicators is of critical importance. As the development process never stops, some indicators may cease to be relevant or require different computation algorithms.

8. A scorecard system is meant to reveal reasons for both success and failure of innovation processes, thus minimizing the risk of future errors.

Establishing a system of innovation performance indicators is a challenging task. According to a recent survey by PricewaterhouseCoopers, almost a half of top managers among 355 North American private companies attempt to measure innovation with a system of quantitative indicators. The following criteria were used to measure success of innovative decisions: impact on company revenue increase (78 %), customer satisfaction (76 %), revenue increase from new products (74 %), performance improvement (71 %), profitability dynamics (68 %). At the same time, organizations use different approaches to measure their innovative activity, and few of them use a reliable scorecard system which is well integrated in the strategic vision of the company [7, 11].

Considering the implementation of innovation, the majority of executives discourse on market share, customer satisfaction, improvement of customer service, product diversification, but

when it comes to the execution phase of a specific project, the whole problem comes down to figures, that is what the impact of the innovation will be, how to weigh up the merits of one project versus the other and choose the most beneficial one. Business performance is measured by profit markup, revenue increase and growth of earnings from new products. Nevertheless, such innovation indicators as customer satisfaction, market share gains and competitive growth may also be utilized to assess the company performance, as business has to operate in the new information economy. This implies that, in the given context, a new approach to understanding and evaluating innovative performance of any business, including the banking sector, has to be adopted.

It is certainly possible to use traditional expensive measurement methods in the age of the new economy, but the question is whether this approach will provide an objective appraisal of quite an intricate effect of information technologies and innovative processes on the final result of a company's activities.

One of the distinguishing characteristics of the new economy is that service industries, including financial services organizations, start to account for the largest share of GDP. Performance evaluation of these industries is not so much a quantitative as a qualitative concept. The traditional performance measurement system relies on the statistical methodology which renders it unable to evaluate such essential phenomena of the new economy phenomena as dynamism, focus on innovation, and adaptability. As a result, the traditional system based on economic indicators fails to encompass the factual information technologies performance while tending to statistically undervalue it.

'The irony is,' says Erik Brynjolfsson, a world renowned expert on high-technology industries, 'that while we have more raw data today on all sorts of inputs and outputs than ever before, productivity in the information economy has proven harder to measure than it ever was in the industrial economy.' [8]

So, performance evaluation in the new economic reality requires a new up-to-date measurement framework. Only then can the existing, but not yet fully recognized, economic impact of the new economy be evaluated objectively.

All of the aforesaid is applicable to banking with its current trend towards innovation. Also, innovation performance in banking should be evaluated with due regard to the strategic goals of the bank. Criteria for innovation performance in banking should include financial results of innovation (income and profits, return on innovation) as well as all the set of bank performance indicators (competitiveness, liquidity, credibility, risks) with consideration for their financial value and consistency with the objectives relevant to the bank and its socio-economic environment. When evaluating performance, it is vital to take into consideration the whole range of individual advantages and achievements (that are of critical importance for any bank) all of which can hardly be identified by applying mathematical 'resources-costs-results' models. In such a manner it is possible to retain the most valued customers while attracting new ones, to expand service offerings for primary customers, to increase the speed of transactions and to enhance banking security.

The whole range of criteria is to be regarded as a system or a combined characteristic that reflects the correspondence of a commercial bank's objectives with its observed performance at any given moment. Therefore, only meeting all the criteria makes innovation efficiency of the bank obvious.

The information economy has predetermined the emergence of new tools that allow to measure innovation performance by making use of quantitative as well as qualitative indicators.

Current bank performance evaluation systems appear to be a new tool providing a bank with a path to long-term success. Such systems constitute a strategic management system which enables resources allocation, personnel management, data collection and the improvement of management processes. Every element of this system is related to the very essence of business: acquisition of new customers, a diversification of new products and service lines, intangibles including, increased brand value, etc. There are a lot of ways to bring specific performance indicators together constructing a comprehensive system instrumental in company management.

One of the most well-known mainstream evaluation methods in banking is the Balanced Scorecard that efficiently aligns a company's daily activities to its strategic objectives [1–6, 9, 10, 12].

In general, the algorithm for the model of bank performance evaluation and its innovation activity can be presented as the following process:

– setting up a mission and strategic goals of the bank activity;

– the mission and bank strategy underlie the development of a strategy for each bank unit;

– working out the hierarchy of goals aimed at the mission achievement, where the bank innovation activity is positioned at the level of strategic goals.

Afterwards, it is necessary to move on to key indicators of the bank performance. The importance of the key performance indicators is determined in the following terms:

– clear and precise tools to evaluate each bank unit;

– annual transparent indicators of each bank activity;

– key performance indicators with 80 % referring to standard bank processes and 20 % referring to deviations;

– necessity of the operating system to manage long-term motivation of the staff.

The system of key performance indicators shall take into account four projections (finance, customers, business processes, staff training). At the same time, a number of indicators characterize the local goal achievement by a bank unit, whereas other indicators reflect the goal achievement by the bank as a whole.

The next step for working out the system of key performance indicators is to set up norms (acceptable in a given period) for the indicators, to draw up techniques for their computation and to create the system of data collection.

On completing the process of working out the system of key performance indicators (KPI) for all divisions, it is necessary to verify the whole KPI system, to set up the balance which has to be changed according to the number of transactions, planning indices, and common banking priorities.

The KPI system will help managers of business units to solve the following problems:

– delegating authority and controlling key parameters, which will allow the manager of a business unit to focus on his/her responsibilities;

– improvement of business unit budgeting;

– staff quality improvement;

– maintaining and improving the status of a business unit;

– transition from the reactive performance to proactive performance;

– decisions about priorities in managers' and subordinates' performance.

The balanced system of indicators will allow top managers to discuss the issues of current performance and future goals. This method will encourage top managers to reflect on opportunities, on potential revenues, on evaluation techniques of future bank results.

The bank innovative performance can be evaluated using the existing balanced KPI system. Launching an innovative product within a single direction (e. g. in retail), it is necessary to add modifications in order to evaluate the overall effect of the innovation. Correcting the bank strategy will be essential only in case the bank launches an absolutely innovative service, unavailable in the bank business before (e. g. entrance of clearing banks to the stock market). Correcting the strategic goals of a business unit, affected by the innovative product, is feasible and shall be fulfilled.

Most significant modifications and corrections will be made in the KPI system. If a bank launches an innovative product or service, it is likely to have to introduce new indicators targeted at the evaluation of the innovative solution.

Having analysed the necessity and feasibility of bank innovative performance evaluation, the following conclusions have been drawn:

– necessity of launching innovations to improve the bank performance has been validated;

– principles of the effective bank innovative performance have been suggested;

– reasons for the necessity to use the indicators system of bank innovative performance have been identified;

– compliance requirements for the indicators system of bank innovative performance have been worked out;

– as the traditional performance evaluation techniques do not allow to measure the innovative component of the new economy, a need to create new tools relevant to the current information era has been justified;

– in order to evaluate the bank innovative performance, the possibility to use the method of the balanced system of indicators (BSI), which allows to correlate strategic and operating goals of a bank has been validated.

– The research results are of practical importance, because they can be widely used in the development of the evaluation system of bank innovative performance.

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INSTRUMENTS FOR MANAGEMENT OF INDUSTRIAL ENTERPRISES' HIGH-TECH MANUFACTURE ON THE BASIS OF SIMULATION MODELING

В.В. Кобзев, А.Е. Радаев

ИНСТРУМЕНТАРИЙ УПРАВЛЕНИЯ ВЫСОКОТЕХНОЛОГИЧНЫМ ПРОИЗВОДСТВОМ ПРОМЫШЛЕННЫХ ПРЕДПРИЯТИЙ НА ОСНОВЕ ИМИТАЦИОННОГО МОДЕЛИРОВАНИЯ

This article covers current issues in the area of design and application of automated or high-tech manufacturing into the structure of domestic industrial enterprises. Instruments for the management of high-tech manufacturing within industrial enterprises on the basis of simulation modeling are created.

HIGH-TECH MANUFACTURING. INDUSTRIAL ENTERPRISE. SIMULATION MODELING. OPTIMIZATION MODEL. SIMULATION MODEL.

Рассматриваются современные проблемы в области проектирования и внедрения автоматизированных производств в структуру отечественных промышленных предприятий. В настоящее время упомянутые производства называют высокотехнологичными. Разработан инструментарий управления высокотехнологичным производством промышленных предприятий на основе имитационного моделирования.

ВЫСОКОТЕХНОЛОГИЧНОЕ ПРОИЗВОДСТВО. ПРОМЫШЛЕННОЕ ПРЕДПРИЯТИЕ. ИМИТАЦИОННОЕ МОДЕЛИРОВАНИЕ. ОПТИМИЗАЦИОННАЯ МОДЕЛЬ. ИМИТАЦИОННАЯ МОДЕЛЬ.

Modern trends of enterprise development in the high-tech sector of industrialized countries in combination with intensive improvement of opportunities provided by computing machinery and increasing importance of information technologies in project works stimulate researches in the area of design and application of high-tech manufacturing into the structure of domestic industrial enterprises [1, 3]. Currently, the most actual elaborations concern the automation of manufacturing and management at the enterprises of domestic industry for increasing the share of science-intensive production, which meets the modern requirements of Russian economy's modernization in order to be competitive in the world markets. One of the ways to increase the adequacy of managerial decisions taken in the area of high-tech manufacturing is connected to the application of simulation software tools to manufacturing management at the different stages of the life-cycle. In spite of the extensive spread of simulation modeling into Russian practice of management of industrial enterprises including high-tech manufacturing, scientific achievements proceedings in the corresponding area do not include concrete methodical groundwork and instrumental tools. The last circumstance determined the need for scientific research, which is focused on the elaboration of instruments for the management of industrial enterprises' high-tech manufacturing on the basis of simulation modeling.

The research is based on the concept of management within industrial enterprises' high-tech manufacturing which involves simulation modeling software. The elaborated concept includes specified terms of «high-tech manufacture

(HTM)», «organizational design» and «organization of functioning»; formulated principles of management (integration, flexibility, adaptability, reliability, economization, automaticity [5]); proposed discrete-event approach in the area of simulation modeling (SM), which supposes the implementation of modeling object as a system of processing similar elements (calls, transacts) using disposable resources; formed composition and sequence of the tasks for HTM management for most important (towards sustainable development of the enterprise) stages of life-cycle: organizational design and organization of functions.

The list of tasks (in the area of management for industrial enterprises' HTM) was used as the basic for classification of the factors of functioning effectiveness. The classification particularly defines the factors for functional areas of production, transportation, control and storage, traditionally assigned in line with conception of lean production, which is an inseparable component of any modern HTM.

This concept of HTM management and the classification of the factors of the object's functioning effectiveness became the basis for the elaboration of an algorithm to solve the tasks in the area of HTM management at the stages of the organizational design and the organization of functioning with the application of SM software tools. The algorithm supposes the creation (in the process of task implementation), optimization and simulation models, their integration within respective procedures, in which an optimization component formalizes the objectives and conditions of subject's functioning, and a simulation component forms alternative variants of this functioning.

The complexity of HTM functioning and the need for the detailed economic analysis determined the reasonability for the elaboration of the system of target and planning-and-control indicators [8], which should be used as output parameters of simulation models (building within the process of task implementation) to obtain the adequate of selection and the accuracy of control over the managerial decision's realization in the area of industrial enterprises' HTM [6]. The structure the of the proposed system of indicator is shown in Fig. 1. The indicators of Net Present Value (NPV) and Return On Investment Capital (ROIC) were proposed as target indicators responsible for selection of managerial decisions made for long- and short-term periods during the research. A system of interconnected planning-and-control indicators was created for the target indicators. The system includes:

– coefficients of cost – shares of different articles of enterprise expenditures in sales proceeds;

– coefficients defining effectiveness of different asset groups of the enterprise;

– indicators describing the structure of the enterprise capital.

To take into account the main principles of HTM management (including the principle of economization) during the process of control over the respective managerial decisions' realization, a hieratical structure of effectiveness indicators was elaborated. Elaborated structure includes:

1. Low level which contains absolute and relative particular indicators of effectiveness which correspond with the proposed planning-and-control indicators. Absolute indicators characterize factual and planned values of economic characteristics; relative indicators characterize the ratio of factual and planned indicators; if the value of a relative indicator is greater or less than a unit indicator, the deviation between factual and planned values of indicator occurs. These deviations must be classified according to the places they appear, causes and responsible persons.

2. Middle level – includes the so-called key indicators of effectiveness, which describe the degree to which the industrial enterprise achieves the goals in a certain area of functioning (production, transportation, control and storage) described by the group of low-level indicators. If key indicator value is not equal to the unit indicator, the deviation between planned and real goals' achievement scenarios occurs within a current area of industrial enterprise functioning. As each key indicator is connected to several relative indicators of effectiveness, the methods of indicator grouping in the order of importance were proposed during the research:

– differential qualimetry method should be used in case indicators are of equal importance and therefore are grouped with the application of a mean arithmetical formula;

– complex qualimetry method should be used in case indicators are of different importance and therefore are grouped according to the weighted average formula including the calculation of weighted coefficients describing indicators' importance.

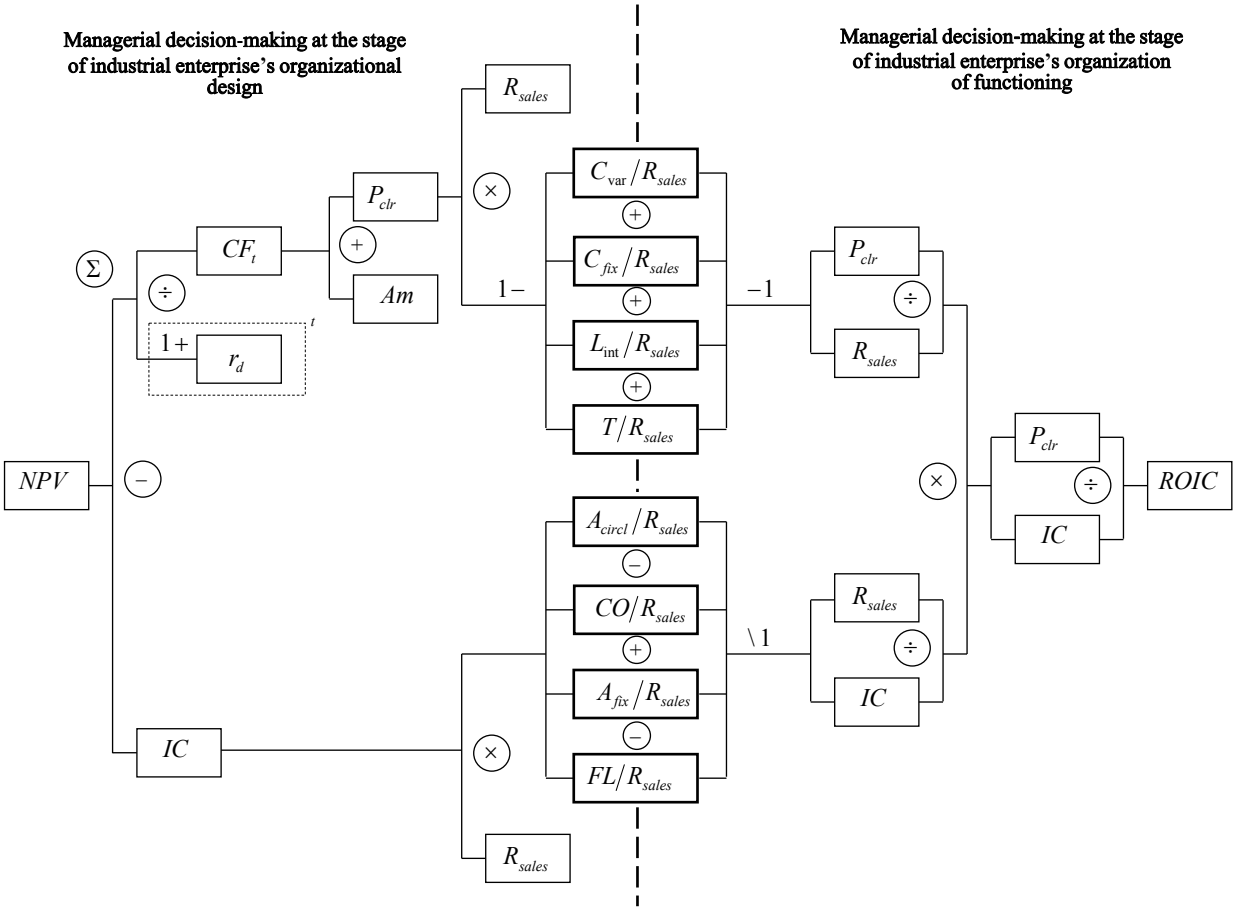

Fig. 1. Structure of the system of target and planning-and-control indicators elaborated during the research

Indicators used:

NPV – net present value; *ROIC* – return on invested capital; CF_t – current flow for time period; r_d – discounting rate; t – time period sequence number; P_{clr} – clear profit for time period; *Am* – total depreciation costs for period; R_{sales} – sales proceeds (revenue); C_{var} – variable costs for period; C_{fix} – fixed costs for period; L_{int} – loan interest; T – accrued taxes; *IC* – invested capital; A_{circl} – circulating assets; *CO* – current obligations; A_{fix} – fixed assets; *FL* – fixed liabilities.

– hybrid qualimetry method is based on the combination of the above mentioned methods.

Weighed coefficients describing indicators' importance in complex and hybrid qualimetry methods should be calculated using expert judgments method and relative preferences method.

3. High level is based on the so-called total effectiveness indicator describing the degree of goals achievement for the whole industrial enterprise. If the total indicator value is not equal to the unit indicator, factual and planned states of industrial enterprise are different. High-level indicator calculation is based on the grouping of key indicators of effectiveness according to the same principles and methods as described above.

Managerial decisions must be made concerning deviations calculated during the procedure of relative, key and total effectiveness indicators within a certain factor, area and the whole industrial enterprise respectively.

Thus, the process describing the implementation of the task of management in the area of industrial enterprises HTM with the application of SM software tools includes the following main stages:

1. Preparation of initial data concerning the object of exploration.

2. Economic-and-mathematical definition of the task by building optimization model including the factors of internal and external environment [2, 10, 11].

3. Creation of simulation model on the basis of preliminarily built optimization model with target and planning-and-control indicators as the output parameters of the simulation model.

4. Selection of the optimal combination of simulation model input parameters' values, which are corresponding to the most efficient managerial decision, by minimizing / maximizing the values of the target indicator, which are calculated during the series of simulation experiments with the created model.

5. Formation of absolute (planned) values of indicators to control HTM managerial decisions realization by treating statistical results of simulation experiments for certain combination of output parameters' values corresponding to the most efficient managerial decisions.

The complex of optimization economic-and-mathematical models based on the algorithm for solving management tasks in the area of industrial enterprises HTM with the application of SM software tools and also the system of indicators to control the selection and realization of managerial decisions was elaborated during the research. The complex includes:

– model of throughput optimization of the elements of manufacturing structure in the area of HTM;

– model of throughput optimization of the production sector concerning integrated processing of production items;

– model of optimization if the number of machinery within different technological zones.

The complex of optimization models described above ensures the interdependent managerial decisions in line with manufacturing structure in the area of industrial enterprises with HTM [4].

The elaborated complex of optimization models became the basis for the creation of the complex of respective simulation economic-and-mathematical models built with the application of AnyLogic simulation software. The complex includes:

– simulation model implementing the functioning of the elements of HTM manufacturing structure;

– simulation model of the production sector with fixed processing technology;

– simulation model of the production sector with regulated processing technology;

– simulation model of the distribution center of raw materials and finished products in the area of HTM service.

The elaborated complex of simulation economic-and-mathematical models ensures the accurate predictable data during the process of economic reasoning of managerial decisions made at the consecutive stages of the design and exploitation of industrial enterprises HTM [9].

AnyLogic simulation software used during the research ensures the interaction between the models and external data sources and, consequently, the integration of the models into the enterprise automated management system. In addition, this fact defined reasonability for the elaboration of informations system, ensuring automated calculation of planning-and control indicators (proposed for of the control over the realization of managerial decisions in the area of industrial enterprises HTM) and also the control over the dynamics of indicators values for different time periods. Information system was created with the application of AnyLogic software tool as static simulation model connected with external data source (usually Microsoft Office Excel electronic table is used in line with AnyLogic educational license; Microsoft Office Access database can be used within AnyLogic professional license). The main benefits of using created the information system are:

– minimal time costs for calculation of the effectiveness of indicators due to special algorithms in AnyLogic simulation software and its computational capability;

– accumulation (due to special features of AnyLogic software) of the results of the effectiveness indicators calculation, which ensures high quality of indicators dynamics analysis and, as a consequence, high effectiveness of warehouse system managerial decisions;

– simplicity and user-friendliness of the information system due to the application of standard control elements of the Windows operation system, which most administration personnel within industrial enterprises are familiar with.

The information system includes the following elements:

– calculation block – for the calculation of the effectiveness indicators values;

– main panel – for the demonstration of the indicators' values (Fig. 2);

– additional panel – for the representation of the indicators values dynamics in different time periods (Fig. 3);

– external data source with sectored tables (in Microsoft Excel file columns are connected to time periods) for the calculation and accumulation of effectiveness indicators.

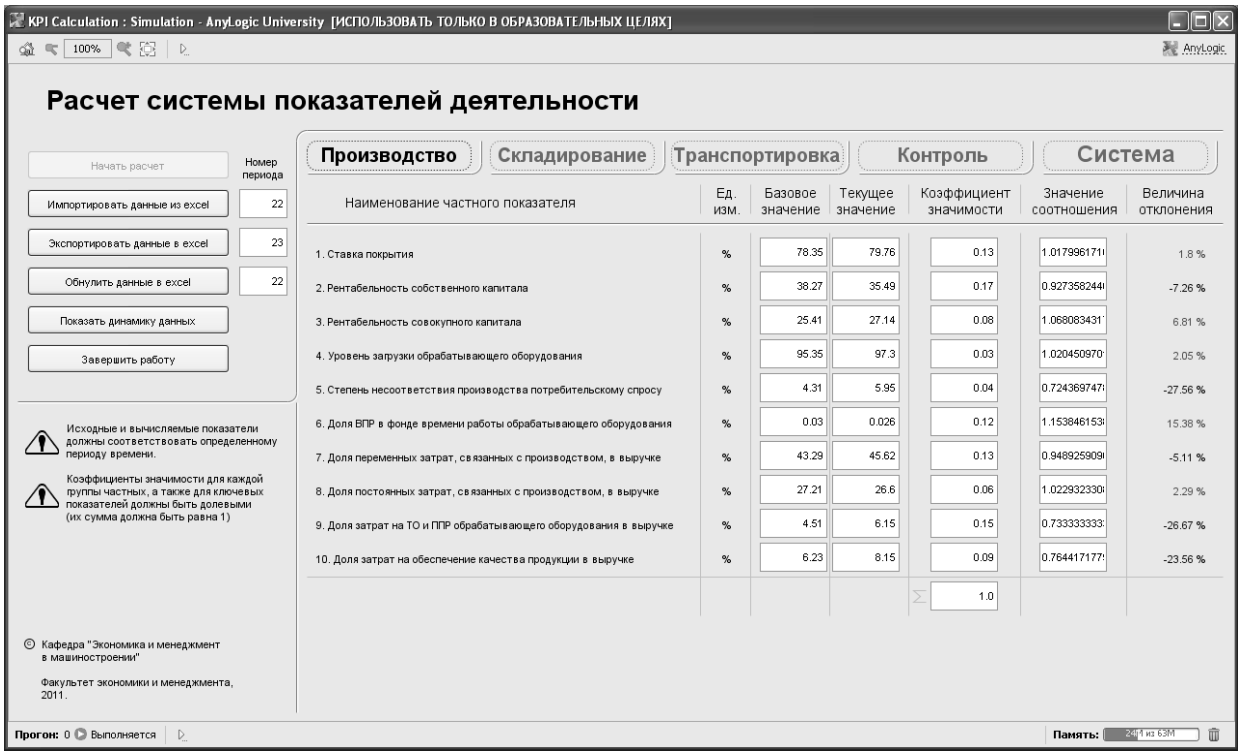

Fig. 2. Main panel of the information system elaborated during the research

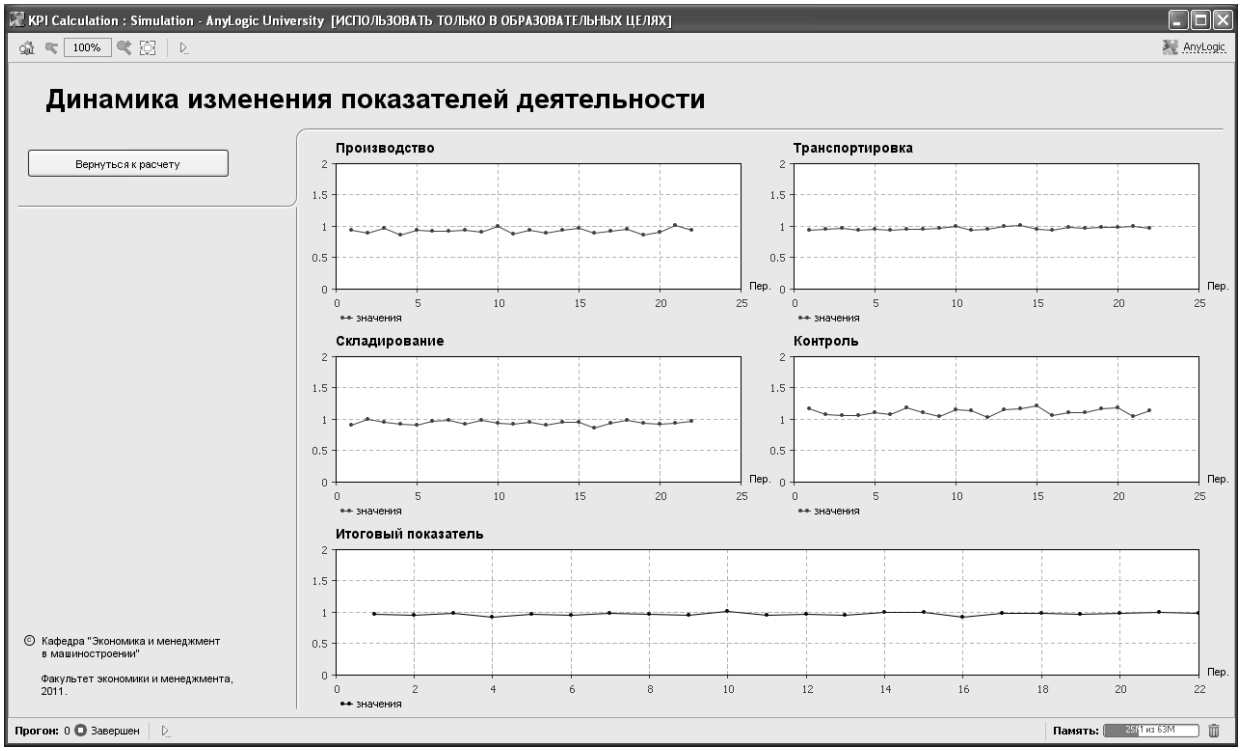

Fig. 3. Additional panel of the information system elaborated during the research

On the basis of scientific results, the method of organization and estimation of economic effectiveness of industrial enterprises HTM using SM [7] was created.

The structure of the method is defined by the sequence of the main phases (modules), where each one is connected to a certain scientific result, generated at the previous stages of the research.

The elaborated method was applied to the real object for the task to determing the optimal number of production machinery. During the procedure, an optimization economic-and-mathematic model was created as the basis of the corresponding simulation model built with AnyLogic simulation software. The simulation experiments provided the optimal number of machinery according to the maximization of ROIC target indicator. Economic reasoning of a corresponding managerial decision was realized. As a result simple simulation experiments, the planned values of the elements of planning-and-control indicators' system were estimated for the further control over the realization of managerial decisions.

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THE ELABORATION OF AN ECONOMIC AND MATHEMATHICAL MODELS FOR THE PRODUCTION PROGRAM OF THE ENTERPRISE

Н.А. Соколицына

МОДЕЛИРОВАНИЕ ПРОИЗВОДСТВЕННОЙ ПРОГРАММЫ ПРЕДПРИЯТИЯ

Economic and mathematical models for the enterprise production program with homogenous product have been elaborated. Account passing product stocks, free store capacity, average labor in the product, market demand, and other basic resources have been taken into account. These models are used as the base for analogical models with heterogeneous product, allowing optimally coordinate material flows and enterprise's financial resources in a given period.

ECONOMIC AND MATHEMATICAL MODEL. PRODUCTION PROGRAM. ACTIVITY. RESOURCES. FLOWS. PRODUCT. ENTERPRISE.

Разработаны экономико-математические модели формирования производственной программы предприятия при однопродуктовой деятельности с учетом переходящих запасов готовой продукции, свободной емкости склада, трудоемкости изготовления продукции, рыночного спроса и других основных ресурсов. На их базе сформированы модели данной задачи при многопродуктовой деятельности, позволяющие оптимально согласовывать материальные потоки и имеющиеся финансовые ресурсы предприятия в рассматриваемом плановом периоде.

ЭКОНОМИКО-МАТЕМАТИЧЕСКАЯ МОДЕЛЬ. ПРОИЗВОДСТВЕННАЯ ПРОГРАММА. ДЕЯТЕЛЬНОСТЬ. РЕСУРСЫ. ПОТОКИ. ПРОДУКЦИЯ. ПРЕДПРИЯТИЕ.

Reducing costs of manufacturing and selling product and increasing business effectiveness results from a successful transformation in a business organization and technologies. At the same time, the plausibility and effectiveness of such a transformation increases, if its character matches to a large extent the nature of the relevant and effective processes that constitute the enterprise's development strategy.

Let's consider this transformation in a system of interaction between production and commercial functions of the enterprise. It includes a complex of organizational and economic measures to improve the system of interaction of production and commercial functions of the enterprise, including the distribution channels and nets system.

For the given enterprise, according to its specificity, let's use a modification with a one-level distribution channel – the manufacturing of one product, and a store with several sales departments.

1. Models of the production program for the business with one homogenous product

Costs of production, storage and sales of a product are determined and storage of the production is vary in different periods. The business is carried out in the given T time periods, this period is divided into separate equal time periods ($t = \overline{1, T}$) [1, 6, 7, 9].

The price is determined and can be vary in different time periods. Storage occurs in a limited capacity stock. The business can be carried out at its own expense or by credit.

Modeling the business with homogenous product at own expense

Given the assumed premises, the production and sales plan can be represented as a linear optimizing task.

Let's denote the unknown variables as: x_t – volume of production in t time period ($x_t \in N$, $t = \overline{1, T}$); y_{tj} – volume of sales in t time period through the sales department j ($y_{tj} \in N$, $t = \overline{1, T}$, $j = \overline{1, n}$).

Other parameters are: A – initial stock of the product; B – allowable storage capacity; A_{T+1} – rolling stock of the product in $T+1$ time period; c_t – costs of manufacturing and storing one item of the product in t time period; c'_{tj} – costs of selling one item of the product in t time period through the sales department j; C'_t – allocations of equity in t time period; $в_{ut}$ – labor-output ratio of manufacturing one item of the product using equipment group u in t time period; $Ф_{эфut}$ – effective working time of equipment group u in t time period; $d_{\ell t}$ – amount of ℓ resource for one item of the product in t time period; $D'_{\ell t}$ – allocations of ℓ resource in t time period; M_{tj}, M'_{tj} – respectively lower and upper limits of sales in t time period through the sales department j; p_t – product price in t time period.

Thus, the model of the business with a homogenous product at own expense has the following form:

The volume of production and initial stock in r time periods cannot be less than the volume of sales in these r time periods:

$$\sum_{t=1}^{r} y_t - \sum_{t=1}^{r} x_t \le A, \quad h = \overline{1,H};\ r = \overline{1, T-1}; \tag{1}$$

$$\sum_{t=1}^{T} x_t - \sum_{t=1}^{T} y_t = A_{T+1} - A, \quad r = T. \tag{2}$$

The volume of production in r time periods cannot be more than the volume of sales and free storage capacity in these r time periods:

$$\sum_{t=1}^{r} x_t - \sum_{t=1}^{r} y_t \le B - A, \quad r = \overline{1, T}. \tag{3}$$

The total costs in r time periods cannot be more than allocations of equity in these r time periods:

$$\sum_{t=1}^{r} c_t x_t \le \sum_{t=1}^{r} C'_t, \quad r = \overline{1, T}. \tag{4}$$

The total labor-output ratio in r time periods cannot be more than effective working time of equipment groups in these r time periods:

$$\sum_{t=1}^{r} в_{ut} x_t \le \sum_{t=1}^{r} Ф_{эфut}, \quad u = \overline{1, U};\ r = \overline{1, T}. \tag{5}$$

The total use of other resources in r time periods cannot be more than allocations of resources in these r time periods:

$$\sum_{t=1}^{r} d_{\ell t} x_t \le \sum_{t=1}^{r} D'_{\ell t}, \quad \ell = \overline{1, L}, \quad r = \overline{1, T}. \tag{6}$$

Restrictions of sales, determined by demand:

$$M_{tj} \le y_{tj} \le M'_{tj}, \quad t = \overline{1, T}; \quad j = \overline{1, n}. \tag{7}$$

The maximum profit in T time periods is:

$$f(x, y) = \sum_{t=1}^{r} p_t\ y_t - \sum_{t=1}^{T} c_t x_t \to \max. \tag{8}$$

Modeling the business with one homogenous product by credit

In forming production program by simple interest credit, got in the start and fully repaid in the finish of the plan time period T, in the model (1)–(8), instead of the restriction (4), the restriction (9) is introduced, and the objective function (8) is changed [2, 8].

The credit and volume of sales in r time periods cannot be less than costs and payments for the credit in these r time periods:

$$\kappa + \sum_{t=1}^{r} p_t y_t \ge \sum_{t=1}^{r} c_t x_t + k \sum_{t=1}^{r} \varepsilon_t, \quad r = \overline{1, T}; \tag{9}$$

$$f(x, y, \kappa) = \sum_{t=1}^{T} p_t y_t - \sum_{t=1}^{T} c_t x_t - \left[1 + \sum_{t=1}^{T} \varepsilon_t\right]\kappa \to \max, \tag{10}$$

where κ – unknown volume of the starting credit ($\kappa \ge 0$); ε_t – interest rate in t ($t = \overline{1, T}$) time period.

If repayment of the credit is carried out in stages in t plan time periods, than the restriction (9) and the objective function (10) are changed as follows:

$$\sum_{t=1}^{r} c_t x_t - \sum_{t=1}^{r} \sum_{j=1}^{n} \left(p_t - c'_{tj}\right) y_{tj} \le \le \left(1 - \sum_{t=1}^{r-1} E_t - \sum_{t=1}^{r} \left(1 - \sum_{t=1}^{r-1} E_t\right) \varepsilon_t\right) \kappa, \quad r = \overline{1, T}; \tag{11}$$

$$f(x, y, \hat{e}) = \sum_{t=1}^{\mathrm{T}} p_t y_t - \sum_{t=1}^{T} \tilde{n}_t x_t - \\ - \left[1 + \sum_{t=1}^{T}\left(1 - \sum_{t=1}^{T-1} E_t\right)\varepsilon_t\right]\hat{e} \to \max, \quad (12)$$

where E_t – a part of the credit repayment in t time period on the condition that $\sum_{t=1}^{T} E_t = 1$.

With compound interest lending, getting the credit in the start and full repayment in the finish of the plan time period T, the restriction (9) and the objective function (10) are changed respectively:

$$\sum_{t=1}^{\mathrm{r}} \tilde{n}_t x_t - \sum_{t=1}^{r}\sum_{j=1}^{n} p_t y_t \le \\ \le \left(1 - \sum_{t=1}^{r}\left[(1+\varepsilon)^t - 1\right]\right)\hat{e}, \quad r = \overline{1, T}; \quad (13)$$

$$f(x, y, \hat{e}) = \sum_{t=1}^{T} p_t y_t - \sum_{t=1}^{T} \tilde{n}_t x_t - \\ - \left[1 + \sum_{t=1}^{T}\left[(1+\varepsilon)^t - 1\right]\right]\hat{e} \to \max. \quad (14)$$

If repayment of the compound interest credit is carried out in stages in t plan time periods, than the restriction (11) and the objective function (12) have the following form:

$$\sum_{t=1}^{\mathrm{r}} c_t x_t - \sum_{t=1}^{\mathrm{r}} p_t y_t \le \\ \le \left\{1 - \sum_{t=1}^{r-1} E_t - \sum_{t=1}^{r}\left(1 - \sum_{t=1}^{r-1} E_t\right)\left[(1+\varepsilon)^t - 1\right]\right\}\kappa, \quad (15)$$
$$r = \overline{1, T};$$

$$f(x, y, \kappa) = \sum_{t=1}^{\mathrm{T}} p_t y_t - \sum_{t=1}^{\mathrm{T}} c_t x_t - \\ - \left\{1 + \sum_{t=1}^{r}\left(1 - \sum_{t=1}^{r-1} E_t\right)\left[(1+\varepsilon)^t - 1\right]\right\}\kappa \to \max. \quad (16)$$

2. Models of the production program for the business with heterogeneous product

Models of the production program at own expense

The model of forming the production program at own expense has the following form: [11]

$$\sum_{t=1}^{r} y_{ht} - \sum_{t=1}^{r} x_{ht} \le A_h, \quad h = \overline{1, H}; \quad (17)$$
$$r = \overline{1, T-1};$$

$$\sum_{t=1}^{T} x_{ht} - \sum_{t=1}^{T} y_{ht} = A_{hT+1} - A_h, \quad (18)$$
$$h = \overline{1, H}; \quad r = T;$$

$$\sum_{t=1}^{r}\sum_{h=1}^{H} x_{ht} v_h - \sum_{t=1}^{r}\sum_{h=1}^{H} y_{ht} v_h \le \\ \le B - \sum_{h=1}^{H} A_h v_h, \quad r = \overline{1, T}; \quad (19)$$

$$\sum_{t\ 1}^{r}\sum_{h=1}^{H} c_{ht} x_{ht} \le \sum_{t=1}^{r} C'_t, \quad r = \overline{1, T}; \quad (20)$$

$$\sum_{t=1}^{r}\sum_{h=1}^{H} e_{hut} x_{ht} \le \sum_{t=1}^{r} \Phi_{эфut}, \quad (21)$$
$$u = \overline{1, U}; \quad r = \overline{1, T};$$

$$\sum_{t=1}^{r}\sum_{h=1}^{H} d_{h\ell t} x_{ht} \le \sum_{t=1}^{r} D'_{\ell t}, \quad (22)$$
$$\ell = \overline{1, L}; \quad r = \overline{1, T};$$

$$M_{htj} \le y_{htj} \le M'_{htj}, \quad j = \overline{1, n}; \quad (23)$$
$$h = \overline{1, H}; \quad t = \overline{1, T};$$

$$f(x, y) = \sum_{t=1}^{T}\sum_{h=1}^{H} p_{ht} y_{ht} - \\ - \sum_{t=1}^{T}\sum_{h=1}^{H} c_{ht} x_{ht} \to \max. \quad (24)$$

In this model, all legend is identical to the model with one homogenous product excluding the additional index h ($h = \overline{1, H}$) of h product, and v_h – volume of this product.

Models of the production program by credit

In modeling business with heterogeneous product by simple interest credit, got in the start and fully repaid in the finish of the plan time period T, in the model (17)–(24), instead of the restriction (20), the restriction (25) is introduced, and the objective function (24) is changed [7, 8].

$$\sum_{t=1}^{r}\sum_{h=1}^{H} c_{ht} x_{ht} - \sum_{t=1}^{r}\sum_{h=1}^{H} p_{ht} y_{ht} \le \\ \le \left(1 - \sum_{t=1}^{r} \varepsilon_t\right)\kappa, \quad r = \overline{1, T}; \quad (25)$$

$$f(x, y, \kappa) = \sum_{t=1}^{T}\sum_{h=1}^{H} p_{ht} y_{ht} - \\ - \sum_{t=1}^{T}\sum_{h=1}^{H} c_{ht} x_{ht} - \left[1 + \sum_{t=1}^{T} \varepsilon_t\right]\kappa \to \max. \quad (26)$$

If repayment of the credit is carried out in stages in t plan time periods, than the restriction (25) and the objective function (26) are changed respectively:

$$\sum_{t=1}^{r}\sum_{h=1}^{H} c_{ht} x_{ht} - \sum_{t=1}^{r}\sum_{h=1}^{H} p_{ht} y_{ht} \le \\ \le \left(1 - \sum_{t=1}^{r-1} E_t - \sum_{t=1}^{r}\left(1 - \sum_{t=1}^{r-1} E_t\right)\varepsilon_t\right)\kappa, \quad r = \overline{1, T}; \quad (27)$$

$$f(x, y, \kappa) = \sum_{t=1}^{T}\sum_{h=1}^{H} p_{ht} y_{ht} - \sum_{t=1}^{T}\sum_{h=1}^{H} c_{ht} x_{ht} - \\ - \left[1 + \sum_{t=1}^{T}\left(1 - \sum_{t=1}^{T-1} E_t\right)\varepsilon_t\right]\kappa \to \max. \quad (28)$$

In modeling business with heterogeneous product by compound interest credit, got in the start and fully repaid in the finish of the plan time period T, in the model (17)–(24), instead of the restriction (20), the restriction (29) is introduced, and the objective function (24) is changed:

$$\sum_{t=1}^{r}\sum_{h=1}^{H} c_{ht} x_{ht} - \sum_{t=1}^{r}\sum_{h=1}^{H} p_{ht} y_{ht} \le \\ \le \left(1 - \sum_{t=1}^{r}(1+\varepsilon)^t - 1\right)\kappa, \quad r = \overline{1, T}; \quad (29)$$

$$f(x, y, \kappa) = \sum_{t=1}^{T}\sum_{h=1}^{H} p_{ht} y_{ht} - \sum_{t=1}^{T}\sum_{h=1}^{H} c_{ht} x_{ht} - \\ - \left[1 + \sum_{t=1}^{T}(1+\varepsilon)^t - 1\right]\kappa \to \max. \quad (30)$$

If repayment of the compound interest credit is carried out in stages in t plan time periods, than the restriction (27) and the objective function (28) have the following form:

$$\sum_{t=1}^{r}\sum_{h=1}^{H} c_{ht} x_{ht} - \sum_{t=1}^{r}\sum_{h=1}^{H} p_{ht} y_{ht} \le \\ \le \left\{1 - \sum_{t=1}^{r-1} E_t - \sum_{t=1}^{r}\left(1 - \sum_{t=1}^{r-1} E_t\right)\left[(1+\varepsilon)^t - 1\right]\right\}\kappa, \quad (31)$$
$$r = \overline{1, T};$$

$$f(x, y, \kappa) = \sum_{t=1}^{T}\sum_{h=1}^{H} p_{ht} y_{ht} - \sum_{t=1}^{T}\sum_{h=1}^{H} c_{ht} x_{ht} - \\ - \left[1 + \sum_{t=1}^{T}\left(1 - \sum_{t=1}^{T-1} E_t\right)\left[(1+\varepsilon)^t - 1\right]\right]\kappa \to \max. \quad (32)$$

The formed tasks are linear optimizing tasks.

With the distribution channels (shops or sales departments) described models are modified this way.

3. Modification of the formed models with distribution channels

Modeling the business with one homogenous product at own expense

Let's denote the unknown variables as: x_t – volume of production in t time period ($x_t \in N$, $t = \overline{1, T}$); y_{tj} – volume of sales in t time period though the sales department j ($y_{tj} \in N$, $t = \overline{1, T}$, $j = \overline{1, n}$) [4, 5, 10].

Other parameters are: A – initial stock of the product; B – allowable storage capacity; A_{T+1} – rolling stock of the product in $T+1$ time period; c_t – costs of manufacturing and storing one item of the product in t time period; c'_{tj} – costs of selling one item of the product in t time period though the sales department j; C'_t – allocations of equity in t time period; θ_{ut} – labor-output ratio of manufacturing one item of the product using equipment group u in t time period; $\Phi_{эфut}$ – effective working time of equipment group u in t time period; $d_{\ell t}$ – use of ℓ resource on one item of the product in t time period; $D'_{\ell t}$ – allocations of ℓ resource in t time period; M_{tj}, M'_{tj} – respectively lower and upper limits of sales in t time period though the sales department j; p_t – product price in t time period.

Thus, the model of the business with one homogenous product at own expense has the following form:

The volume of production and initial stock in r time periods cannot be less than the volume of sales in these r time periods:

$$\sum_{t=1}^{r}\sum_{j=1}^{n} y_{tj} - \sum_{t=1}^{r} x_t \le A, \quad r = \overline{1, T-1}; \quad (33)$$

$$\sum_{t=1}^{T} x_t - \sum_{t=1}^{T}\sum_{j=1}^{n} y_{tj} = A_{T+1} - A, \quad r = T. \quad (34)$$

The volume of production in r time periods cannot be more than the volume of sales and free storage capacity in these r time periods:

$$\sum_{t=1}^{r} x_t - \sum_{t=1}^{r}\sum_{j=1}^{n} y_{tj} \le B - A, \quad r = \overline{1, T}. \quad (35)$$

The total costs in r time periods cannot be more than allocations of equity in these r time periods:

$$\sum_{t=1}^{r} c_t x_t \le \sum_{t=1}^{r} C'_t, \quad r = \overline{1, T}. \quad (36)$$

The total labor-output ratio in r time periods cannot be more than effective working time of equipment groups in these r time periods:

$$\sum_{t=1}^{r} \theta_{ut} x_t \le \sum_{t=1}^{r} \Phi_{эфut}, \quad u = \overline{1, U}; \quad r = \overline{1, T}. \quad (37)$$

The total use of other resources in r time periods cannot be more than allocations of these resources in these r time periods:

$$\sum_{t=1}^{r} d_{\ell t} x_t \le \sum_{t=1}^{r} D'_{\ell t}, \quad \ell = \overline{1, L}, \quad r = \overline{1, T}. \quad (38)$$

Restrictions of sales, determined by demand:

$$M_{tj} \le y_{tj} \le M'_{tj}, \quad t = \overline{1, T}; \quad j = \overline{1, n}. \quad (39)$$

The maximum profit in T time periods is:

$$f(x, y) = \sum_{t=1}^{r}\sum_{j=1}^{n} (p_t - c'_{tj}) y_{tj} - \sum_{t=1}^{T} c_t x_t \to \max. \quad (40)$$

Models of forming production program by credit have the following form:

In forming production program by simple interest credit, got in the start and fully repaid in the finish of the plan time period T, in the model (33)–(40), instead of the restriction (36), the restriction (41) is introduced, and the objective function (40) is changed:

The credit and volume of sales in r time periods cannot be less than costs and payments for the credit in these r time periods:

$$\kappa + \sum_{t=1}^{r}\sum_{j=1}^{n} (p_t - c'_{tj}) y_{tj} \ge \sum_{t=1}^{r} c_t x_t + \sum_{t=1}^{r} \varepsilon_t \kappa, \quad r = \overline{1, T}; \quad (41)$$

$$f(x, y, \kappa) = \sum_{t=1}^{T}\sum_{j=1}^{n} (p_t - c'_{tj}) y_{tj} - \sum_{t=1}^{T} c_t x_t - \left[1 + \sum_{t=1}^{T} \varepsilon_t\right] \kappa \to \max, \quad (42)$$

where κ – unknown volume of the starting credit ($\kappa \ge 0$); ε_t – interest rate in t ($t = \overline{1, T}$) time period.

If repayment of the credit is carried out in stages in t plan time periods, than the restriction (41) and the objective function (42) are changed as follows:

$$\sum_{t=1}^{r} c_t x_t - \sum_{t=1}^{r}\sum_{j=1}^{n} (p_t - c'_{tj}) y_{tj} \le \left(1 - \sum_{t=1}^{r-1} E_t - \sum_{t=1}^{r}\left(1 - \sum_{t=1}^{r-1} E_t\right)\varepsilon_t\right)\kappa, \quad r = \overline{1, T}; \quad (43)$$

$$f(x, y, \kappa) = \sum_{t=1}^{T}\sum_{j=1}^{n} (p_t - c'_{tj}) y_{tj} - \sum_{t=1}^{T} c_t x_t - \left[1 + \sum_{t=1}^{T}\left(1 - \sum_{t=1}^{T-1} E_t\right)\varepsilon_t\right]\kappa \to \max, \quad (44)$$

where E_t – a part of the credit repayment in t time period on the condition that $\sum_{t=1}^{T} E_t = 1$.

With compound interest lending, getting the credit in the start and full repayment in the finish of the plan time period T, the restriction (43) and the objective function (44) are changed respectively:

$$\sum_{t=1}^{r} c_t x_t - \sum_{t=1}^{r}\sum_{j=1}^{n} (p_t - c'_{tj}) y_{tj} \le \left(1 - \sum_{t=1}^{r}\left[(1+\varepsilon)^t - 1\right]\right)\kappa, \quad r = \overline{1, T}; \quad (45)$$

$$f(x, y, \kappa) = \sum_{t=1}^{T}\sum_{j=1}^{n} (p_t - c'_{tj}) y_{tj} - \sum_{t=1}^{T} c_t x_t - \left[1 + \sum_{t=1}^{T}\left[(1+\varepsilon)^t - 1\right]\right]\kappa \to \max. \quad (46)$$

If repayment of the compound interest credit is carried out in stages in t plan time periods,

than the restriction (45) and the objective function (46) have the following form:

$$\sum_{t=1}^{r} c_t x_t - \sum_{t=1}^{r}\sum_{j=1}^{n} (p_t - c'_{tj}) y_{tj} \le$$

$$\le \left\{1 - \sum_{t=1}^{r-1} E_t - \sum_{t=1}^{r}\left(1 - \sum_{t=1}^{r-1} E_t\right)\left[(1+\varepsilon)^t - 1\right]\right\}\kappa, \quad (47)$$

$$r = \overline{1, T};$$

$$f(x, y, \kappa) = \sum_{t=1}^{T}\sum_{j=1}^{n} (p_t - c'_{tj}) y_{tj} - \sum_{t=1}^{T} c_t x_t -$$

$$- \left\{1 + \sum_{t=1}^{r}\left(1 - \sum_{t=1}^{r-1} E_t\right)\left[(1+\varepsilon)^t - 1\right]\right\}\kappa \to \max. \quad (48)$$

Models of the production program for the business with heterogeneous product

The model of forming the production program at own expense has the following form [6]:

$$\sum_{t=1}^{r}\sum_{j=1}^{n} y_{htj} - \sum_{t=1}^{r} x_{ht} \le A_h, \quad (49)$$

$$h = \overline{1, H}; \quad r = \overline{1, T-1};$$

$$\sum_{t=1}^{T} x_{ht} - \sum_{t=1}^{T}\sum_{j=1}^{n} y_{htj} = A_{hT+1} - A_h, \quad (50)$$

$$h = \overline{1, H}; \quad r = T;$$

$$\sum_{t=1}^{r}\sum_{h=1}^{H} x_{ht} v_h - \sum_{t=1}^{r}\sum_{h=1}^{H} y_{htj} v_h \le$$

$$\le B - \sum_{h=1}^{H} A_h v_h, \quad r = \overline{1, T}; \quad (51)$$

$$\sum_{t=1}^{r}\sum_{h=1}^{H} c_{ht} x_{ht} \le \sum_{t=1}^{r} C'_t, \quad r = \overline{1, T}; \quad (52)$$

$$\sum_{t=1}^{r}\sum_{h=1}^{H} e_{hut} \le \sum_{t=1}^{r} \Phi_{эфut}, \quad (53)$$

$$u = \overline{1, U}; \quad r = \overline{1, T};$$

$$\sum_{t=1}^{r}\sum_{h=1}^{H} d_{h\ell t} x_{ht} \le \sum_{t=1}^{r} D'_{\ell t}, \quad (54)$$

$$\ell = \overline{1, L}; \quad r = \overline{1, T};$$

$$M_{htj} \le y_{htj} \le M'_{htj}, \quad j = \overline{1, n}; \quad (55)$$

$$h = \overline{1, H}; \quad t = \overline{1, T};$$

$$f(x, y) = \sum_{t=1}^{T}\sum_{h=1}^{H}\sum_{j=1}^{n} \left(p_{ht} - c'_{htj}\right) y_{htj} -$$

$$- \sum_{t=1}^{T}\sum_{h=1}^{H} c_{ht} x_{ht} \to \max. \quad (56)$$

In this model, all legend is identical to the model with one homogenous product excluding the additional index j $(j = \overline{1, n})$ of j sales department, and c'_{tj} – costs of selling one item of the product in t time period though the sales department j.

Models of the production program by credit

In modeling business with heterogeneous product by simple interest credit, got in the start and fully repaid in the finish of the plan time period T, in the model (49)–(56), instead of the restriction (52), the restriction (57) is introduced, and the objective function (56) is changed:

$$\sum_{t=1}^{r}\sum_{h=1}^{H} c_{ht} x_{ht} - \sum_{t=1}^{r}\sum_{h=1}^{H}\sum_{j=1}^{n} \left(p_{ht} - c'_{htj}\right) y_{htj} \le$$

$$\le \left(1 - \sum_{t=1}^{r} \varepsilon_t\right)\kappa, \quad r = \overline{1, T}; \quad (57)$$

$$f(x, y, \kappa) = \sum_{t=1}^{T}\sum_{h=1}^{H}\sum_{j=1}^{n} \left(p_{ht} - c'_{htj}\right) y_{htj} -$$

$$- \sum_{t=1}^{T}\sum_{h=1}^{H} c_{ht} x_{ht} - \left[1 + \sum_{t=1}^{T} \varepsilon_t\right]\kappa \to \max. \quad (58)$$

If repayment of the credit is carried out in stages in t plan time periods, than the restriction (57) and the objective function (58) are changed respectively:

$$\sum_{t=1}^{r}\sum_{h=1}^{H} c_{ht} x_{ht} - \sum_{t=1}^{r}\sum_{h=1}^{H}\sum_{j=1}^{n} \left(p_{ht} - c'_{htj}\right) y_{htj} \le$$

$$\le \left(1 - \sum_{t=1}^{r-1} E_t - \sum_{t=1}^{r}\left(1 - \sum_{t=1}^{r-1} E_t\right)\varepsilon_t\right)\kappa, \quad r = \overline{1, T}; \quad (59)$$

$$f(x, y, \kappa) = \sum_{t=1}^{T}\sum_{h=1}^{H}\sum_{j=1}^{n} \left(p_{ht} - c'_{htj}\right) y_{htj} -$$

$$- \sum_{t=1}^{T}\sum_{h=1}^{H} c_{ht} x_{ht} -$$

$$- \left[1 + \sum_{t=1}^{T}\left(1 - \sum_{t=1}^{T-1} E_t\right)\varepsilon_t\right]\kappa \to \max. \quad (60)$$

In modeling business with heterogeneous product by compound interest credit, received in the beginning and fully repaid at the end of the plan time period T, in the model (49)–(56), instead of the restriction (52), the restriction (61) is introduced, and the objective function (56) is changed:

$$\sum_{t=1}^{r}\sum_{h=1}^{H} c_{ht}x_{ht} - \sum_{t=1}^{r}\sum_{h=1}^{H}\sum_{j=1}^{n}\left(p_{ht} - c'_{htj}\right)y_{htj} \le \le \left(1 - \sum_{t=1}^{r}(1+\varepsilon)^t - 1\right)\kappa, \quad r = \overline{1, T}; \tag{61}$$

$$f(x, y, \kappa) = \sum_{t=1}^{T}\sum_{h=1}^{H}\sum_{j=1}^{n}\left(p_{ht} - c'_{htj}\right)y_{htj} - \\ - \sum_{t=1}^{T}\sum_{h=1}^{H} c_{ht}x_{ht} - \left[1 + \sum_{t=1}^{T}(1+\varepsilon)^t - 1\right]\kappa \to \max. \tag{62}$$

If repayment of the compound interest credit is carried out in stages in t plan time periods, the restriction (59) and the objective function (60) have the following form:

$$\sum_{t=1}^{r}\sum_{h=1}^{H} c_{ht}x_{ht} - \sum_{t=1}^{r}\sum_{h=1}^{H}\sum_{j=1}^{n}\left(p_{ht} - c'_{htj}\right)y_{htj} \le \\ \le \left\{1 - \sum_{t=1}^{r-1} E_t - \sum_{t=1}^{r}\left(1 - \sum_{t=1}^{r-1} E_t\right)\left[(1+\varepsilon)^t - 1\right]\right\}\kappa, \tag{63}$$
$$r = \overline{1, T}$$

$$f(x, y, \kappa) = \sum_{t=1}^{T}\sum_{h=1}^{H}\sum_{j=1}^{n}\left(p_{ht} - c'_{htj}\right)y_{htj} - \\ - \sum_{t=1}^{T}\sum_{h=1}^{H} c_{ht}x_{ht} - \left[1 + \sum_{t=1}^{T}\left(1 - \sum_{t=1}^{T-1} E_t\right)\times\right. \tag{64}$$
$$\left.\times \left[(1+\varepsilon)^t - 1\right]\right]\kappa \to \max.$$

The formed tasks are linear optimizing tasks.

Thus, the elaborated economic and mathematical models for the production program of the enterprise with one homogenous product with taking into account rolling product stocks, free storage capacity, product labor-output ratio, demand and other resources both at own expense and by simple and (or) compound interest credit differ by forming the set of trajectories making the tasks by calculating the pessimistic and optimistic variants of its solution in terms of the objective function – profit maximum. Based on the elaborated models with one homogenous product, economic and mathematical models of determining production program of the enterprise with heterogeneous product have been formed. Account conjoint usage free storage capacity, effective working time of equipment groups, financial and other resources needed for making the heterogeneous product at own expense and (or) by credit have been taken into account.

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MODELING OF PROCESSES INVOLVING EXTERNAL FINANCIAL RESOURCES FOR SUSTAINABLE DEVELOPMENT OF THE INDUSTRIAL ENTERPRISE

А.С. Соколицын, М.В. Иванов, Н.А. Соколицына

МОДЕЛИРОВАНИЕ ПРОЦЕССОВ ПРИВЛЕЧЕНИЯ ВНЕШНИХ ФИНАНСОВЫХ РЕСУРСОВ В ЦЕЛЯХ ОБЕСПЕЧЕНИЯ УСТОЙЧИВОГО РАЗВИТИЯ ПРОМЫШЛЕННОГО ПРЕДПРИЯТИЯ

An economic utility of using short- and long-term financial resources for fixed and circulating capital is determined based on an economic-mathematical model which involves an aggregative balance sheet scheme in order to ensure the sustainable development of industrial enterprises.

CIRCULATING CAPITAL. FIXED CAPITAL. BALANCE SHEET. MODEL. SHOT- AND LONG-TERM CREDITS. LOANS.

Определяется экономическая целесообразность привлечения краткосрочных и долгосрочных финансовых ресурсов под внеоборотные и оборотные активы на основе экономико-математической модели на базе укрупненной схемы баланса в целях обеспечения устойчивого развития промышленного предприятия.

ОБОРОТНЫЕ АКТИВЫ. ВНЕОБОРОТНЫЕ АКТИВЫ. БАЛАНС. МОДЕЛЬ. КРАТКОСРОЧНЫЕ И ДОЛГОСРОЧНЫЕ КРЕДИТЫ. ЗАЕМНЫЕ СРЕДСТВА.

In the modern social and economic conditions, an increasing effectiveness of industrial enterprises and their sustainable development are of particular importance. The main directions of the enterprise development are associated with manufacturing new product and reorganizing production. At the same time, this development is possible because of finance from several sources. If the enterprise does not have enough own funds for development, it should use loans. Thus, the basic sources of financial means for the enterprise development are:

– short-term credits or loans for circulating capital;

– short-term credits or loans for fixed and circulating capital;

– long-term credits or loans for fixed and circulating capital;

– using cash flows for fixed and circulating capital [8].

These sources of finance are used in order to increase revenue and profit by increasing the necessary fixed and circulating capital. This is accompanied by the growth of accounts payable and receivable, inventory and budget payments.

Let's determine the economic expediency of borrowing short- and long-term financial resources for fixed and circulating capital using an economic and mathematical model. For this, let's construct an integrated scheme of the enterprise's balance sheet, shown in Fig. 1, where FC – fixed capital; CC – circulating capital; CR – capital and reserves; LTP – long-term passives; STP – short-term passives; IC – inventory and costs; L – loans; AR – accounts receivable; AP – accounts payable; OP – other passives; a – minimal profit rate on short-term loan; a' – minimal profit rate on long-term loan; b – rate of the profit tax; x – required projected volume of the short-term loan; x' – required projected volume of the long-term loan; z – required figure of rising (decreasing) accounts receivable; y – required figure of rising (decreasing) inventory; v – required figure of rising (decreasing) accounts payable (excluding rising profit tax); w – required figure of rising (decreasing) fixed capital [11].

$FC + w$	CR including: $ax + a'x'$
CC including: $L + y$ $AR + z$	$LTP + x'$
	SHP including $L + x$ $AP + v + \frac{(ax + a'x')b}{1 - b}$
$A + y + z + w$	$P + (1 + a)x + (1 + a')x' + v + \frac{(ax + a'x')}{1 - b}b$

Fig. 1. Integrated scheme of the enterprise balance sheet with short- and long-term credits for fixed and circulating capital

Short- and long-term credits are used to increase revenue and profit, which leads to consequent changes:

– fixed capital on w;
– circulating capital on $y + z$;
– capital and reserves on the net profit $ax + a'x'$;
– long-term passives on x';
– short-term passives on $x + v + \frac{(ax + a'x')b}{1 - b}$.

According to this, let's form the following system of mathematical relations:

1. Projected balance sheet parameters

$$y + z + w = (1 + a)x + (1 + a')x' + v + \frac{(ax + a'x')b}{1 - b}. \quad (1)$$

2. Relation of projected revenue, costs and balance profit

$$(1 - b)(R - C - BP_0) \geq ax + a'x', \quad (2)$$

where R – projected revenue; C – projected costs; BP_0 – basic balance profit.

3. Relation of projected revenue with circulating («working») capital

$$\frac{R_0}{CC - STP} = \frac{R}{(CC + y + z) - \left(STP + x + v + \frac{(ax + a'x')}{1 - b}b\right)}.$$

Hence

$$y + z - x - v - \frac{(ax + a'x')}{1 - b}b = (CC - STP)P, \quad (3)$$

where $P = \frac{R}{R_0} - 1$.

4. Expediency of getting short- and long-term credits respectively in volumes x и x' can be shown in the following way:

$$(1 - b)\left(\frac{BP_0 + \frac{ax + a'x'}{1 - b}}{(A + y + z + w) - \left(AP + v + \frac{(ax + a'x')}{1 - b}b\right)} - \frac{\overline{BIR} \cdot STVC + BIR \cdot x + \overline{BIR'} \times LTVC + BIR' \cdot x}{STVC + x + LTVC + x'}\right) \times \frac{STVC + x + LTVC + x'}{CR + ax + a'x'} \geq 0,$$

where $\overline{BIR}$, BIR – bank interest rate on short-term credit in basic and current periods (parts of the unit); $STVC$ – current volume of short-term credit; $\overline{BIR'}$, BIR' – bank interest rate on long-term credit in basic and current periods (parts of the unit); $LTVC$ – current volume of long-term credit.

In this case, the second factor is the differential of the financial leverage [5]. Therefore, loans take advantage, if it is not negative, i. e.

$$\frac{BP_0 + \frac{ax + a'x'}{1 - b}}{(A + y + z + w) - \left(CR + v + \frac{(ax + a'x')}{1 - b}\right)b} - \frac{\overline{BIR} \cdot STVC + BIR \cdot x + \overline{BIR'} \cdot LTVC + BIR' \cdot x'}{SLVC + x + LTVC + x'} \geq 0. \quad (4)$$

Result interest rate on short- and long-term credits (СБП) is calculated by the formula

$$BIR = \frac{\overline{BIR} \cdot SLVC + BIR \cdot x + \overline{BIR}' \cdot LTVC + BIR' \cdot x'}{SLVC + x + LTVC + x'}. \quad (5)$$

Determining the result interest rate on short- and long-term credits appears difficult, especially in economic crisis [1, 10]. If determining the interest rate on this credits is difficult or impossible, and, consequently, the enterprise cannot calculate the approximate credit volumes, it should determine the result interest rate with the current data, i. e.

$$BIR = \frac{\overline{BIR} \cdot SLVC + \overline{BIR}' \cdot LTVC}{SLVC + LTVC}.$$

If determining the interest rate on short- and long-term credits for the projected time is not so difficult, and, consequently, the enterprise can calculate the approximate credit volumes, the (4) formula takes the following form:

$$BIR = \frac{BIR \cdot x + BIR' \cdot x'}{x + x'}. \quad (6)$$

Result interest rate on the described credits is calculated by (6) formula, in case the enterprise has no debts by the end of the current period.

Thus, the enterprise can determine the result interest rate on short- and long-term credits in several economic conditions. Thereby, the (5) formula takes the form:

$$\frac{BP_0 + \dfrac{ax + a'x'}{1-b}}{(A + y + z + w) - \left(CR + v + \dfrac{(ax + a'x')b}{1-b}\right)} - BIR \geq 0.$$

Hence

$$y + z + w - v - \frac{(ax + a'x')}{1-b} b \leq \leq \frac{ax + a'x'}{BIR(1-b)} + \frac{BP_0}{BIR} - (A - CR). \quad (7)$$

5. Restriction of the period of circulation of the accounts receivable has the form:

$$\frac{zT}{R - R_0} \leq t_z,$$

or

$$z \leq t_z \frac{R - R_0}{T}, \quad (8)$$

where t_z – allowable period of circulation of the accounts receivable; R_0 – current revenue; T – plan period [2, 4, 6, 7].

6. Restrictions of the current liquidity ratio and own funds have the form:

$$\frac{CC + y + z}{STP + x + v + \dfrac{(ax + a'x')}{1-b} b} \geq d; \quad (9)$$

$$\frac{CR + ax + a'x' - FC - w}{CC + y + z} \geq L, \quad (10)$$

where d, L – minimal figures of current liquidity ratio and the own funds respectively.

7. Restriction of the period of circulation of the fixed capital has the form:

$$w \leq t_w \frac{R - R_0}{T}, \quad (11)$$

or

$$\frac{wT}{R - R_0} \leq t_w,$$

where t_w – allowable period of circulation of the fixed capital [2, 4, 6, 7].

8. If the current profitability indicators are the minimums of projected profitability indicators, the appropriate restrictions on the indicators of the assets profitability, capital and reserves, costs and revenue have the form:

$$\frac{R - C}{A + y + z + w} \geq \frac{BP_0}{A}; \quad (12)$$

$$\frac{R - C}{CR + ax + a'x'} \geq \frac{BP_0}{CR}; \quad (13)$$

$$\frac{R - C}{C} \geq \frac{BP_0}{C_0}; \quad (14)$$

$$\frac{R-C}{R} \geq \frac{BP_0}{R_0}. \quad (15)$$

9. Restriction of the variable (C_{var}) and fixed (C_{const}) costs

$$\frac{R}{R_0} C_{var} + C_{const} \geq C. \quad (16)$$

Relations (1)–(3), (4)–(16) form the basis for the algorithm of determining volumes of short- and long-term credits (Fig. 2). For this let's do more detail iteration analysis of the elaborated system.

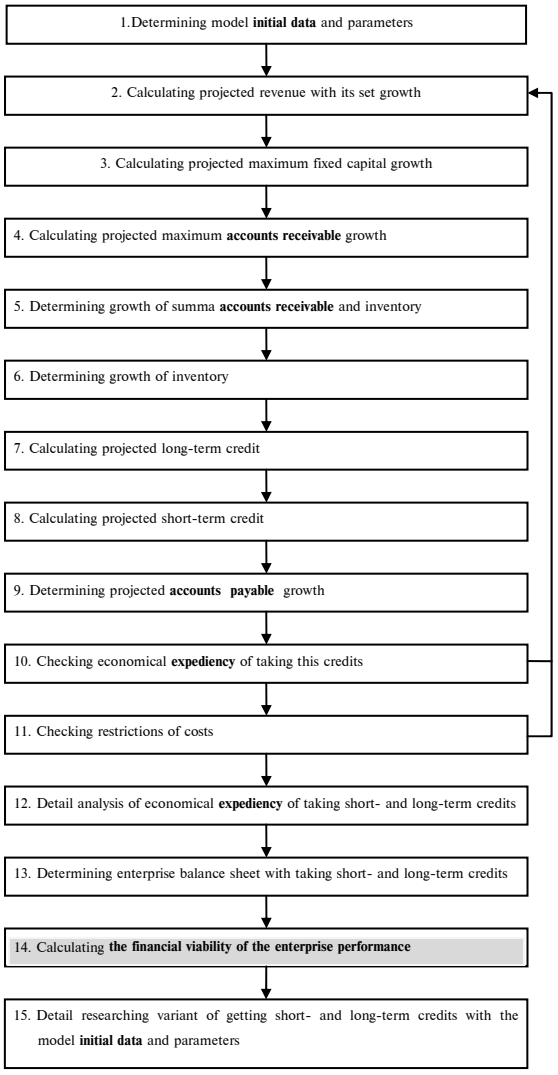

Fig. 2. Algorithm of determining financial viability of the enterprise with short- and long-term credits for fixed and circulating capital

1. Determining model initial data and parameters.

2. Calculating projected revenue

$$R = R_1 = (1+p)R_0,$$

where p – revenue growth, equal $\left(\frac{R}{R_0} - 1\right)$.

3. Using the (11) relation, we should calculate projected maximal growth of fixed capital, connected with the revenue growth (plan period is one quarter or 90 days):

$$w \leq \frac{t_w R_0 p}{T}, \quad (17)$$

where t_w – allowable period of circulation of the fixed capital, calculated on current data with the formula

$$t_w = \frac{FC \cdot T}{R_0}.$$

4. Using the (8) relation, the should calculate projected maximal growth of accounts receivable, connected with the revenue growth:

$$z \leq \frac{t_z R_0 p}{T}, \quad (18)$$

where t_z – allowable period of circulation of the accounts receivable, calculated on current data with the formula

$$t_z = \frac{AR \cdot T}{R_0}.$$

5. Determining growth of summa accounts receivable and inventory – $y + z$ with the (9) relation:

$$y + z = \frac{dSTP - (CC - STP)pd - CC}{1-d}. \quad (19)$$

6. Growth of inventory is determined by (17) formula:

$$y = \frac{dSTP - (CC - STP)pd - CC}{1-d} - z. \quad (20)$$

7. For calculating projected long-term credit – x', let's use (10) relation, if the enterprise own funds, calculated on current data – L_{ϕ}, are more than normative, i. e.

$$CR + ax + a'x' - FC - w \geq \geq L_{\phi}(CC + y + z). \quad (21)$$

In this relation, let's substitute the projected short-term credit – x, determined with (1) and (3) relations:

$$x = \frac{(CC - CR)p + w - (1 + a')x'}{a}. \qquad (22)$$

Substituting formula (20) in (21), we get:

$$x' = CR + (CC - STP)p - FC - \\ - L_{ф}(CC + y + z). \qquad (23)$$

w and $y + z$ are determined with (18) and (19).

8. Projected short-term credit – x is calculated by substituting (22) in (23).

9. Determining projected accounts payable growth v is done with (1) and (3) relations.

$$v = y + z + \left(\frac{1 + a'}{a} + \frac{b}{1 - b}\right)x' - \left(\frac{1}{a} + \frac{b}{1 - b}\right)w - \\ - (CC - STP)p\left(1 + \frac{1}{a} + \frac{b}{1 - b}\right). \qquad (24)$$

Substituting $y + z$, x' and w, determined in (19), (24) and (17), we should calculate v.

10. The check of the economic expediency of getting these credits is done with (4) by substituting w, $y + z$, x, x' and v, shown respectively in (17), (17), (21)–(24).

If the (7) relation is correct, go to 11, other wise you need to increase revenue to B_2 and repeat steps 2–9.

11. Checking restrictions of costs ((2), (12)–(16)):

$$C \le \begin{cases} (1 + p)R_0 - \dfrac{ax + a'x'}{1 - в} - BP_0; \\ (1 + p)R_0 - \dfrac{BP_0}{A}(y + z + w) - BP_0; \\ (1 + p)R_0 - \dfrac{BP_0}{CR}(ax + a'x') - BP_0; \\ \dfrac{(1 + p)R_0}{1 + \dfrac{BP_0}{C_0}}; \\ (1 + p)(R_0 - BP_0); \\ (1 + p)C_{var} + C_{const}. \end{cases}$$

If this conjunction is correct, the calculated costs reach the maximum, without worsening other financial parameters, otherwise need to increase revenue to B_2 and repeat steps 2–11.

12. Detail analysis of the economic expediency of getting short- and long-term credits.

If (4) is false, you need to calculate r_1 and r_2:

$$r_1 = y + z + w - v - \frac{(ax + a'x')}{1 - b}\left(b + \frac{1}{BIR}\right)$$

$$\text{and } r_2 = \frac{BP_0}{BIR} - (A - AP).$$

If $r_1 \ge 0$, $r_2 < 0$, getting short- and long-term credits in these amounts is not economically viable.

If revenue growth due to the credits is not economically viable, you need to increase revenue growth to P. The solution is finalised by the last revenue variant, appropriate for (1)–(3), (4)–(16), if the revenue growth in this variant is not more than maximal. Otherwise getting short- and long-term credits with such revenue growth is not economically viable.

13. Determining enterprise balance sheet with short- and long-term credits.

14. Calculating the financial viability of the enterprise performance.

15. Detail research of the variant with short- and long-term credits using the model initial data and parameters.

Determining a simultaneous use of short- and long-term financial resources in order to increas performance of industrial enterprises allows calculate most effective credit amounts for the best results with the integrated scheme of the enterprise's balance sheet. An increase of fixed and circulating capital in the most preferred destinations of enterprise development using these credits will lead to a long-term climb of revenue and profit, i. e. to an increase in competitiveness and financial stability [3, 9].

There are also two variants in the algorithm realization: first, for given values of a, a', b, $СБП$, $СБП'$ getting credits for fixed and circulating capital is not economically viable; second – credits are economically viable. In the second variant there can be several relevant decisions. An optimum variant is giving

$$\max_i NP_i\left[q_i(R_i)\right],$$

where $NP_i[q_i(R_i)]$ – net profit in i $(i = \overline{1, m})$ variant of the enterprise development with the short- and long-term credits, according to the possibility q_i of getting projected revenues R_i in plan period if $\sum_{i=1}^{m} q_i(R_i) = 1$.

Such is the integrated scheme of a company's involvement in the short-term and long-term loans for non-current and current assets, which is formed on the basis of economic and mathematical model for determining those financial resources for the sustainable development of the enterprise and, at the same time, characterized by the calculation of these types of loans. On the basis of this model, algorithm for calculating a required amount of money involved is formed, which allows to suggest a number of feasible solutions. In conclusion, it should be noted that the important task of strategic management of industrial firms is embodied in the life of the model. The proposed model can be used in various sectors of the national economy, taking into account the specifics of a particular company.

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HOW KEY RUSSIAN UNIVERSITIES ADVANCE TO BECOME LEADERS OF WORLDWIDE EDUCATION: PROBLEM ANALYSIS AND SOLVING

Д.Г. Родионов, И.А. Рудская, О.А. Кушнева

ПРОДВИЖЕНИЕ ВЕДУЩИХ РОССИЙСКИХ УНИВЕРСИТЕТОВ В ЧИСЛО ЛИДЕРОВ МИРОВОГО ОБРАЗОВАНИЯ: АНАЛИЗ ПРОБЛЕМЫ И ПУТИ РЕШЕНИЯ

The paper studies in detail and analyze local rankings by faculty and by subject according to the QS World University Ranking. The paper also suggests a method to clearly display a university status by faculty and by subject. A comparative analysis of leading world universities' performance has been done by faculty and by subject. The ways to increase performance of national universities by faculty and by subject are looked into, as well as the ways for them to advance in the world rankings.

RANKING. COMPETITIVENESS. PERFORMANCE. UNIVERSITY. GLOBAL EDUCATION MARKET.

Подробно рассмотрены и проанализированы локальные рейтинги по отдельным научным направлениям (*by Faculty*) и предметам (by Subject) формируемые QS World University Ranking. Также в статье предложен метод наглядного отображения состояния дел в университете по направлениям и предметам. Проведен сравнительный анализ результативности отдельных направлений и предметов у ведущих университетов мира. Рассмотрены пути повышения результативности отечественных вузов университете по направлениям и предметам, а также продвижения в мировых рейтингах.

РЕЙТИНГ. КОНКУРЕНТОСПОСОБНОСТЬ. РЕЗУЛЬТАТИВНОСТЬ. УНИВЕРСИТЕТ. МИРОВОЙ РЫНОК ОБРАЗОВАНИЯ.

International Prestige of Russian Higher Education

In recent years the President and Government of the Russian Federation have paid a lot of attention to what can be done in order to increase prestige of the Russian higher school, which has suffered considerable damage starting from 1990s. In Soviet time a lot of students came to study in Russian universities from socialistic European countries, such as Poland, Bulgaria, Eastern Germany, Czechoslovakia, etc., from the countries of Asian and African regions, such as China, Vietnam, India, Pakistan, Algeria and many others. Correspondingly, diplomas issued by Russian universities were recognized in these countries (and in some others as well!) as a document confirming full-rate tertiary education.

Unfortunately, the reforms in 1990s, which were meant to establish market relations in the country and, above all, to ensure profitable economy, were also introduced in Russian science, including higher school. During the severe economic crisis which the country was experiencing and a dramatic decrease in funding, universities had to struggle for survival on their own. A wide-scale introduction of part-time learning on a commercial basis was one of the ways universities used to develop self-financing. This resulted in increased workload on the teaching staff and, correspondingly, poorer quality of education. An industrial production crisis destroyed

contacts and connections between enterprises and university science and, therefore, scientific research sectors in Russian universities either reduced sharply in number or stopped existing. Consequently, by the early 21stt century both Russian science and Russian higher school had lost their international prestige to a great extent.

Meanwhile, by that time educational services had grown into a very profitable activity for universities whereas university rankings, which had become more and more popular, turned into a powerful advertising tool.

Vertical Race: Ranking Advancement and Universities' Fight for Students

Nowadays, how the attractiveness of a university for students and prestige of its diplomas for employers largely depend on its ranking position. Best universities rankings are regularly worked out by various agencies and posted on the Internet, the most accessible information platform. Russian universities occupy fairly modest positions in these rankings. This contributes to the Russian higher education discredit both on a global and domestic scale. Thus, for instance, the survey, conducted by the Institution of Educational Sociology of the Russian Academy of Education (*Rus*: Institut sotsiologii obrasovania Rossiiskoi Akademii Obrazovania) among Moscow senior high school students, revealed that 46.3 % of them would like to continue their education abroad, whereas 41.8 % of teenagers dream of getting a job in a foreign country [4]. As for foreign students who study in Russian universities, they often choose to do so because of tuition costs or due to the fact that their score is not high enough to enter western universities. Thus, for example, in China they believe that the most prestigious education can be obtained in the USA, the UK and other western European countries and students turn to Russian universities only after rejecting other options.

Encouraged by the President and Government of the Russian Federation, the Ministry of Education and Science of the RF and the National Training Foundation have developed a draft The concept of the Russian Federation's Educational Service Export for 2011–2020', which reviews, in particular, the change dynamics in Russia's positions on the global market of educational services. The Soviet Union used to be ranked number two (after the USA) by the number of foreign students, but now Russia is ranked number nine in this category. According to the Organization of Economic Co-operation and Development (OECD), in 2007 the total number of foreign students was 3 million. Russian universities accounted for 2 % of this number, whereas the share of the USA was 20 % and that of the UK was 12 %. Germany and France teach 9 % and 8 % respectively. Moreover, a large number of students study in Australia (7 %), Canada (4 %), and Japan (4 %) [2].

The strategic goals of the national educational policy are listed below:

– to improve the attractiveness and competitiveness of the Russian educational system in the global and regional educational sphere;

– to ensure an effective participation of Russia in the global and major regional processes of education development;

– to increase an export share of educational services in the GDP of Russia.

In order to achieve these goals it is essential, first of all, to advance our best universities (quite a few of them!) in global rankings.

One of the most reputable rankings is the *QS World University Ranking*, which is given by the consulting company Quacquarelli Symonds (QS) since 2004. To be ranked by this particular agency is not only prestigious but also promises large revenues from teaching foreign students. So universities strive for being noticed by the company QS. This trend is clearly seen in the dynamics of the constantly growing number of universities in the published rankings. In 2007 619 universities were presented, in 2001 this figure was 724. In 2013 the ranking covered 834 universities from 76 countries. To select them from about 3000 universities who had applied, 62.094 opinions of scientists from various countries, and 27.957 views of employers were considered [5, 10].

Starting from 2005, five Russian universities took their positions in this ranking (Tab. 1).

It is obvious that there have been no considerable improvement in the ranking positions of the Russian universities although their number has increased to 8. This does not mean that our universities started to perform worse in the education and research field. It just reflects that universities in other countries tend to pay much more attention to their ranking indices and make more efforts to improve them.

Table 1

Russian universities in the QS World University Ranking 2005–2010

Name of University	2005	2006	2007	2008	2009	2010
1. Lomonosov Moscow State University	93	93	231	183	101	93
2. St. Petersburg State University	164	164	239	224	168	210
3. Novosibirsk State University	346	346	440	401–500	312	375
4. Moscow State Institute of International Relations (MGIMO)	–	–	–	–	601+	601+
5. National Research University «Higher School of Economics»	–	–	–	–	501–600	451–500
6. Ural Federal University named after the first President of Russia B.N. Yeltsin	–	–	–	–	601+	501–550
7. Tomsk State University	269	269	466	401–500	401–500	401–500
8. Kazan (Volga region) Federal University	476	476	528	501+	501+	501–600

From the data of the QS World University Ranking [5].

It is worth mentioning that the importance of being present in the international rankings is increasingly understood by the management of Russian universities. This is proved by the fact that the number of national universities in the *QS World University Ranking* increased considerably over the past three years (Tab. 2).

As Tab. 2 shows, the number of universities in the 2013 rankings more than doubled (from 8 to 18). Even though the positions of several universities are in the rearguard sector (ranking 701+) and they can hardly be considered as stable ones, there is hope that determined efforts of the Russian universities to improve their indices in the ranking will yield.

According to the Russian Federal State Statistics Service (*Federal'naya sluzhba gosudarstvennoi statistiki*), there are 1046 higher educational institutions in Russia [3]. So 1.7 % of Russian universities are represented in the *QS* ranking. In contrast, according to the 2009 data, there were 4352 higher educational institutions in the USA, and the 2013 ranking comprises 144 universities, i. e. 3.3 %. At a first glance, our representation in the *QS* ranking is just twice as low as that of the USA, but we should not forget that the number of American universities ranged in the *QS* is 8 times as many as that of the Russian ones. Interestingly, the USA population is only twice as big as the population of Russia, which means that higher education is much more accessible for the USA residents than for the people who live in Russia. This statistics makes us believe that there is some inconsistency between the country's innovation development course, which has been proclaimed by the Government of the Russian Federation and which needs educated specialists in all fields of economy, and the projects designed for a considerable reduction in the number of national universities. Moreover, the universities we refer to are not private but state educational institutions.

Performance analysis of educational and scientific activities of universities is the basis for their harmonious development

University rankings by educational and scientific faculty developed by the British company «Quacquarelli Symonds» (*QS*) are very useful, as they allow to analyze strengths and weaknesses of multidisciplinary universities. There is no need for additional research to design these rankings. The information basis is the data used for the key ranking, the *QS World University Ranking*. The local ranking is awarded by each faculty and includes 400 best universities. The assessment is conducted by a narrower range of indices: academic reputation, reputation by employers, number of citations per paper published, h-index. It is worth saying that, for each faculty, the weight of these indices is different (Tab. 3).

Tab. 3 shows that in local rankings for Art & Humanities and Social Sciences & Management, academic reputation is the most influential one, whereas the citation indices are notably less considerable. As for Life Sciences & Medicine, the influence of the citation indices becomes crucial for ranking.

Table 2

Russian universities in the QS World University Ranking 2011–2013

Name of University		2011	2012	2013
1. Lomonosov Moscow State University	Ranking	112	116	120
	Line	112	116	120
2. St. Petersburg State University	Ranking	251	253	240
	Line	251	253	240
3. Bauman Moscow State Technical University	Ranking	379	352	334
	Line	379	352	334
4. Novosibirsk State University	Ranking	400	371	352
	Line	400	371	352
5. Moscow State Institute of International Relations (MGIMO)	Ranking	389	367	386
	Line	389	367	386
6. Moscow Institute of Physics and Technology (State University)	Ranking			441–460
	Line			443
7. Saint Petersburg State Polytechnical University	Ranking			441–460
	Line			457
8. The Peoples' Friendship University of Russia	Ranking	551–600	501–550	491–500
	Line	573	522	495
9. National Research University «Higher School of Economics»	Ranking	551–600	501–550	501–550
	Line	537	550	518
10. Ural Federal University named after the first President of Russia B. N. Yeltsin	Ranking		451–500	501–550
	Line		469	549
11. Tomsk Polytechnic University	Ranking	551–600	601+	551–600
	Line	541	616	583
12. Tomsk State University	Ranking	451–500	551–600	551–600
	Line	451	568	584
13. Kazan (Volga region) Federal University	Ranking	601+	601+	601–650
	Line	648	697	612
14. Southern Federal University	Ranking			601–650
	Line			626
15. Far Eastern Federal University	Ranking		601+	701+
	Line		612	723
16. N.I. Lobachevsky State University of Nizhny Novgorod	Ranking		601+	701+
	Line		646	740
17. Plekhanov Russian University of Economics	Ranking		601+	701+
	Line		623	747
18. Voronezh State University	Ranking			701+
	Line			832

From the data of the QS World University Ranking [5].

Table 3

Ranking indices by faculty

Faculty Area	Academic Reputation	Employer Reputation	Citations per Paper	H-index Citations
Arts & Humanities	60 %	20 %	10 %	10 %
Engineering & Technology	40 %	30 %	15 %	15 %
Life Sciences & Medicine	40 %	10 %	25 %	25 %
Natural Sciences	40 %	20 %	20 %	20 %
Social Sciences & Management	50 %	30 %	10 %	10 %

Table 4

Local ranking indices by faculty in 2013
(*QS World University Ranking by Faculty 2013*)

School Name	QS Rank	Rank by Faculty				
		Arts & Humanities	Life Sciences &ёMedicine	Social Sciences	Engineering & Technology	Natural Sciences
Massachusetts Institute of Technology (MIT)	1	18	6	7	1	2
Ecole normale supйrieure, Paris	28	109	0	0	136	74
Peking University	46	23	101	25	38	21
Technische Universitдt Мьnchen	53	0	83	246	17	15
University of Helsinki	69	46	55	75	186	82
Lomonosov Moscow State University	120	0	374	271	199	84
Saint-Petersburg State University	240	0	0	0	0	275

From the data of the QS World University Ranking [5].

It is visible achievements in these fields in an innovation economy that drive development, while publications in international scientific press strengthen the results obtained and provoke vivid feedback, which results in the intensive citing in these areas of activities. Thus, the combination of academic activities indices and scientific performance indices affects significantly the position of the university by 70–90 % in the ranking by faculty.

Only two universities represent Russia in these local rankings: Moscow State University and St. Petersburg State University. To make the picture complete, let us compare the local rankings of American, French, German, Finnish, and Chinese universities, which occupy the best positions among universities of their countries in the major ranking, and the indices of our leading universities (Tab. 4). In our table, the USA universities are represented by Massachusetts Institute of Technology (MIT), the absolute world leader according to QS. A French university with the highest position in the ranking is the Йcole normale supйrieure, the foremost technical university, whose prestige in France is even higher than that of the famous Sorbonne. One of the best German universities in the ranking is the Technische Universitдt Мьnchen, which specializes in exact sciences. Although several European universities have higher positions in the ranking, for our survey we have chosen the University of Helsinki because our universities have been actively collaborating with Finnish ones for quite a while and a large number of Russian students study in Finnish educational institutions and subsequently they even find interesting jobs in that country. Moreover, Finland occupies the second place by the education index.

Table 5

Performance of Universities by Faculty

School Name	Rank by Faculty				
	Arts & Humanities	Life Sciences & Medicine	Social Sciences	Engineering & Technology	Natural Sciences
Massachusetts Institute of Technology (MIT)	0,96	0,99	0,99	1,00	1,00
Ecole normale supйrieure, Paris	0,73	0,00	0,00	0,66	0,82
Peking University	0,95	0,75	0,94	0,91	0,95
Technische Universitдt Мьnchen	0,00	0,80	0,39	0,96	0,97
University of Helsinki	0,89	0,87	0,82	0,54	0,80
Lomonosov Moscow State University	0,00	0,07	0,33	0,51	0,79
Saint-Petersburg State University	0,00	0,00	0,00	0,00	0,32

According to the assessments of international experts, universities in the Asian region have been developing rapidly. We have taken Peking University as an example. It attracts attention because all its faculties and sciences have been developing harmoniously.

Tab. 4 shows a position of the university in the general ranking and the number of the line the university occupies in the local ranking. These data prove that even the best universities have different performance by various scientific faculties. Normalized coefficients are always more demonstrative for comparison. To assess performance by faculty, a *performance coefficient by faculty* (C_{per}) can be proposed:

$$C_{res} = \frac{N - (m-1)}{N}, \qquad (1)$$

where C_{per} – performance coefficient by faculty; N – number of universities in the local ranking; m – number of the line the university takes in the ranking.

After the formula, proposed by the authors, have been applied (1), coefficients are obtained which reflect the performance of universities by faculty (Tab. 5).

The data presented in Tab. 5 are much more convenient both for further analysis and their graphic interpretation (Diagram 1).

The leader of the QS ranking, Massachusetts Institute of Technology, is harmoniously developed in all faculties, its performance coefficient by faculty (C_{per}) is within the range of 0.96 to 1.00, which is also shown in its graphic representation. Both Peking University and the University of Helsinki strive for the same harmonization of their achievement. Peking University has C_{per} from 0.75 to 0.95. Having these high indices, it takes just the 46th position in the ranking, which shows how tough the competition between leading universities is. The University of Helsinki has the performance indices (C_{per}) within the limits of 0.54 to 0.89. Comprising all faculties, it keeps its position in the first hundred (69 position) among universities by the QS ranking.

Diagram 1 also shows two institutions whose achievements are concentrated in a limited range of faculties. These are the institutions which are primarily famous for their success in the field of exact sciences and technology – Ecole normale supйrieure, Paris, (28 position) and Technische Universitдt Мьnchen (53 position). Good ranking positions have been reached due to high performance by the chosen faculties.

Although Lomonosov Moscow State University is a multidisciplinary university, the diagram clearly shows that its performance coefficient changes within broad limits: from 0.07 by Life Sciences & Medicine to 0.74 by Natural sciences. It is, of course, an honor to occupy the 120th position in the ranking, but to become a world educational leader and to achieve harmonious development by all faculties, our best university will have to do big system-based work.

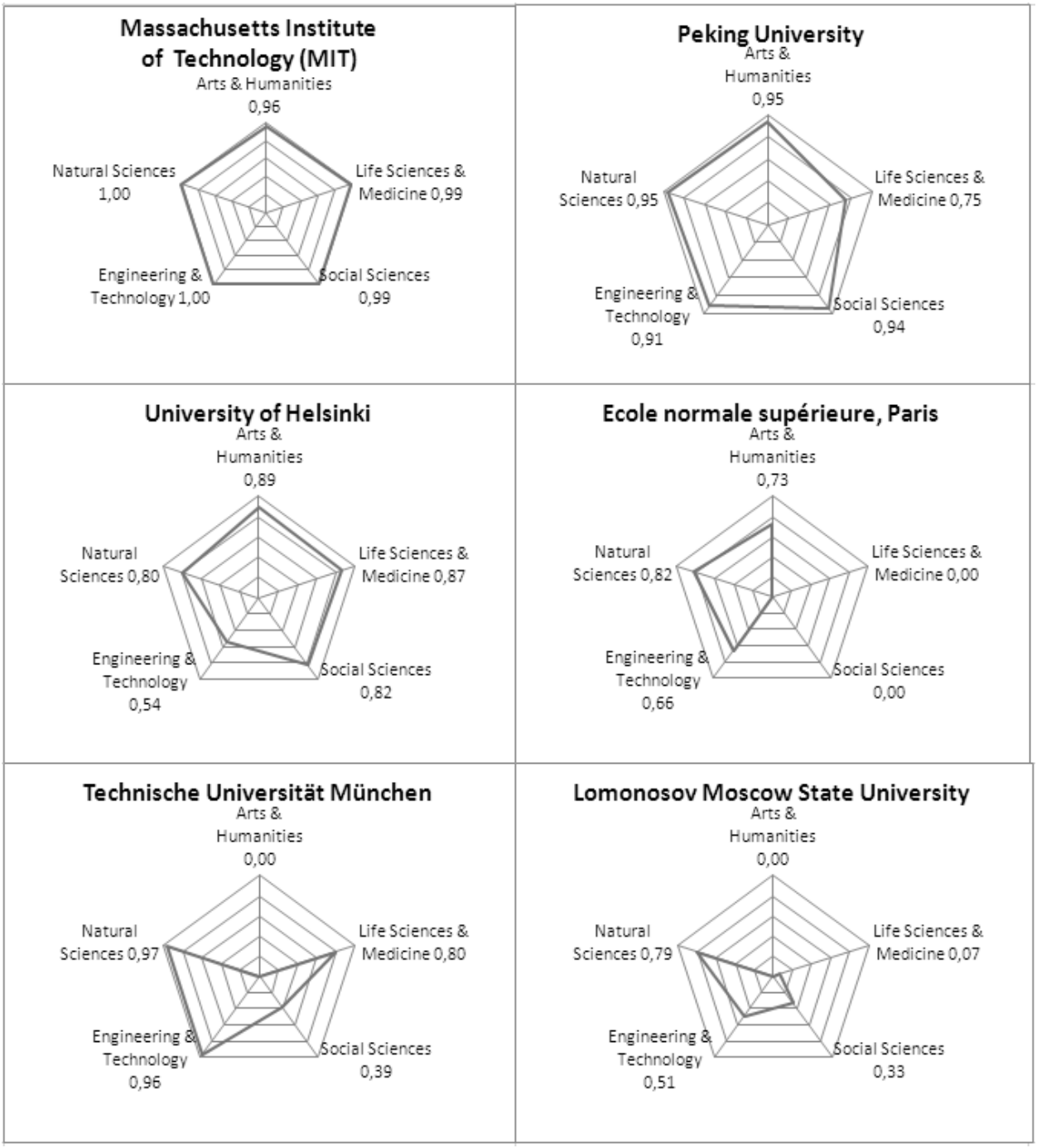

Diagram 1. University performance indices by faculty

The information available allowed *QS* not only to research the activities of universities by faculty, but also to present details by subject. However, local rankings by subject include only 200 best universities. The list of subjects used in the rankings is given in Tab. 6.

The words ‘subject’ and ‘discipline’ are often used as synonyms, but in the current table the notion ‘subject’ is aggregated and comprises a number of disciplines, that are normally covered by a whole faculty of a Russian university.

Table 6

List of subjects for ranking by subject (QS World University Rankings by Subject)

Number	Subject	Number	Subject
	Arts & Humanities		**Law and Legal Studies**
1	Philosophy	15	Economics & Econometrics
2	Modern Languages	16	Accounting & Finance
3	Geography	17	Communication & Media Studies
4	History and Archaeology	18	Education
5	Linguistics		**Engineering & Technology**
6	English Language & Literature	19	Computer Science & Information Systems
	Life Sciences & Medicine	20	Chemical Engineering
7	Medicine	21	CiviI & Structural Engineering
8	Biological Sciences	22	Electrical & Electronic Engineering
9	Psychology	23	Mechanical, Aeronautical & Manufacturing Engineering
10	Pharmacy & Pharmacology		**Natural Sciences**
11	Agriculture & Forestry	24	Physics & Astronomy
	Social Sciences	25	Mathematics
12	Statistics & Operational Research	26	Environmental Sciences
13	Sociology	27	Earth & Marine Sciences
14	Politics & International Studies	28	Chemistry
		29	Materials Sciences

From the data of the QS World University Ranking [5].

Classification by subject provides much more material for analysis and helps reveal advantages and drawbacks of scientific and educational activities of a university at large. Tab. 7 includes information about positions that the aforementioned universities occupy in local rankings by subject.

By using the aforementioned method, let us present the data from Tab. 7 in graphics (Diagram 2).

Diagram 2 clearly demonstrates that to be the first, one does not necessarily have to be the first in all areas. Even world education leaders show different performance in scientific and research work by individual subjects.

Let us look at the diagrams of Massachusetts Institute of Technology. The diagram by faculty has a form of a practically regular pentagon (by number of faculties) and the worse result, 0.96 (!) by the Arts & Humanities faculty. The diagram by subject demonstrate that MIT's performance by such subjects as Geography, Psychology, Pharmacy & Pharmacology, Agriculture & Forestry, Law and Legal Studies, Education is either rather low or absent. This implies that the university, even though it is a multidisciplinary one, has a clear strategy and is not trying to embrace unembracable, but focuses on the most promising fields and achieves perfect results on its way. These achievements not only cover <hollow> fields that we mention, but also ensure the first position of the university in the QS ranking.

Peking University, on the contrary, strives for the most complete harmonization of scientific and educational activities. The table and the diagram demonstrate good results by all subjects, excluding agrarian field, which is much less developed, chemical engineering and civil and structural engineering. Having determined its goal as to become the leader of the world development, China has been implementing this

Table 7

Indices of universities in rankings by subject in 2013

Subjects	Massachusetts Institute of Technology (MIT)	Ecole normale supйrieure, Paris	Peking University	Technische Universitдt Mьnchen	University of Helsinki	Lomonosov Moscow State University	Saint-Petersburg State University
Philosophy	6	35	17	–	90	–	–
Modern Languages	21	53	13	–	93	63	–
Geography	–	–	25	–	51	–	–
History and Archaeology	57	–	41	–	92	–	–
Linguistics	2	–	20	–	49	–	–
English Language & Literature	40	–	50	–	92	–	–
Medicine	15	–	64	67	48	–	–
Biological Sciences	2	153	45	67	88	–	–
Psychology	–	–	47	–	92	–	–
Pharmacy & Pharmacology	–	–	60	65	91	162	–
Agriculture & Forestry	–	–	–	41	93	–	–
Statistics & Operational Research	2	106	44	–	190	112	–
Sociology	35	–	64	–	90	–	–
Politics & International Studies	37	–	22	–	89	–	–
Law and Legal Studies	–	–	41	–	132	–	–
Economics & Econometrics	2	–	37	–	185	–	–
Accounting & Finance	5	–	35	–	–	–	–
Communication & Media Studies	12	–	64	–	43	–	–
Education	–	–	65	–	33	–	–
Computer Science & Information Systems	1	55	35	42	140	163	–
Chemical Engineering	1	–	–	39	–	–	–
CiviI & Structural Engineering	5	–	–	77	–	–	–
Electrical & Electronic Engineering	1	–	36	34	–	–	–
Mechanical, Aeronautical & Manufacturing Engineering	1	–	36	23	–	–	–
Physics & Astronomy	1	46	29	17	143	64	
Mathematics	2	50	35	79	145	42	168
Environmental Sciences	3	–	39	124	88	–	–
Earth & Marine Sciences	3	104	69	171	188	109	–
Chemistry	1	–	15	24	142	108	–
Materials Sciences	1	–	20	76	–	168	–

From the data of the QS World University Ranking [5].

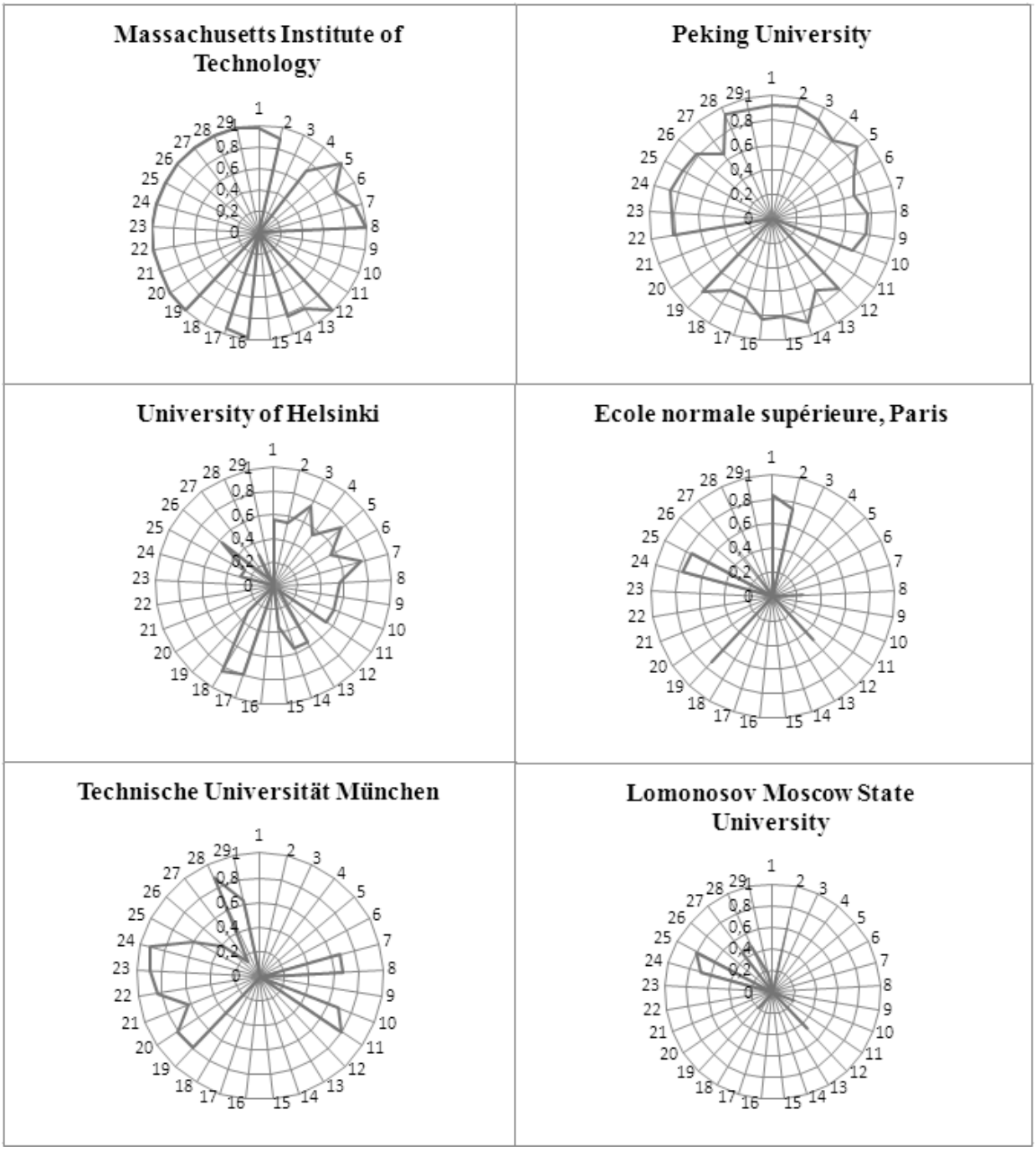

Diagram 2. Performance indices of universities by subject

scheme in all areas, including education. In 2013, the number of Chinese universities in the QS ranking is as high as 25. By this index China takes the 9th position out of more than 60 countries whose rankings are provided in the 2013 ranking.

It is reasonable to pay attention to the strategy of the University of Helsinki, which within the period of 2011–2013 moved from the 89th to the 69th position in the ranking. Its performance coefficient by subject never goes above 0.8 level, but since the university improves its achievements in many subjects, it was included into the 200 best universities in 23 subjects out of 29. Even though in local

ranking its position by some subjects is rearguard, this has not prevented the university from taking a stable position in the first hundred best universities of the world. There is one more specific feature of this university: it has achieved most considerable progress in Humanities, whereas it has failed to reach ranking positions in exact sciences.

Another strategy has been chosen by the Ecole normale supйrieure. Even though it is a multidisciplinary university, it unlocks its highest potential in a limited range of subjects, which include both science and arts.

The Technische Universitдt Mьnchen fully complies with its name. All scientific and educational activities here are focused on research and teaching in the field of engineering, technology, and computer science, as well as such highly important areas as natural sciences, biology and medicine.

When comparing these universities in the ranking and revealing their, as it would seem, 'one-dimensional' activity, we come to a conclusion that good indices in the ranking can be reached not only by multidisciplinary universities but also by specialized ones, which are highly efficient in their work by subjects. This is proved by a large number of scientific publications in peer-reviewed journals with high citation index. For example, so as to take the 28th position among the leading universities, the Ecole normale supérieure showed high results in only 8 subjects out of those 29 which are used to build rankings.

National Scale Problem is to Increase Russian Universities' Ranking

This analysis is designed to reveal the «secrets» of the best world universities' success and to help other educational institution, primarily Russian ones, develop a good strategy to mobilize efforts and increase their competitiveness, as well as to reach leading positions in the global education market.

Russian universities should strive for these ambitious goals, although their current positions and international prestige leave much to desire, which, of course, worry the executives of Russian education at all levels. Consequently, over the last decade our higher school has been permanently reformed. No doubt, change is necessary. But it is hard to stabilize academic work or improve it when regulations are constantly changing. In these turbulent circumstances only such a strong scientific and educational liner as Lomonosov Moscow State University, which took the 120th position in the 2013 ranking, keeps steady. This university is closest, comparing to all others, to reach the goal which the President has set, saying at least five Russian universities are to be included into the first hundred leading world universities according to the world university ranking by 2020' [1].

There is hope to implement the goals articulated by the President and the Chairman of the Government of the Russian Federation and catch up with the best universities in the world, maintain and strengthen wonderful traditions of national science and education.

A systematic approach towards problem-solving will allow leading universities of the country to advance steadily and to improve in all areas of scientific thought and educational process. On this way, universities will need badly national support, which implies more than funding. A complex scheme has to be developed and implemented to revive university science by using government contract system and by stimulating businesses so that they will come into agreements with universities and the latter can do actual science-driven research. The problem can be partially solved due to the grant system. But one should not forget that successful scientific work should not just end up in a handover act delivered to the customer or a completion report, but must be followed by publications in well-established scientific journals, including the ones in English. In our opinion, a paper in a peer-assessed foreign journal should become a must for grant giving (in case open publication of materials does not threaten national security). Only then the world scientific community will know about the achievements of Russian universities and relevant databases, used as a basis for international ranking of universities, will be updated, which will result in the growth of our scientists' personal status.

Moreover, universities will also have a large share of responsibility. Since fight for a position in the world rankings has not only competitive component, but also an economic one – in terms of state financial support, flow of foreign

students, an opportunity to establish higher tuition fees without fearing that this will result, in lowering demand for the university services among students. For example, studies in Massachusetts Institute of Technology cost 42.000–44.000 USD per year, whereas this figure for Lomonosov Moscow State University is 8.000–10.000 USD. Since the percentage of foreign students is a ranking indicator, it becomes an item of competition in the market of educational services. That is why some world universities charge foreign students much less than their own citizens.

Every Russian university needs a strategic scheme to advance in rankings. It has to contain:

– self-assessment of a university in order to reveal its strengths and weaknesses;

– using the item lists in Tab. 6, to evaluate which of these items approach the level of world education leaders;

– on the basis of the analysis conducted, to identify the most promising fields of scientific work;

– to elaborate measures to expand the area for scientific and research work, to create working groups including teaching staff, postgraduate students, and senior students;

– to create a special working group whose task will be to select papers for translation and publication;

– to publish selected papers in foreign peer-reviewed scientific journals, to contact publishers;

– to develop a system of incentives for those who publish their papers in well-established Russian and foreign titles.

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INNOVATIVE-EDUCATIONAL CLUSTER AS AN EFFECTIVE MECHANISM OF REGIONAL INNOVATION SYSTEM DEVELOPMENT

И.В. Скворцова, В.М. Макаров

ИННОВАЦИОННО-ОБРАЗОВАТЕЛЬНЫЙ КЛАСТЕР КАК ЭФФЕКТИВНЫЙ МЕХАНИЗМ РАЗВИТИЯ РЕГИОНАЛЬНОЙ ИННОВАЦИОННОЙ СИСТЕМЫ

The article is devoted to the problem of integration of science, production and education, the formation of a new approach to the development of innovative regional economy with the use of innovative-educational clusters, which will allow universities to become centers of the accumulation and dissemination of ideas, knowledge and technologies which can effectively influence the development of science and society as a whole.

INNOVATION INFRASTRUCTURE. INNOVATIVE-EDUCATIONAL CLUSTER. ORGANIZATIONAL STRUCTURE OF MANAGEMENT. THE PROJECT-ORIENTED UNIVERSITY. INNOVATIONS.

Статья посвящена проблеме интеграции науки, производства и образования, формированию нового подхода по развитию инновационной региональной экономики с применением инновационно-образовательных кластеров, что позволит вузам стать центрами накопления и расширения идей, знаний и технологий, способных эффективно влиять на развитие науки и общества в целом.

ИННОВАЦИОННАЯ ИНФРАСТРУКТУРА. ИННОВАЦИОННО-ОБРАЗОВАТЕЛЬНЫЙ КЛАСТЕР. ОРГАНИЗАЦИОННАЯ СТРУКТУРА УПРАВЛЕНИЯ. ПРОЕКТНО-ОРИЕНТИРОВОЧНЫЙ УНИВЕРСИТЕТ. ИННОВАЦИИ.

Education and science have an increasingly significant position in the development of modern society and become leading factors of getting competitive advantage of the country in the international arena.

The most important priority of the state innovation policy in Russia is the creation of effective innovation system supporting the development of innovative activities of higher education: improving the quality of specialists' training, developing research and technological base, stimulating universities' innovation activity.

The modern infrastructure of higher school combines fundamental science, retrieval and applied scientific-research activities, educational work as well as the processes of commercialization of the scientific results and the integration of university's educational and scientific potential in innovation within the economic system of the country.

At present, the higher school system of the Russian Federation hosts an innovative infrastructure which includes 163 technoparks; 185 business-incubators; 12 regional training centers in the field of innovative entrepreneurship; 22 regional information-analytical centers; 46 regional innovation centers; 118 innovative-technological centers; 122 technology transfer centers; 73 centers of collective use of unique scientific equipment and 46 science cities [8, 11]. But according to the Ministry of education and science of Russia, the higher education sector in the Russian Federation is represented by 1,115 higher education institutions. Thus the quantitative indicators of higher school innovation infrastructure mentioned above are not sufficiently high in comparison with the number of higher education institutions.

Most modern universities can be characterized by a low level of legal and economic support in the field of intellectual property, spontaneous nature of innovation activity and the lack of systematic approach to managing it.

Nowadays a serious problem in Russia is an inefficient use of resources in the field of education (the irrational structure of the issue) and science (low demand for knowledge in the market, the initiating character of R&D, a low

level of commercialization of innovations). There is disconnection of education, science, and business. Thus the innovative infrastructure of the higher school does not fully exploit its opportunities, which directly affects the results of innovation development both in the regions and in the whole country.

In recent years, the state has been paying more and more attention to the solution of this problem [3]. In the framework of the «The Strategy of the Development of Science and Innovation in the Russian Federation up to 2015» the Ministry of education and science plans the establishment of technological platforms as a mechanism which would unite representatives of business, science, and government interested in conducting long-term joint scientific-technical activities aimed at the implementation of the following actions:

– intensification of efforts to create prospective commercial technologies and new products (services);

– attraction of additional resources for research and development involving all stakeholders (business, science, state);

– improvement of the legal base in the field of scientific and technological innovation development [1].

One of the possible forms allowing active cooperation between science, business and society is ***an innovative-educational cluster (IEC)*** on the basis of higher school[3].

Based on the practice of a number of regional universities: Perm National Research Polytechnical University, Stavropol State Agrarian University, Tambov State Technical University, etc., clustering has established itself as an effective mechanism of integration of the results of higher school's innovation activities in the real sector of economy, universities' development as well as their positioning in Russian and international educational area [4].

An innovative-educational cluster is a multilateral treaty or associative union of educational institutions, enterprises of the real economy, scientific organizations with matching long-term aims of joint activities in the field of the development, implementation in manufacturing and commercialization of new technologies and new kinds of competitive products, professional training and improvement of staff skills in the interests of the participants of the cluster, the creation of joint infrastructure which supports innovation cycle of development and product manufacture, provision of necessary staff.

The objective of the IEC activities is an identification, a formation and an attraction of competitive resources (knowledge, human resources, equipment and technologies, intellectual property), the promotion of informational support for research and development, the creation of favorable conditions for the transformation of its results into competitive advantages of the region and the country[7].In pursuing these objectives the IEC addresses the following tasks:

1. Generation of innovative ideas and projects implementation in the field of natural sciences, engineering and arts, also interdisciplinary fields.

2. Promoting the creation of small innovation enterprises.

3. Formation of personnel reserve in university.

4. Strengthening international scientific cooperation.

5. Encouraging of requests for research and development from the business community [2, 12].

6. Transformation of knowledge, experience, and technology which universities possess into commercially successful product.

7. Increasing the competitiveness of businesses in the cluster.

8. Increasing the level of education in the region (not only of higher education but also of secondary and secondary vocational education).

The participants of the cluster are educational institutions (colleges, universities, advanced training institutes), commercial organizations (manufacturing and engineering, consulting and venture capital firms), innovative infrastructure of university (scientific-educational centers, technoparks, small innovative enterprises), as well as governmental and municipal authorities (Fig. 1). Business, in this case, is one of the customers of educational and research activities of universities [7].

The core of IEC is often formed by educational institutions which determine the competitiveness of enterprises. First of all, it concerns the development and implementation of new technologies, training and improvement of qualification of the personnel, consulting firms in various fields of activity, joint use of innovative infrastructure (technoparks, business incubators, centers for collective use of equipment, technologies transfer centers, etc.), accumulation and transmission of knowledge between companies in the cluster.

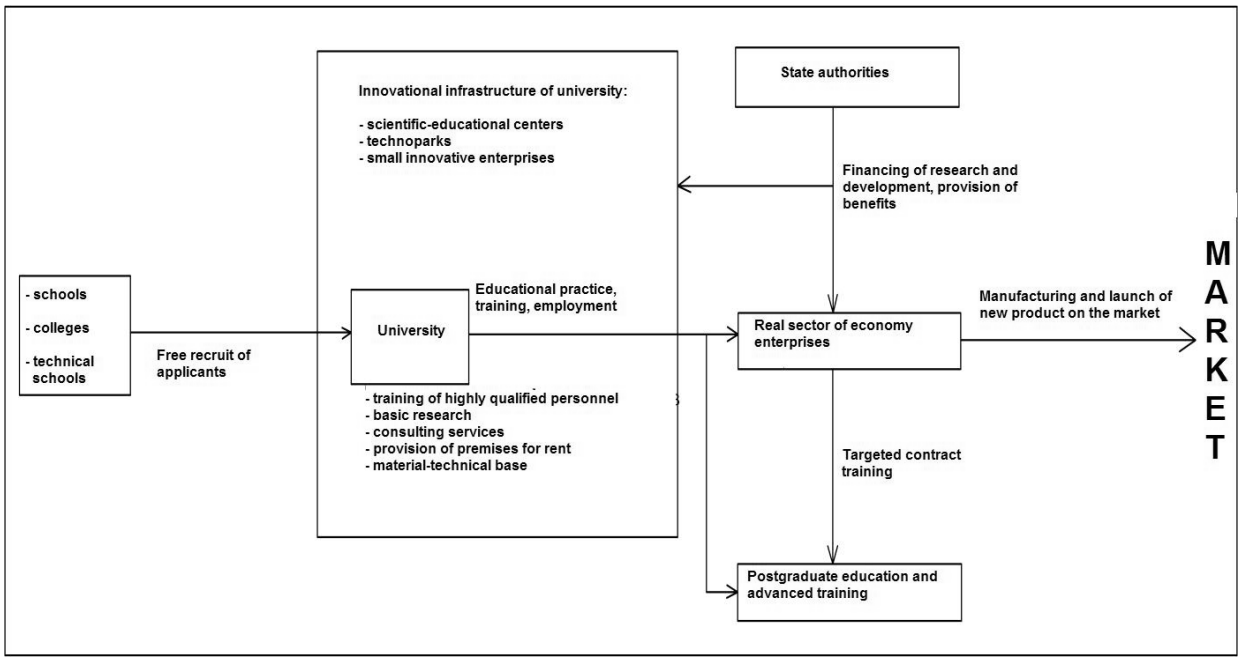

Fig. 1. Regional IEC model

By implementing these functions, educational institutions, in turn, will get access to the funding for research from private firms, will implement commercial educational programs for employees of companies in the cluster, improve educational programs in order to ensure their compliance with the current needs, organize students internship and training at the enterprises of the cluster, attract specialists and experts from the enterprises, participants of the cluster, to the educational process and also improve the qualification of university staff on the basis of the enterprises, participants of the cluster.

It is possible to say that the most effective system is the partnership in IEC of representatives of different levels of professional education, including interaction with the public schools. Schools and colleges are integrated into the system of continuing education and school leavers get access to higher education by signing agreements with universities about the enrollment without entrance examinations taking into account the level of their education [7].

One of the basic elements of the cluster is an innovative infrastructure of the university representing a network of interrelated and complementary elements of innovation activity, where there is a transfer of knowledge, innovational projects and their further commercialization. University ***scientific-educational centers (SEC)*** should be focused on the provision of advisory, educational and research services to the enterprises of the cluster. The material base of SEC should satisfy interests of not only universities, but also of private entrepreneurs, small and medium-sized businesses as well as the local authorities.

Technoparks are an important element of the IEC; they include a variety of specific functional areas: offices, research laboratories, industrial, storage and exhibition areas. The infrastructure of technoparks is diversified by nature and may include consulting, staffing, advertising agencies, investment, legal and insurance companies, real estate valuation agencies and audit agencies, etc.

The key factor in the effectiveness of IEC is the maximum convergence of educational and production purposes, the effective use of personnel, and the scientific-technical potential of the region [7]. And also:

– multidisciplinary approach to research and educational activities that is most obvious if polytechnic university becomes the core of the cluster;

– common goals of IEC entities and their compliance federal state and regional interests, which is typical mainly for large industrial centers such as Moscow, St. Petersburg and others;

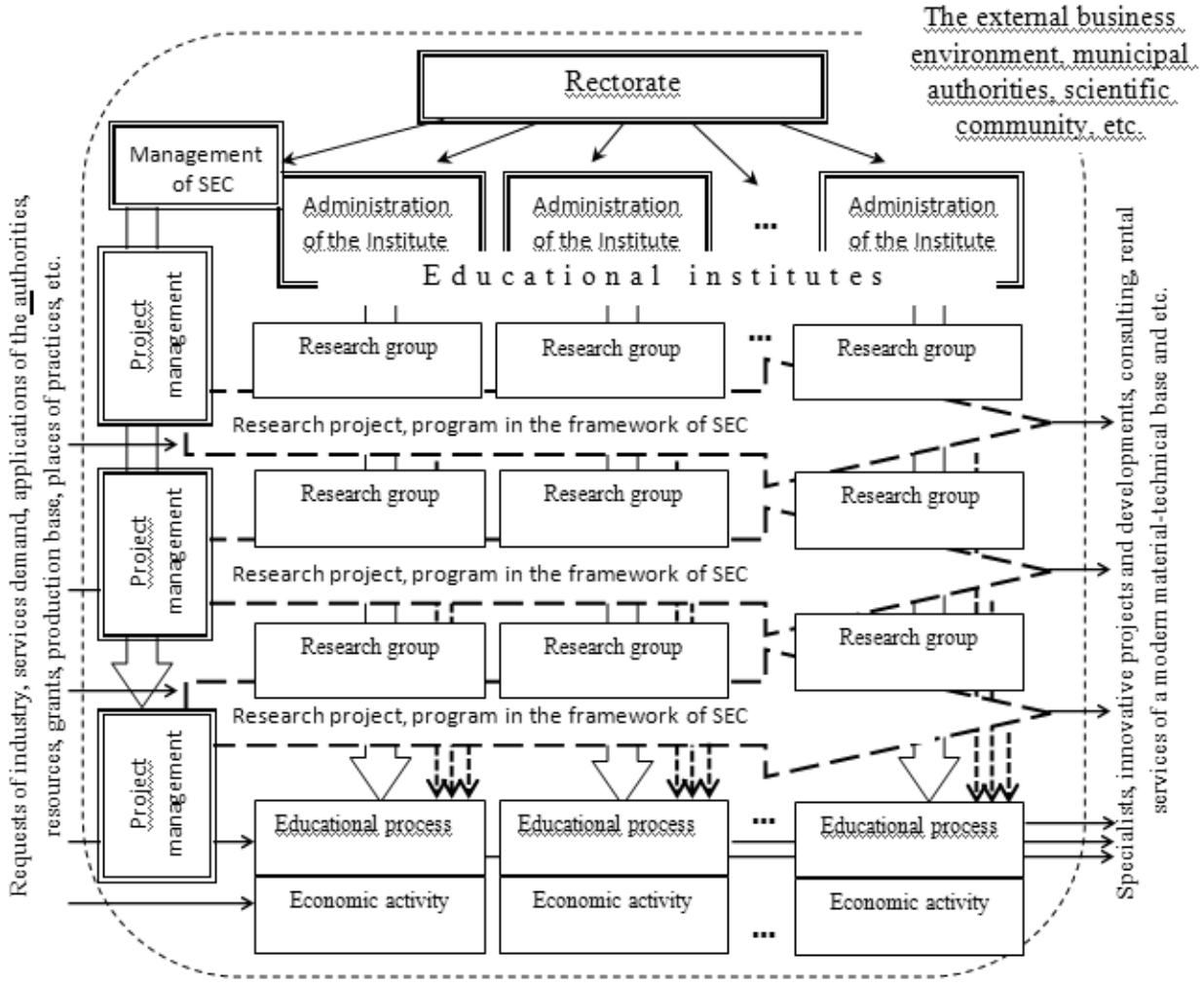

Fig. 2. An example of matrix organizational structure of university management

– territorial localization which allows to build IEC on the base of already existing or developing industrial and financial groups (in Saint-Petersburg, energy and power engineering is an example of the first kind of groups, and automobile manufacturing – of the second);

An effective system of intraclaster interaction provides a balance of its participants' interests and the emergence of an «effect of the system» or a synergetic effect [5].

For universities, the synergetic effect reveals itself in:

– increase in a university's rating;

– professional development of the faculty staff and graduates through their participation in the implementation of innovative R&D according to the order from the real economy sector;

– involvement of the most competent employees from the real economy sector in educational process, implementing joint projects with universities;

– application of the results of advanced R&D in the educational process;

– extension of the access to market information for universities and facilitation of products and services of the SEC promotion to the markets of financial and industrial groups;

– possibility of additional earnings for university faculty staff due to their participation in the scientific-technological development and consulting services;

– exploitation of the possibilities of attracting investments and grants for the SEC.

Almost all universities consider clusters as the most advanced form of strategic partnership with science, business, and authorities of the region. Many of them have experience in the implementation of the cluster approach and

cluster policy. But they lack methodological recommendations concerning the organization of this process. In fact, the process of IEC formation has to change the ***organizational structure of management*** of the university on the basis of the system approach principles.

The theory of systems states: the change of targets and strategy of organization development (including scientific and educational organizations) should be accompanied by its restructuring. The creation of SEC implies a change in the structure of the executive subsystem of the university. But the appropriate change of management subsystem must correspond with it.

The basis of the formation of new organizational structure of management is an idea of the ***project-oriented university***. Its realization requires the decentralization of the university management, which can be achieved, for example, through the transformation of faculties into institutes by transferring part of authority to the operational management. It will increase their autonomy, flexibility in decision-making, responsibility and will activate the «bottom-up initiatives».

In institutes, it is appropriate to establish a system of responsibility centers (departments, research laboratories, other divisions) which can focus on increasing the income (profit centers) or on the cost savings (cost centers) within the allocated budget. In terms of university's economy, this approach implements a concept of controlling and, in terms of management, it corresponds with the essence of the matrix model of university management (Fig. 2).

In this matrix model, the vertical control actions provided by institutions support educational and economic processes, and horizontal linkages are formed within the scientific-research programs and applied projects by various divisions, integrated into the SEC. The purpose of such complexity of the organizational structure is an improvement of management efficiency and profitability of operations of the IEC parent educational institution, as well as simplifying its integration into the external environment [7].

In the framework of the innovative economy, universities become centers of the accumulation and extended reproduction of ideas, knowledge and technologies, centers of the development of new intellectual technologies capable to influence education and science in the region and in the whole country.

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УСЛОВИЯ ПУБЛИКАЦИИ СТАТЕЙ

в журнале «Научно-технические ведомости Санкт-Петербургского государственного политехнического университета. Экономические науки»

ОБЩИЕ ПОЛОЖЕНИЯ

Журнал «Научно-технические ведомости Санкт-Петербургского государственного политехнического университета. Экономические науки» является периодическим печатным научным рецензируемым изданием. Зарегистрировано Федеральной службой по надзору в сфере информационных технологий и массовых коммуникаций (Роскомнадзор). Свидетельство о регистрации ПИ № ФС77-52146 от 11.12.2012 г. С 2008 года выпускается в составе сериального периодического издания «Научно-технические ведомости СПбГПУ» (ISSN 1994-2354).

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