
Russian Engineering Services Market: Theory and Practice of Modern High-Tech Business

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Abstract:

In the modern market economy, active use of scientific and technological progress, creation of high-tech products requires appropriate capacities and development of infrastructure, the presence of modern technology, advanced manufacturing, know-how and high-tech engineering services. The level of engineering services today defines and prerequisites improving the competitiveness of the national economy and an important competitive advantage for the government.

Despite the fairly good theoretical work on engineering services development, today there is no detailed methodological basis of management, formation and development of engineering in countries with emerging market economies. In this regard, in the study an attempt is made to synthesize the theory and practice of market development of engineering services on the example of the Russian Federation. This focuses on the development and market forecasting of engineering.

In a study a deep analysis of the theory and practice of development of Russian market of engineering services is made, the main trends and challenges of this market in close coordination with the global trends are identified, classification and segmentation of the global and Russian market of engineering services is carried out, the author's approach to the interpretation of "complex engineering services" is proposed, the reasonable forecast and recommendations for the development of the engineering market for the period up to 2022 is prepared.

Key Words: *Engineering, business services, engineering services market, factor analysis, process engineering.*

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1. Introduction

1.1 Introduction to the Problem

In the 21st century challenges in the field of high-tech business become more complicated, which causes the necessity of new approaches to solve them. Questions of industrial services and the provision of business services are actively solved at all the levels of the economy: federal, regional, organizational. The need for the development of engineering services is connected with the priority support for innovative development of regions, cities and individual companies that are the economic basis of wealth growth.

Engineering is one of the main sources of future economic growth of Russia. Currently, the market of engineering services serves as an important component of any developed economy. According to the Center for Strategic Research “North-West” and round table “On the development of engineering activities”, which was held on July 29, 2014 in the Chamber of Commerce of the Russian Federation, the world market of engineering services reaches 750 bln. USD, and by 2020 is projected to increase its twofold raise to 1.4 trillion USD. (Information and analytical portal on engineering, 2014). This is one of the most profitable “drivers” of the economy (Knyagin, 2013). Today, however, Russia does not take part in these processes: large companies of category “Engineering Services” are absent and engineering, based on attracting foreign capital is only 0.7%. The use of engineering resources, concentrated in profile companies designed to ensure the overcoming of economic barriers for the transition to a new technological structure of the economic system and to increase the effectiveness of the Russian economy.

Solutions for business-engineering development are the generator for not only economic but also technological development of the country. Creating favorable conditions for engineering activities, subsequent technical improvement of manufacturing and the use of innovations, development and implementation of promising projects in the field of engineering is an important task of the authorities at all levels. It actualizes the need to solve problems of the operational development of the Russian market of engineering services and promoting the activities of engineering companies.

1.2 Importance of the Problem

Active development of scientific and technological progress and some sectors of the modern economy caused a number of technological transformations. The general trend is the complication of technologies, especially in their stage (elongation of the production chain) and network expansion (increasing the field of subordination factor). At the same time the use of new technology is not only limited to niche of material production (Yakunin, Bagdasaryan, Sulakshin, 2009). According to the Russian Ministry of Economic Development the most important quantitative indicator of leadership and innovation in Russia in 2020 is a significant proportion of activity in the markets of high-tech and intellectual services (10.5%) for 5-7

positions by the doubling of the share of the high-tech sector in GDP (from 10.9 to 17-20%), an increase of five to six times the share of innovative products in the production industry, four or five times - the share of innovative active companies (from 9.4% up to 40-50%) (Ministry of Economic Development, 2010).

Over the period from January to September, 2014 according to the Central Bank of the Russian Federation (2015) export of services declined marginally to 50.2 bln. USD (51.5 bln. USD in 2013). At the same time import of services also decreased to 94.4 bln. USD (95.4 bln. USD in 2013) (Gokhberg, 2011). This fact is a positive trend in the development of the national market where engineering services sector has currently a significant growth potential.

Therefore, the problem requires additional study, which will be focused on assessment of the engineering market structure, applied tools and will allow identifying the key points of market growth, and factors influencing the market development barriers.

1.3 Background/Review of Literature

Theoretical and methodological approaches to the study of the business services market are represented in the works of Solovyov (2006), Voskolovich (2007), Moiseeva, Kostina, Konysheva, Korotkova, Piskunova, Pankratova, Maljutina, Romanova (2006), Evans, Berman (1987), Morozova (2000), Ivasenko, Nikonova, Sizova (2009) Morozova, Grishina (2010), etc.

Identification and systematization of categorical instrument of engineering problems, issues of engineering services classification, construction of structures and the development of a mechanism for implementing the engineering services are represented in works of Rapoport, Skubchenko (2001), Chernovaya, Kibalko (2013), Knyaginina (2013), Maslova, Bozhuk, Kovalik (2006), Voskolovich (2007), Abramova (1991), Osipova, Sinyaeva (2001), Kovalev (2002), Morozov (2000), Bogaldin-Malykh (2010), Lambin, Chumpitaz, Schuiling (2007), Carbone and Haeckel (1994), Boone, Kurtz (2012), Blockley (2012), Lilien, Rangaswamy (1998), etc.

The modern conditions of development of the services of technological engineering sector caused by the intensification of project growth for creation of new high-tech industries, helped to raise the attention of scientists and practitioners to this issue. Studies in the field of process engineering and peculiarities of its organization were conducted by Gitelman, Ratnikov (2013), Knyaginina (2013), Mazur, Shapiro (2009), Shapiro, Bonona (1983), Shapiro, Jackson (1978), Gorodetskiy, Zharnitskiy, Tulupov (2014) and others.

Research methods of internal and external factors affecting the development of the services market are considered in the works of such scientists as: Assael (1990), Kabushkin (2009), Kotler P., Keller K. (2011), Lambin, Chumpitaz., Schuiling

(2007) , Porter (1998), Boone, Kurtz (2012), Maslova, Bozhuk, Kovalik (2006), Solovyov (2006) and others.

Consideration of works in the field of assessment of the condition and structure of the market of engineering services allows making a conclusion about deep enough degree of studying the categorical instrument and key attributes of engineering classification. At the same time, the use of existing theories in the practical study is difficult because of their fragmentation, inadequate accounting of the dynamic factors of the market development of engineering services in the transformation of the technological structure of the Russian economy.

1.4. Hypotheses and Research Design

Empirical studies show that the process of redistribution of material and financial resources and workforce in favor of sectoral separation of services is stipulated by two basic reasons. Firstly, emerged and rapidly developing areas of intellectual services (engineering, consulting, design, and others.). Secondly, on the accumulation of competencies, these trends began to act as a generator of new individual types of business services. This fact may indicate the emergence of a separate market of specific services in today's economy, having sufficiently clear boundaries, the laws of existence and development.

Taking into account the fragmentation of the theoretical basis of study on engineering services and the need to identify basic trends of classification of its development, it is necessary not only to create a comprehensive classification system, but also to identify the main trends of formation of engineering services market in Russia. The identification of the key factors determining growth vectors of analyzed market and barriers to ongoing development of the high-tech sector is particularly important.

The study is aimed at solving the following issues:

- systematization of the categorical instrument used in the description and identification of the main trends of the market development of engineering services in the economy which is at the stage of transition to a new technological order
- determination of key features of the classification of engineering, in particular the establishment of process classification
- building a structure and development of the mechanism for the implementation of engineering services in the conditions of dynamically developing industries-recipients of the engineering.

It's worth noting that the accelerated development of business services and service in general is a long-term trend of increase in the share of intangible factors in economic growth. Securing such a reasonable status of the perspective for business services market will attract to this area special attention of a wide range of different business subjects and, potentially, will form a new “growing-points” in high-tech sectors of

the economy.

2. Method

The application of the content analysis was caused by significant stratification and fragmentation of scientific approaches to the definition of engineering. Content analysis in the retrospective aspect allowed structuring the complex concept of service and highlighting key features of engineering from the perspective of its consideration in the context of business services. Systematization of secondary sources of information reflecting the results of study in the subject area, allowed identifying the common features of the concepts that characterize the engineering. It is technological, industrial character of the definition as a business service.

The application of the method of content analysis allowed the author to formulate a definition of engineering. In our opinion, in a generalized sense the term “engineering” can be described as the provision of engineering, consulting, technical, technological and economic support to the project and practical work on a commercial basis.

Extension of theoretical ideas about the structure of engineering allowed determining its main types and forming an idea of the complex engineering services. To ensure the required quality of the study the factor analysis was used. When analyzing the trends of development of the Russian market of business and industrial services the correlated variables were combined into factors, resulting in redistribution of the dispersion between the components, and the simplest visual structure of factors appeared. This procedure also made it possible to identify latent variables which is especially important in the analysis of the market of business and industrial services.

The main result of the factor analysis was the allocation from the entire set of variables affecting the development of the business services market only a small number of latent independent groups (such as the diversification of companies, the growth of computer-aided manufacturing and market and industrial services, etc.), in which the variables are linked stronger than the variables belonging to different groups.

Using predictive extrapolation based on analysis of the dynamics of the process engineering market development in the retrospective period allowed making a long-term forecast of the market until 2022. This method allowed describing a function that characterized the movement of the market of process engineering and to link data on the dynamics of the market with analysis of the logic of its development.

To describe the dynamics of the process engineering market development procedures were used, approximating the actual time values to the trend by approximation, which is a logarithmic averaging of time-series.

One of the main methods used in the preparation of the study was the method of segmentation. Its use allowed making a comprehensive and thorough analysis of the structure of the world and Russian market of engineering services; classifying the market of business and engineering services; identifying areas for development of engineering services in Russia.

During the segmentation the basic rules and principles of segmentation were observed: the difference between the segments, the segments values, measurability and other segments.

3. Results and Discussion

3.1. Engineering Services Classification

Despite the high growth rate of the services market as a whole, according to scientists of Hofstra University in Hempstead J. Evans and B. Berman, the data on services is often underestimated (Evans, Berman, 1987). In addition to the basic indicators of the development of the service sector the hidden sector related to maintenance, installation, training, consulting, repair and other similar types of work provided by the individual companies of industrial services, is not taken into account.

The influence of the services on the scope of commodity turnover is increasing, especially on the scope of technically complicated products (Pankratov, 2007). Therefore, the classification of the service market is an important issue in all the areas (Pankratov, 2007), (Morozov, Grishina, 2010). This allowed determining the precise boundaries of the service market in the field of engineering. Otherwise it's difficult to assess the potential of a particular market segment properly and, as a consequence, it is difficult to take management decisions. Growing competition among service providers, improvement of the welfare of the population and the investment attractiveness of the business, growth of complicated technical and high-tech products that require specialized care, are major causes of the dynamic development of the service market. These factors lead to rapid growth in the last decade in the business service sector.

As promising trends of the industrial sector of the economy, causing the potential of the Russian market of business and industrial services, today scientists highlight various trends (Pankrukhin, 2007), (Avanesova, 2005), (Semenov, Vasilieva, 2012), (Maykova, Okunev, Maslennikova, 2014) represented on Figure 1.

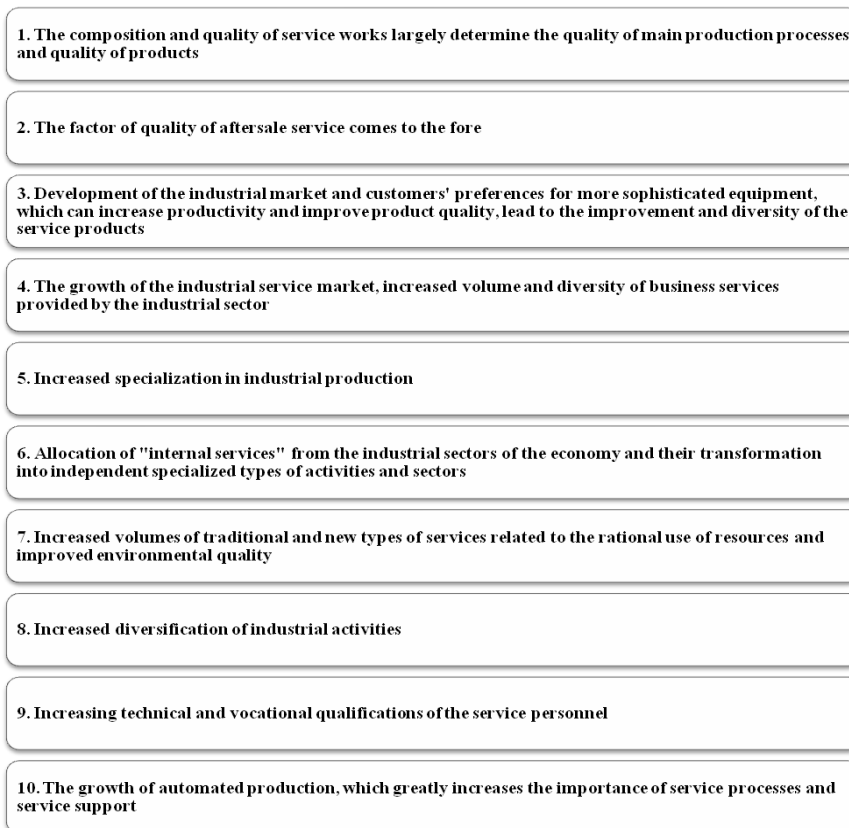


Figure 1. Trends in the Russian market of business and industrial services

- In this connection, business services, as part of an economic complex, are involved in the system of economic relations, and are subordinated to the general economic laws. A particularly important role of services in the economy causes the following factors:
- high profitability (liquidity) of services that are generally consumed at the time of their production;
- relatively low consumption of materials (including intangible services), which increases their added value and, therefore, the national income;
- relatively short time of receiving the payment for services.

The effect of different trends in the service sector caused by overall dynamics of the gross domestic product, changes in demand for industrial products and capital goods, employment and income of the population, as well as a number of other important macro and micro economic factors.

In Voskolovich's opinion these factors gradually lead to the fact that the role of the service sector in economic development becomes more significant (Voskolovich,

2007). With the growth of the business services its reverse impact on the structure of the national economy, the deepening of specialization, better use of resources is enhanced. The cumulative effect of many factors in the development of services allows creating and obtaining a multiplier effect on the other sectors of the economy and spheres of life, shown in deepening the intersectoral and interfirm ties, strengthening the integration between them.

Therefore, services are the priority area of modern business innovation-oriented economy. Business services are services for maintenance, equipment repair, consulting, implementation and other services (Pankrukhin, 2007). The main consumers of business services are a large majority of industrial enterprises, which are able to get competent solution that they could not find on their own, or it is not financially beneficial in terms of the costs to be taken if such structures were in the structure of the company. Important arguments in this case are: the existence of a license, accreditation, any other forms of confirmation of the competence and professionalism of the executive company, providing business services. On this basis, Razumovskaya, besides the traditional characteristics of intangibility, elusiveness, perishability, heterogeneity, variability and continuity of production and consumption, identifies three main components specifying to the service in different combinations and determining its essence (Razumovskaya, 2009):

- 1) Individualization (the service is a unique product that exceeds its value compared with the importance of a standardized product).
- 2) Modification of options (presents in the services that the client cannot provide on his\her own, because they are associated with any additional resources and execution of the services will not be possible while maintaining quality without specialized personnel or certain production facilities, the acquisition of which will be useless for the company). There are no market alternatives for such service.
- 3) Time (presents in the services that the customer may provide for him/herself on his/her own but does not consider it necessary for some reason, usually due to lack of time).

Components that reveal the essence of business services do not exist in isolation from each other, which creates the unique features of services. In connection with this, the essence of providing the services is that the service is considered as a modification of a set of components features, which is its primary value, compared to manufactured goods. At the same time different business services have products mainly in the industrial market.

Solovyov, characterizing features of products for industrial purposes, allocates engineering services as one of the characteristics of an industrial product (Solovyov, 2006). A well-known expert in the field of industrial marketing Webster (Webster, F., 1995) and management consultant Ames (Ames B. Charles, July-August, 1970), as the main differentiating factor, noted especially large dependence between efficiency of engineering, together with manufacturing processes, inventory

management, research, development, engineering development, and other business functions and strategic planning throughout the industrial company. Scientists recognize this high degree of functional interdependence of the company as the main distinguishing feature of the industrial market, because in an industrial company changes in corporate strategy entail the need for new investment commitments, changes in research and development activities, non- Traditional methods for engineering and manufacturing (Ames, 1970), (Ames, 1968), (Monis, 1988), (Corey, 1976). In addition, considering the current trends of the Russian industrial market Pankrukhin also highlights a shift in emphasis of industrial buyer from the purchase of certain types of high-tech equipment to the complex supply of production lines, upgrade of the industrial range in the direction of design of industrial sectors in conjunction with the whole technological cycle and engineering services (Pankrukhin, 2007). In this regard, engineering services, acting as one of the links of the functional interdependence on the industrial enterprise, at present, play an especially important role in its activities, because the quality of their provision may affect the activities of industrial companies in general.

According to a number of leading scientists in the field of economics, management and marketing, engineering belongs to the category of market of business, high-tech services, as well as services in the industrial service activities. Scientific views on the concept of engineering, from the position of its consideration in the context of business services, are presented in the Table 1.

Table 1. Scientific views on the concept of engineering as a category of business services

Author of “engineering” as a category of business services	Definition of “engineering” as a category of business services
Solovyov (2006)	High-tech business services
Voskolovich(2007)	Engineering and technological business services
Moiseeva, Kostina, Konysheva, Korotkova, Piskunova, Pankratova, Malyutina, Romanova (2006)	Industrial services
Evans , Berman (1987)	Business services in the industry
Morozov (2000)	Technical and technological services
Ivasenko, Nikonova, Sizova (2009)	Scientific and technical services
Morozov i Grishina (2010)	Professional services

Presented in Table 1 definitions of engineering from the position of business services, given by the Russian and foreign scientists have some differences in the views on them. The common features of these concepts that characterize engineering are technological, industrial character of this definition as a business service.

Categorical analysis of the concept of engineering has more than 500 definitions for different types of engineering (Table 2).

Table 2. Scientific views on the definition of engineering

Author of the definition	Definition
Maslova, Bozhuk, Kovalik (2006)	The set of intellectual aspects of attaining the best results from capital investments or other costs associated with the implementation of various projects: research, design and construction, industrial, etc.
Voskolovich (2007)	Variety of professional counseling in the technical area by engineering consulting and related services
Abramova (1991)	Services on the creation of infrastructure facilities, including a complex of works on preliminary studies, development of feasibility studies, etc. Marketing of the whole complex of services for the construction of the object, as well as the organization of sales, including: engineering design, engineering, construction management, training, commissioning, maintenance and other services. It can be a separate product.
Osipova, Sinyaeva (2001)	Business of rendering the services for customers in the construction of industrial and social facilities, including recommendations for the selection of the optimal variant of construction, the development of the construction project, equipment delivery, machinery, tools, construction of "turnkey" objects, its operation and implementation of effective technology solutions. This is the execution of the set of operations to provide industrial, commercial and technical services, provided by engineering and consulting, industrial, construction and commercial organizations.
Rapoport, Skubchenko (2001)	Complex of commercial services for the preparation and maintenance of the process of manufacturing and sales, maintenance and operation of industrial, infrastructure and other facilities, which can include both individual components and the whole set of services: the choice of technology, the development of design documentation, development of investment project, purchase and installation of equipment, carrying out commissioning works, etc.
Kovalev (2002)	Consultations in the field of new technologies
Morozov (2000)	One of the main forms of commercial information transfer

In this regard, in spite of the common commercial nature and character of engineering services, the interpretations of the engineering, presented in Table 2, are defined by scientists in different ways, from the perspective of broad and narrow approaches. So, Abramova represents engineering from complex position, noting

that the marketing of industrial facilities should have technology options in company's portfolio, technical innovations, patents, know-how, that together with engineering can act as an independent product in the markets. On this basis, it should be noted that not coincidentally, the service industry is considered by scientists as a prime example of integrated marketing (Sinyaeva, 2009). The basis of this concept is the fact that companies need to use and keep the integration of all of its activities on the basis of detailed market research and integrated approach to management of the entire business. Other scientists, on the contrary, interpret engineering from narrower position (form of commercial information or advice transfer in the field of new technologies).

In the opinion of Gitelman and Ratnikov the purpose of engineering is model's designing and the creation of an object, the most appropriate for this model, but taking into account the real parameters of the whole chain: ideally from the investment plan and start of designing to completion of the life cycle of this object. The functions of modern engineering is the development and practical implementation of technical and technological, organizational, financial and economic models of technical objects corresponding to the characteristics set by customers (investors) (Gitelman, Ratnikov 2013).

In our opinion, in a generalized sense, the term engineering can be described as the provision of engineering, consulting, technical, technological and economic support of the project and practical work on a commercial basis.

3.2. Engineering Structure

The structure of engineering works is quite diverse and can be divided into economic and consulting work related to engineering and technical consulting on the development of plans for the development of industries, businesses and designing of industrial and other facilities, as well as engineering work on the implementation of the developed plans and projects such as construction of the project, supply of equipment, its installation and commissioning, training of the necessary personnel. Basic operations to provide engineering services by utility companies include:

- market research about the order placement;
- conclusion of a contract to perform engineering services;
- obtaining financial resources in the loan company;
- feasibility study of the project;
- development of technological projects;
- monitoring the progress of work;
- customer personnel training and start-up process;
- provision of services on technological support of the project;
- improvement of the management of the project.

The structure of the market of engineering services has the following segments:

- construction or general engineering, covering pre-design work, engineering, supply of equipment, installation, assembly and the accompanying

engineering.

- consulting engineering, including work-related engineering and technical consulting, designing the objects, development of construction plans and monitoring its implementation; this type of engineering does not involve the supply of equipment, implementation of construction activities, technology transfer or licensing;
- process engineering, involving the provision of technological information necessary for the creation and implementation in industrial production and construction of the object and its operation, research and development of new products and services, production planning, purchase of new technologies and equipment related to technological innovation and other pre-production for the manufacturing of new products and new services (including marketing research, education and training).

In addition, Gitelman and Ratnikov within engineering as a specific business area allocated mainly two main types: construction and operational. Currently building engineering associated with the business process in the framework of investment projects is the most used and its functions are spread on the investment decision to the commissioning inclusive. Industrial engineering is the activities for technical support of production facility during its life cycle, providing the adjustment parameters of the original model of the object for specific operating conditions and under changing target plans of owners (or management).

In addition to construction, operational, advisory, technological and complex engineering, at this moment, other types of engineering may be noted:

- parallel (simultaneous) engineering, assuming a parallel work on design modules using simultaneous commands (Bogaldin-Malykh, 2010);
- marketing engineering, combining software applications, concepts and analytical techniques to facilitate the adoption of marketing solutions (Lambin, Chumpitaz, Schuiling, 2007), (Lilien, Rangaswamy, 1998);
- engineering of buyers' experience, which includes a number of concepts for the "materialization of intangible", which has a special significance for service companies and the services they provide. The company should have a clear idea of what the perception of reality and the knowledge it plans to form in the client's mind and to develop a set of operational and contextual reinforcements for these impressions (Kotler, Keller, 2011), (Carbone and Haeckel, 2012);
- reengineering, involving redesign of business processes in the company in order to achieve increase in efficiency of the whole company;
- environmental engineering, involves making decisions on highly specialized range of services that require sophisticated analysis and lengthy negotiations, in the nature similar to those that occur in the procurement systems and fixed facilities (Boone, Kurtz, 2012);
- energy engineering.

At present, energy saving and efficiency are priorities for development of the Russian economy. In this connection special importance is given to the development of high-tech companies and innovative businesses in energy saving and energy efficiency, support and stimulation of strategic initiatives related to the implementation of major energy projects (Neretina, Korokoshko 2014). Engineering, alongside with energy audits, is also one of the types of markets of energy services, which can be considered as a promising business, consisting in a specialized service of the individual units of energy saving.

3.3. The Interpretation of Complex Engineering Services

Modern transactions systems are increasingly linked to international relations and international exchange of products and services (Bagiev, Tarasevich, Ann, 2006). In this regard, separate consideration from the perspective of engineering services in international markets should be noted. Mazilkina notes that trade of engineering services is an additional mean of increasing the competitiveness of products; it is a necessary condition for its promotion and is one of the modern forms of international trade (Mazilkina, 2012). Osipova, Sinyayeva (2001) consider engineering as an independent type of international commercial transactions, which involves the rendering on the basis of a contract by one party, called the consultant, to the other party, called the client, complex or certain types of engineering and technical services related to project design, construction and putting into operation, development of new technological processes at the customer facilities, improvement of existing production processes through to its implementation.

It should be noted that the most effective and promising form generated internationally, primarily in the field of civil engineering, is an integrated engineering, including numerous different operations performed or provided by a specialized engineering company (research and development, organization of financing, design, supply of equipment and materials, management of construction and installation work, commissioning of industrial facility). Turnkey commissioning of an industrial facility, as a form of engineering works, is particularly promising.

Engineering turnkey services are actually the highest level of organization of engineering activities. It is a single system of financial responsibility for the project as a whole, allowing minimizing the implementation time and effectively stimulating contractual terms compliance. Here the process of work designing and implementing go hand in hand. As a result of this alignment becomes possible to timely detect shortcomings of the project, quickly eliminate them and constantly adjust the project during its implementation.

Engineering turnkey contracts suggest that the general contractors often do not have their own power, their task is to manage all the stages of the investment process, including service during the period of post-warranty service. Turnkey contracts may provide a scheme whereby after transfer to the customer the facility the prolongation of the contract is made with the transfer of management and production experience

(management contract or license agreement for know-how). These contracts are particularly complex, they have elements of operational engineering (Gitelman, Ratnikov, 2013).

In international practice two kinds of turnkey contracts in the field of engineering are distinguished: EPC (engineering-procurement-construction) and EPCM (engineering-procurement-construction-management). The difference between EPC and EPCM contracts is a traditional performance of relevant works (operations, processes), as well as additional data management work. It should be noted that when using both forms of contract there is only one contractor to be selected on a competitive basis and he/she has overall responsibility for the commissioning in accordance with the terms of the contract. Depending on the type of contract the main contractor can invite subcontracting companies to perform certain types of work, partly or in full scope.

Complex project management, provided in EPCM contract type, meaning that the contractor, first, offers its own (innovative and best) technical, technological, organizational and commercial decisions, taking risks and financial responsibility to the customer from the moment of design to the commissioning of the facility; secondly, determine the number of suppliers and contractors; thirdly, coordinates all work and monitors subcontracting. EPC contract with turnkey is used for those projects which provide licensed, proven technologies and standard design and construction solutions with predominantly fast terms of project implementation in connection with parallel design and construction work, when to begin construction does not require the full completion of the design (just 25%) (Gitelman, Ratnikov 2013). Option EPC requires an experienced contractor with the practice of the integration of different activities in a single project and is able to reliably estimate their costs and extent of risks.

In this regard, the main advantage of EPCM and EPC engineering contracts is the ability of the customer to place all executive and financial responsibility for all phases of the project on one engineering company - the general contractor. Use of EPCM and EPC contracts has a positive effect on the experience of the engineering company, as well as on its corporate image. Their use is much more profitable than contracts on which companies are hired for certain types of work as a subcontractor (the amount of compensation can be up to 15% of project cost). But for the development of these contracts engineering company must have competence in turnkey construction of facilities, have trained qualified personnel, have the necessary financial resources (to cover the risks) and positive reputation (Gitelman, Ratnikov 2013).

3.4. Trends in the Russian Market of Engineering Services

Currently, as a result of the restructuring of service companies, in Russia share of engineering services has become more prominent (Osipova, Sinyaeva, 2001). The initial stage of development of the engineering services market was in the 1980s,

when the innovation policy of large organizations started shifting its direction to R&D and production (Morozov, 2000). These changes were reflected primarily in an effort of industrial companies to increase in the range of products the share of new high-tech and innovative products and the subsequent sale of which led to an expansion of related technical services, including engineering. In the early 2000s, due to the strong recovery of the construction industry, the market for engineering services had strong demand, however, there were almost no Russian companies which would be able to perform high-quality work to deliver them (Chernova, Kibalko 2013). The market of engineering services was given to foreign representatives of high-tech and complex business. Currently, Russia has still untapped potential for development of the global market of engineering services (Table 3).

Table 3. The potential of Russia's participation in the global market of engineering services (Knyaginina, 2013)

Parameter of engineering services market development	Current situation of Russian engineering companies	The growth potential of the market of engineering services for 5-7 years, with active support
<i>The share in the world market of engineering services</i>	Lower than 1%	Potential to enter the most high-tech segments
<i>The number of major engineering companies in the world rankings</i>	None	The potential of several large companies in the energy sector
<i>World-class engineering competence centers</i>	None	5-7 centers
<i>Professional forums, communities and associations of international level</i>	None	1-2 professional world-class forums for high-tech engineering per year
<i>The number of specialized engineering schools belonging to the world rankings</i>	None	Higher engineering school with master's programs in the field of design engineering, included in ratings

In this regard, significant growth prospects of engineering services in Russia, characterized by the following directions, remain unresolved:

- Integration of own production chains and entering into third-party supply chain through engineering that becomes part of the management company.
- Due to intensive design automation engineering is largely represents a digital modeling of technological designs and processes. This allows not only accelerating the design, but increasing the use of processes, and also getting to the design, the growth of the outsourcing at engineering services

- market.
- Increased differentiation of functions of engineering and engineering services market, growing of the complexity of outsourced services.
 - Changes in design methodology, the construction of a new engineering platform on the basis of engineering systems, engineering systems based on MBSE (Model-Based System Engineering) models.
 - Engineering education has become a key area of technological development, stimulating factor of which is the development of government programs to support this direction of training.
 - Up to now, the predominant form of Russian engineering centers has been internal divisions, but the differentiation of the market will continue to grow, so appearance of engineering centers working in different sectors and different geographic markets on international standards of design is crucial.
 - In national practice activity in the development of infrastructure to support engineering is low: poorly developed specialized centers of design and programming; clusters focused not only on optimizing process flows, but also on exchange of technological competence; special organizations responsible for the development of engineering.
 - In Russia, the old model of supply dominates, for which cooperation in the field of engineering is insignificant.
 - The basis of modern business in the field of engineering is a flexible engineering design team. In the Russian practice, training for engineering specialists is carried out by industries, which does not form multitechnical competence of experts.

Comparative assessment of the condition of the national innovation systems of Russia and leading foreign countries, conducted by the National Research University Higher School of Economics (Gokhberg, 2011), in the framework of preparation of the Russian innovation index showed significant potential of engineering in the structure of export and import of Russian technologies. The percentage of receipts and payments on the export and import of engineering by categories of agreements are 66.5% and 54.3%, respectively, that represents the highest result in the total export and import of technologies of the Russian Federation.

In Russia, as factors that play positive role in the development of innovation infrastructure in general, and engineering, in particular, the creation of associations and unions, such as the Association of scientific technological parks and business incubators, the Association to support small innovative companies, technological centers and technopolises, the Union of innovative companies, Innovation Union of the Russian Federation, the Union of independent engineering organizations, and others can be mentioned. (Abrameshin, Voronina, Molchanova, Tikhonova, Shlenov, 2001).

3.5. Study of the Russian market of engineering services

According to the International Federation of Consulting Engineers FIDIC (from the

French: Fédération Internationale Des Ingénieurs-Conseils) currently in the structure of the world market of engineering services construction engineering has the major share (up to 75%), 5% is for consulting engineering and 10% for process engineering (Figure 2).

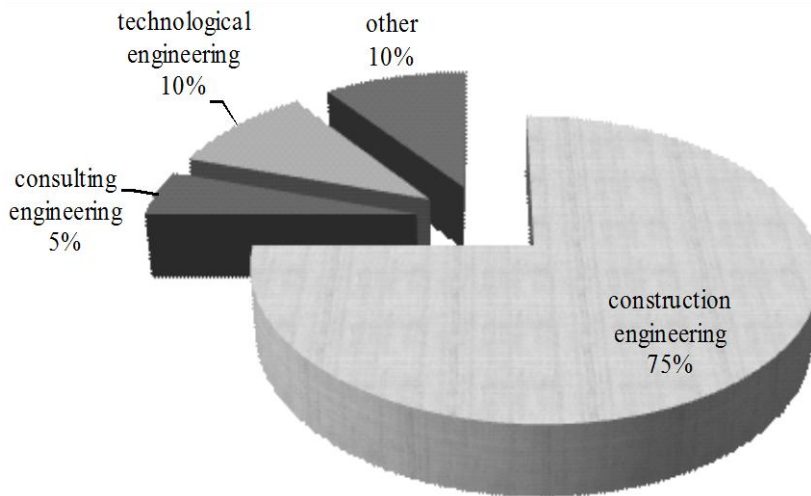


Figure 2. The structure of the world market of engineering services (Knyagin, 2013)

In the country structure of the world market of engineering services, Russia's share is insignificant and makes about 43 bln. USD, by 2018 it's expected to increase to 80 bln. USD (Informational and analytical portal about engineering, 2014). Major international companies operate in the USA, UK, Germany, France, Denmark, and Italy. The market leader in offshore engineering is India. (Knyagin 2013).

World trade of engineering services sufficiently concentrated, 92.6% of export is provided by 15 countries and the 15 largest importers account for 86.7% of the total acquired engineering and consulting services. In addition, the data also allow us to conclude that the share of such major players in the international market as the USA, Japan, Canada declines, but the role of the BRIC and NIC countries, on the contrary increases (International Trade Statistics, WTO, 2009).

Structure of the Russian market of engineering services is different from the world by a larger share of types such as the delivery of equipment and process engineering (Figure 3).

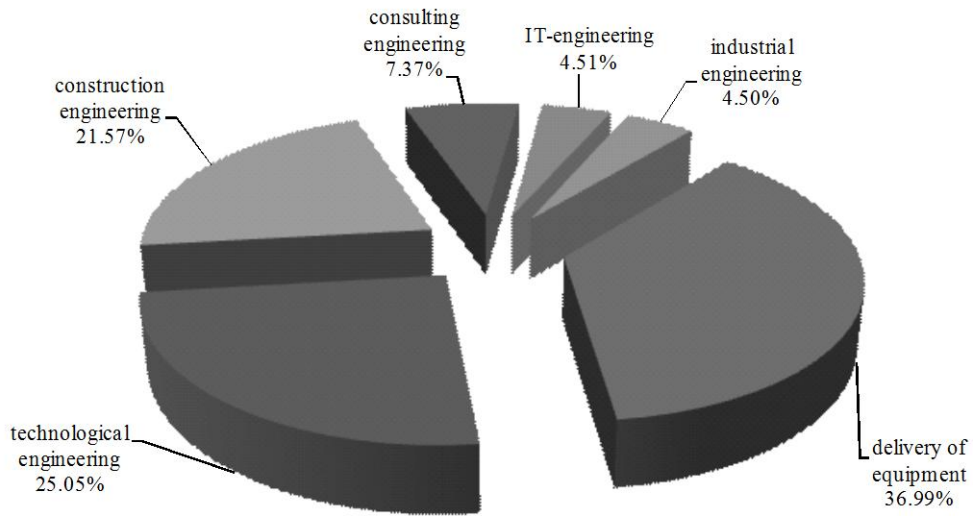


Figure 3. The structure of engineering services by type of engineering in Russia in 2012

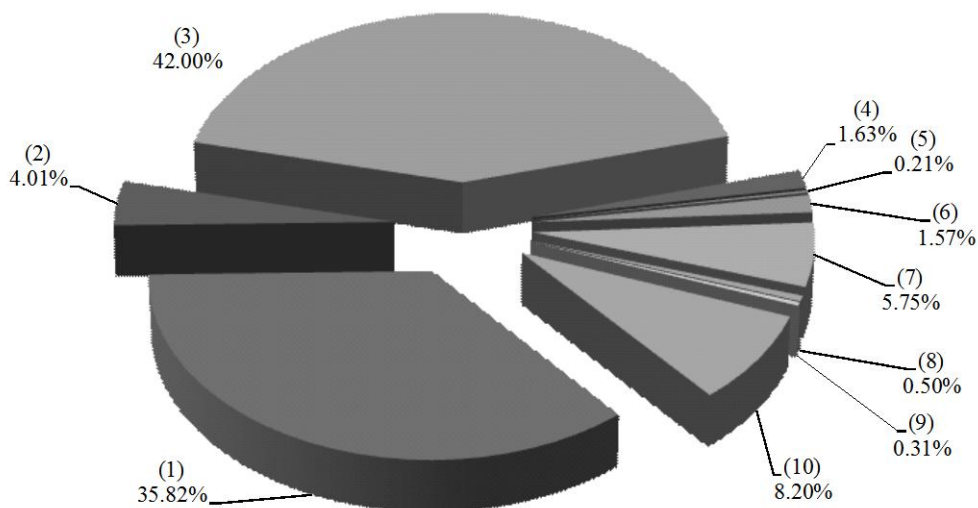
The high proportion of engineering services related to the supply of equipment and technological engineering in Russia is caused, above all, by the structural modernization of the economy, providing high-tech equipment of modern manufacturing (due to the high depreciation of existing equipment), the lack of own manufacturing of high-tech equipment that meets modern requirements of a competitive market, lack of highly qualified personnel (experts in the field of technological adaptation of new equipment into the existing production workflows). In the conditions of actually held technical modernization of high-tech industries at the present stage of development and structural modernization of the economy a significant increase in the share of services in the field of process engineering should be expected. With the significant import of specialized and new technological equipment, in our opinion, the greatest growth potential and investment attractiveness will belong to the market of process engineering.

To determine the capacity of the market of process engineering the method of FIDIC can be used. This technique is based on determining the potential process engineering market capacity in the amount of 8% of the total costs incurred for technological innovations related to the development and implementation of technologically new or significantly improved products, services or methods of their manufacturing, as done by company itself or by third-party companies.

In 2012 the costs of industrial companies on technological innovation were 27,561 bln. USD. (According to the Federal State Statistics Service of the Russian

Federation). Thus, according to calculations by the method of FIDIC potential market of process engineering in the Russian Federation in 2012 were 2.205 bln. USD.

In the structure of process engineering individual elements are allocated. The share of these elements in the total amount of process engineering in the Russian Federation in 2012 is shown on Figure 4.



- (1) research and development of new products, services and methods of production (transfer), new production processes;
- (2) industrial design, design and other developments (non-R&D) of new products, services and methods of its production (transfer), new production processes;
- (3) acquisition of machinery and equipment associated with technological innovation;
- (4) acquisition of new technologies;
- (5) the rights to patents among them, licenses for the use of inventions, industrial designs, utility models;
- (6) acquisition of software;
- (7) other pre-production for the manufacturing of new products, introduction of new services or methods of manufacturing;
- (8) education and training related to innovation;
- (9) marketing studies;
- (10) other costs for technological innovation.

Figure 4. The structure of the market by type of process engineering services in Russia in 2012

It's worth noting that the largest share of the volume of services in the overall process engineering covers the acquisition of machinery and equipment (42.00%), associated with technological innovation. The second largest market is engineering

associated with the research and development of new products, services and technologies (35.82%). Thus the locomotive of the industry engineering services will be the key trend - the development of new products and, especially, new production processes adapted to rapidly changing market conditions. In turn, the implementation of projects to create new high-tech industries will require the acquisition of modern equipment, technological adaptation which causes the growth of technological engineering services sector.

The most dynamic growth is noted in mechanic engineering (79.20%) and metallurgical industries (9.90%). Sectoral structure of engineering services market is presented in Figure 5.

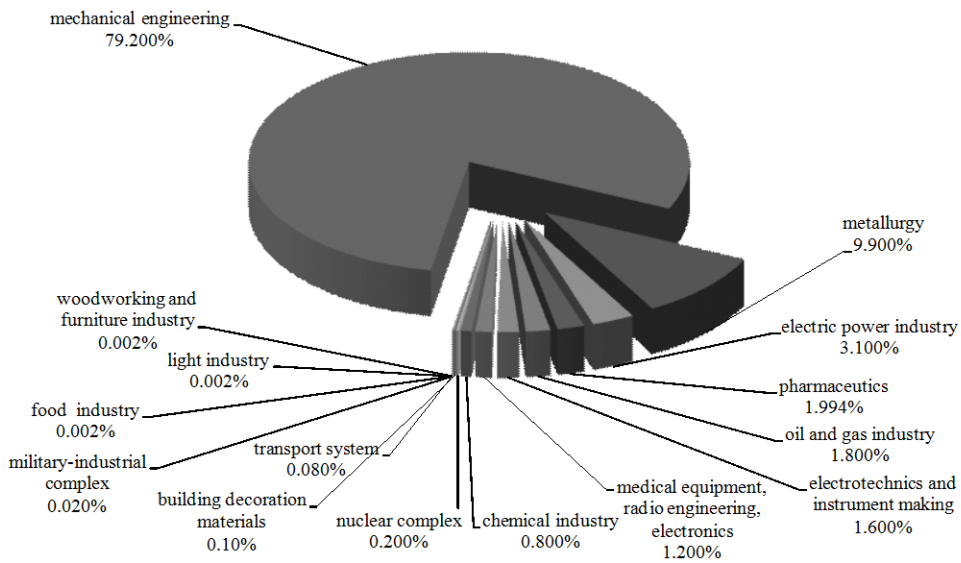


Figure 5. Structure of the market of engineering services for industries and occupations

Taking into account the trends in the development of industries of the Russian Federation and the share of new innovative products, it should be noted that there is the significant growth potential of technological engineering services in the electrotechnics and instrument making (1.60%), nuclear complex (0.20%), pharmaceutics (1.994%). Structure of the market of engineering services by geographical criterion is shown on Figure 6.

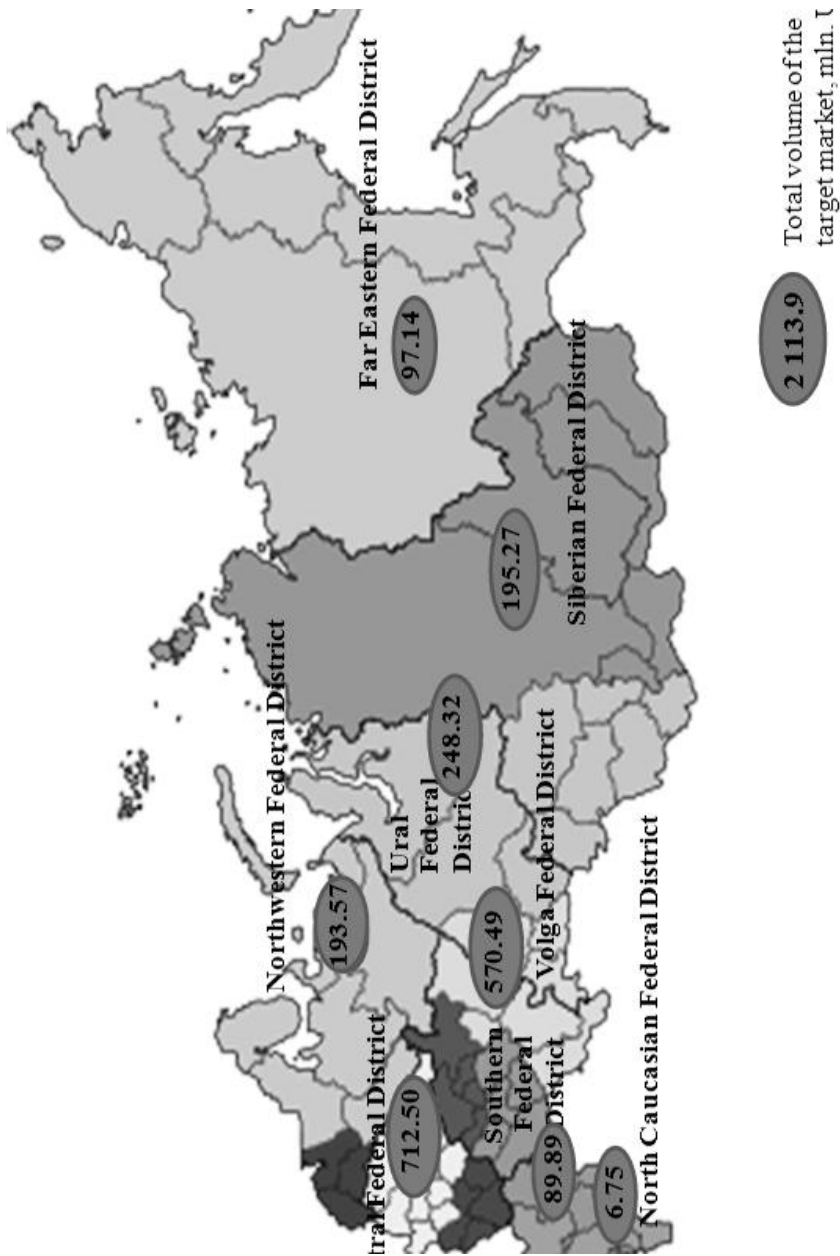


Figure 6. Geography of process engineering services market

The main share of the services consumed accounts for Central Federal District and the Volga Federal District (33.7% and 26.9%, respectively), which is typical for the localization of the modern high-tech production in the Russian Federation.

Taking into account regional market structure and process engineering industries, the

pace of development of recipients of services in this category will allow predicting the dynamics of the target market growth.

3.6. Forecast of dynamics of growth and the key factors of influence on the Russian market of engineering services

The volume of process engineering services market in the long term will increase. Based on the extrapolation method of forecasting, the forecast of the market development is made. So by 2022, the potential capacity of the market will be 10,069 bln. USD. (Figure. 7).

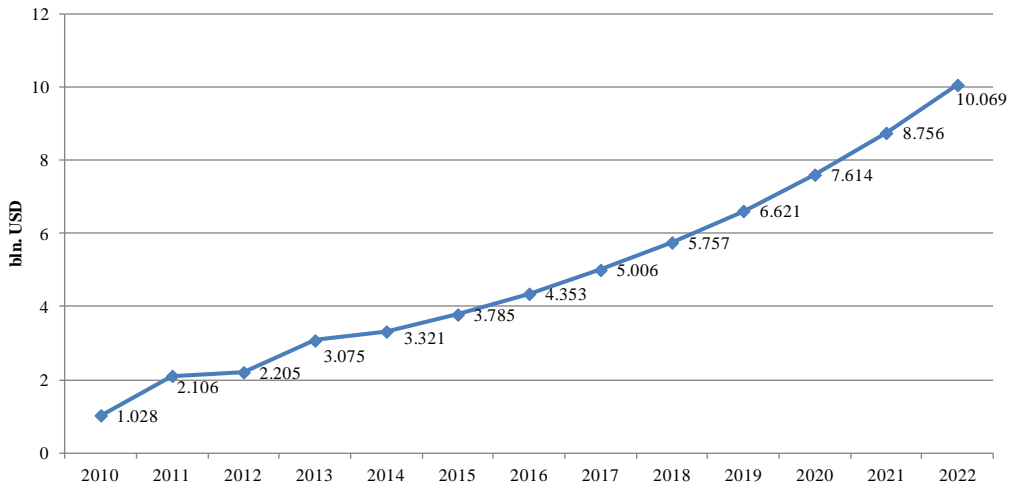


Figure 7. Forecast of development of market of technological engineering for the period up to 2022

Factors supporting the prospects of a significant increase in process engineering services market are:

- growth of innovation activity of industrial enterprises. Over the past 3 years, according to the Federal State Statistics Service, the average annual increase in costs of production companies on technological innovation were equal to 42% (calculated at current prices). In addition, these costs in recent years, on average, were made by only 10.4% of industrial companies, so the significant growth prospects by increasing the number of innovative active companies were maintained;
- implementation of programs of the Government of the Russian Federation to stimulate innovation activities of companies, modernization of the economy, energy efficiency;
- the demand for Russian technologies from foreign companies.

However, there are the risk factors that have a significant pressure on the development of the potential of engineering companies:

- the rendered high-tech services are not normalized for the costs of the initial stage;
- international engineering business is built upon long-term cooperation with regular customers (up to 80% of sales). There is no such experience of newly created Russian engineering companies. However, the government participation in the company can be considered as an additional guarantee of reliability of engineering company at the initial stage of its relations with customers;
- in the world practice there are up to 80% of the costs of the executive paid upon their implementation, and the term of the service can stretch for a longer period, up to 2-3 years, which requires a large initial investment in working capital.
- demand for process engineering is irregular, which also leads to the need to maintain a high level of working capital.

There are the following barriers to entry into the market of engineering services:

- increasing complexity of process engineering;
- high initial investment resources needed to ensure energy service contracts;
- highly qualified staff of companies providing engineering services;
- high level of customer loyalty to existing companies;
- achieving the scale effect ;
- developed vertical integration with partner companies;
- possible aggressive response from existing indirect clients;
- licensing, patenting.

The modern Russian market is characterized by significant technological engineering lag from the West on the level and pace of development and is in the formation stage. Significant growth potential causes high investment attractiveness, but high risks, long-term investment horizon and a large amount of initial investment hold back the market from new entrants having new technologies and multitechnical competences.

Conclusion

Currently, engineering services play a fairly significant role in the economy. This trend is typical for the innovation economy in Russia.

The study allowed systematizing the categorical instrument and defining basic terms, methods, approaches and research tools of the Russian market of engineering services. The identification of the main trends of the development of engineering market in the economy which is at the stage of transition to a new technological order has been implemented.

Highlighting the key features of the engineering classification allowed building the structure of the Russian market of engineering services according to its main forms,

the typology of services, as well as to industry and scope of its application. The study found that at this moment, in the structure of the market the largest share is taken by process engineering, including a range of activities and services for the creation of high-tech innovation project and a portfolio of competitive products and competencies (know-how, licenses, patents and so on.).

The analysis of information on the quantitative composition of engineering companies and the scope of their activities in the field of process engineering allowed building the geographical structure and determine the total volume of the target market of Russia.

Application of predictive extrapolation based on the identified market trends of technological engineering, the factors supporting the growth prospects of its services and the existing barriers, allowed building a forecast of the development of process engineering market for the period up to 2022.

The results of the factor analysis made it possible to adapt the mechanism of implementation of engineering services, developed in international practice, in the conditions of dynamically developing industries-recipients of engineering in Russia. In general, the Russian market of engineering services has a number of trends, characteristic for global trade of engineering services. Prospects for the development of the industry are the development of engineering in Russia and the conquest of new niches in the national and global market (technological, parallel, construction, industrial engineering, turnkey engineering, etc.). However, in this industry there are the problems hindering the development of this market. The main problems are the pricing based on standard costs, a stricter government regulation in comparison with many other countries, and substantial tax burden on companies.

However, the technological modernization of the Russian economy opens up new prospects for engineering companies.

Acknowledgments

The authors are grateful to Alexei Levitsev, Doctor of Engineering Science, Professor, Chairperson of Heat and Power Systems of Ogarev Mordovia State University for the opportunity to participate in the project “Establishment of technology engineering center of pulse heat and water supply” that allowed conducting a comprehensive study of engineering services market in Russia and preparing this work.

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