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The engineering services industry: the state of affairs, problems, and prospects

The article examines the current state of affairs in the Russian services industry and presents the properties of services that distinguish them from tangible assets. It is noteworthy that over the past 30 years, the share of services, provided to the population, has almost doubled. The authors have clustered services into groups and singled out the services provided to the business community. The authors have identified the main features and functions of engineering services that include complex, construction, operational, international, and computer ones. The object of engineering services is the intellectual process of solving creative (engineering) tasks, related to the design and arrangement of production processes, rather than products, design or production. Despite the fact that the share of domestic companies in the Russian engineering and construction markets is currently 67 %, this indicator is projected to decrease in the future. Among the main problems, hindering the development of the engineering services market in Russia, are: 1) the weak institutionalization of engineering services; 2) the insufficient number of highly qualified personnel; 3) underdevelopment of integrated engineering services; 4) insufficient attention to cost engineering; 5) insufficient measures of state support for the engineering industry. To solve the above problems, the authors have proposed measures to stimulate the development of the engineering services market. The Krasnoyarsk Metro project serves as an example of effective engineering, as a result of which budget savings amounted to about 30 %.

Keywords: *engineering, engineering services, human resources, integrated engineering, support measures, project cost management*

The activity of society is composed of various spheres that are closely interrelated. Changes, taking place in one sphere, have effect on the other ones, and transformation processes are also underway. Constant changes in the mode of life of society, as well as the faster research and engineering progress affect the behavior of the population. Given a change in the nature of labour activities, its mechanization and automation, the population has more free time. The growth rate of society's wealth increases the financial capabilities of its citizens and triggers the development of the service industry. This trend is particularly pronounced in urban areas [1].

The service industry is an economic sphere where goods are produced, and its positive effect is manifested by the manufacturing process. From the point of view of economics, a service is a commodity or a benefit in the form of labour, consultation, management art, etc., in contrast to a material commodity [2]. Also, a service is understood as a socio-cultural phenomenon (of non-material nature): a service is designated to satisfy spiritual, intellectual, ethical needs and support the normal life of a consumer, including his/her health, spiritual, physical, and professional development of an individual¹.

Services inherently have a number of specific properties that distinguish them from tangible assets. In the research literature, the main properties of services include intangibility, non-preservation, impermanence of quality, inseparability of a service from its provider, the unity between the consumer and the object of the service, the individual

character, etc. Despite the fact that the service industry does not produce material goods, it establishes fundamental conditions for their production. Analysis of GDP statistics shows that the share of services, provided to the population, has been increasing in the total gross national product of Russia at a significant pace in recent years. In 1990, it was 32.6 %, in 2002 — 48.4 %, in 2008 — 55.3 %, in 2016 — 61.5 % [3]. If the degree of development of the service industry depended on the success of material production in the past, now, on the contrary, material production depends on the service industry [4].

Depending on the types of services, the service industry is most often divided into two blocks:

- 1) production of tangible services (transport, trade, housing and consumer services, etc.);
- 2) production of intangible services (management, activities of the army and security agencies, education, healthcare, science, art, show business, social services, marketing, auditing, lending, insurance, etc.).

Groups of services were made on the basis of the all-Russian classifier (Fig. 1)². Besides, it is necessary to distinguish services provided to the business community, which are understood as services of legal entities and individual entrepreneurs engaged in the activities in the field of services provided to other organizations and individual entrepreneurs³. In practice, business services are designated as professional services. The classification of professional services provided to the business community is presented in Table.

1 GOST R 50646-2012. Services to the population. Terms and definitions. URL: <http://docs.cntd.ru/document/1200102288> (rus.).

2 OK 002-93. The All-Russian classifier of services to the population : approved Resolution of the State Standard of Russia dated June 28, 1993 No. 163 (ed. dated October 17, 2013). URL: https://www.consultant.ru/document/cons_doc_LAW_39420/ (rus.).

3 GOST R 57488-2017. Services for business. Classification and general requirements. Moscow, Standartinform Publ., 2017; 8. (rus.).

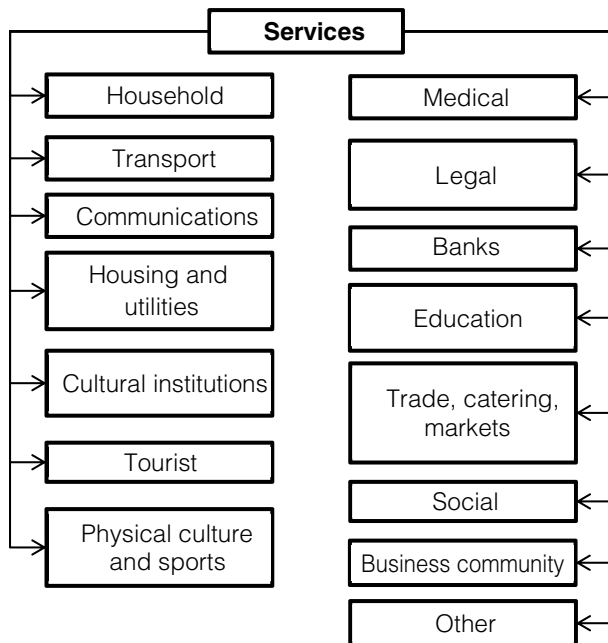


Fig. 1. Groups of services provided to the general public

Engineering services should be singled out as a separate group. The content of the concept of “engineering” is continuously expanding and absorbing the areas that are increasingly far from classical engineering. In general, engineering is understood as engineering consulting activity, the essence of which is the solution of engineering tasks related to the development or improvement of products, systems and (or) processes⁴. The subject of engineering is not a product (the final result of production), its design or production, but the intellectual process of solving creative (engineering) tasks related to the design and organization of production processes (work, services). For the first time, engineering is mentioned in the Treaty on the Eurasian Economic Union (clause 2, section 1 of Annex No. 18 to the Treaty)⁵.

Engineering has the following features.

1. This is a type of intellectual activity that involves, among other things, solving creative tasks. However, most often the task of engineering is reduced not so much to inventing (creating) new objects, processes, systems, as to the creative compilation of the best practices that allows solving a specific business task using minimal resources, given that the risk of failure is minimal, as well. This is the attractiveness of engineering for the business community: a guaranteed reduction in the costs of implementing and launching a business process, even taking into account the costs of engineering services.

2. This is not just design, construction, calculation and graphic works. The scope of engineering is ultimately the creation of a new item of intellectual property, as well as information. Engineering is a superstructure over engineering (design) activities, allowing to bring the results of engineering activities closer to implementation, shorten the path from an idea to its practical implementation. At the same time, from the consumer's point of view, engineering does not create new information, rather, it reduces the uncertainty (entropy) associated with the implementation of the designer's plan.

3. The centre of the engineering activity is not in the field of design, construction, software development, but in the field of organization of design, construction, and software development. At the same time, the scope of engineering always includes “design”, but not the design of objects, systems and processes transferred to the customer. It is the design of engineering processes and systems necessary for the implementation of the customer requirements.

4. This is not a separate special field of activity, but a special combination of well-known activities that allows to obtain a new, synergetic result infeasible as a result of a simple sequence of separate isolated processes of research, design, organization and comprehensive support, development and industrial implementation of an object (system, process).

5. It is impossible to talk about a separate professional activity in the field of engineering due to the fact that this activity includes the knowledge of engineering disciplines (theory of mechanisms and machines, theory of reliability, technology, system engineering), management disciplines (project management, quality management, ecology and safety, human resources management), legal and economic disciplines. Hence, engineering tasks can only

Classification of types of services provided to the business

Groups of professional services	List of types of services provided to the business community
Technical services	Design services, engineering and architectural services, construction works (services), transport services, technical consulting services, communication services, including telecommunication services
Specialized services	Accounting services, banking, financial, auditing, insurance, legal, consulting, marketing (advertising and public relations services), real estate services, services concerning the development and implementation of information technology products, research and analysis services, examination services
Distribution services	Logistics and transportation services, including courier, trade services, agency services
Services accompanying the production of products (goods) of certain types	Maintenance and repair of equipment, instruments, equipment, machines, vehicles, installation, examination and diagnostics, technical testing
Business support services	Rental and leasing services, recruitment services, security services, consulting services, cleaning and maintenance of buildings and territories, catering services for staff, transportation services for staff, social services for staff (provision of medical services, provision of sports, educational services, supply, recreational services), publishing and printing services, services associated with exhibitions and fairs

4 GOST R 57306-2016. Engineering. Terminology and basic concepts in the field of engineering. Moscow, Standartinform Publ., 2016; 15. (rus.).

5 The Treaty on the Eurasian Economic Union : signed in Astana on May 29, 2014, ed. from October 1, 2019. URL: https://www.consultant.ru/document/cons_doc_LAW_163855/ (rus.).

► be professionally solved by teams of professionals specializing in these types of professional activities.

6. As a type of economic activity, it is primarily the provision of services. The distinctive properties of a service are the mandatory involvement of a consumer (customer) in the process of rendering and consuming services in the process of their provision.

Engineering functions can be represented in the form of a temporal logical sequence of the project life cycle (Fig. 2).

The following types of engineering are distinguished⁶.

1. Integrated engineering includes a full range of services, i.e. the justification, development and implementation of a project, including the supply of intellectual property, equipment and turnkey delivery of an object.

2. Construction engineering includes a range of services related to the construction of an industrial facility. An identical concept is engineering services in construction.

3. Operational engineering includes engineering services aimed to improve the production process at a facility in operation.

4. International engineering. A feature of this type of engineering services is the provision of services in the world market. In this case, the contract for the provision of engineering services is an international contract.

Computer engineering is a multidisciplinary, multi-scale (multi-level) and multi-stage research and engineering based on the so-called "multi-physical" knowledge and computer technologies, primarily high-tech technologies of computer engineering.

The most interesting task is to consider an independent area of engineering, engineering in the construction industry. It encompasses engineering consulting services in the process of investment and construction activities carried out by consulting engineers and (or) engineering organizations under contracts with customers and with the ultimate goal of obtaining the best results from capital investments or other costs associated with the implementation of investment and construction projects⁷. The main types of engineering services in the construction industry are shown in Fig. 3.

The engineering services market plays a significant role in the economy, since it marries science and industry. Engineering

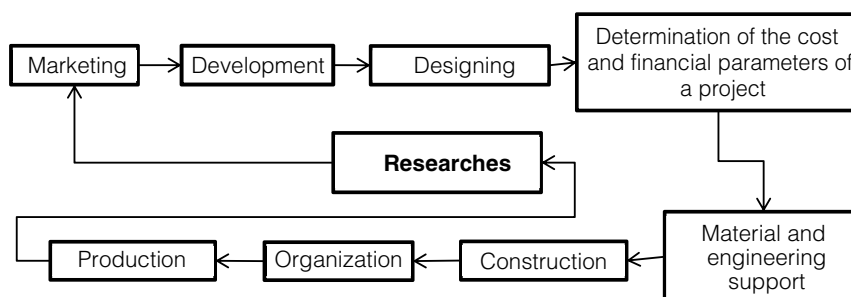


Fig. 2. Engineering functions

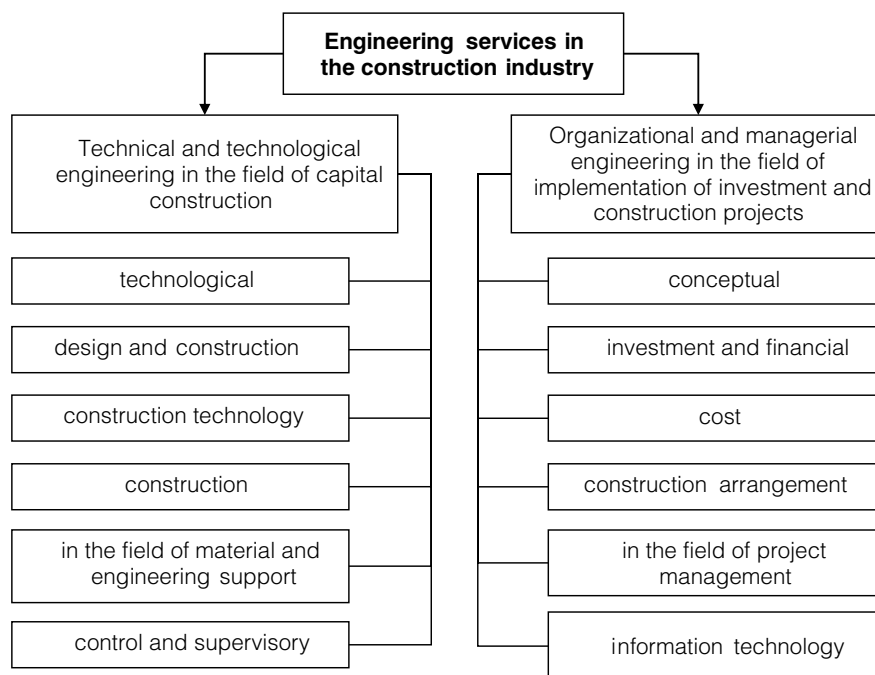


Fig. 3. Types of engineering services in the construction industry

6 Engineering. Wikipedia — free encyclopedia. URL: <https://ru.wikipedia.org/wiki/Engineering> (rus.).

7 GOST R 58179-2018. Engineering in construction. Terms and definitions. Moscow, Standartinform Publ., 2018; 17. (rus.).

companies have a multiplicative effect in the manufacturing regions due to the implementation of large-scale projects. It encompasses employment and qualification of personnel, growing tax revenues, developing territories.

The share of domestic companies in the Russian engineering and construction market in the field of transportation and processing of hydrocarbon raw materials is currently 67 %⁸. However, analysts predict a possible drop in this share to 51 in 2023. The reason for this development pattern lies in the transformation of global energy markets.

The characteristic feature of foreign engineering companies, is that they serve as managers (engineering services in the field of management account for a significant share of 20–60 %) [5]. The profitability of such companies usually ranges from 25–30 %. If we make a comparative analysis of the indicators in the USA and Russia in the field of engineering, we can see significant differences: for example, the engineering market of the USA has 142 thousand firms (both small and large) in this field, where the most developed and largest companies control mere 5 % of the entire market. If we take Russia, where large firms dominate, for example, Stroygazmontazh and Stroygazconsulting, we can see that they occupy 40 % of the market⁹. The reason for this situation is that most of the orders are large-scale capital-intensive projects of the state and state-owned companies, which are implementable only by large companies.

Hence, at present, the state of the engineering market in Russia fails to fit modern global trends, and the range of problems in this area is quite wide. It is possible to identify the main problems hindering the development of the engineering services market in Russia.

1. Weak institutionalization of the sphere of engineering services, accompanied by the imperfect regulatory and legislative framework in the field of engineering.

Currently, there are no legislative acts regulating professional engineering activities in Russia, as well as the relations arising between entities operating in the field of engineering, such as engineering companies, engineering project examination authorities, institutions that finance engineering activities, engineering funds. Back in 2017, a draft law "On engineering activities in the Russian Federation" was developed and submitted for discussion, but it has never been adopted. Therefore, the legal status of a professional engineer, the procedure of his certification, and qualification requirements are still vague today. The problem becomes particularly relevant on the eve of the Year of an Engineer in the Russian Federation in 2024.

2. An insufficient number of highly qualified personnel that have cross-disciplinary knowledge and competencies.

As noted earlier, engineering activities include various technical, management, legal and economic disciplines. Therefore, any successful operation of engineering companies requires specialists having cross-disciplinary knowledge and skills in several fields of engineering research and practice, such as design, engineering and marketing services. The present training model used to train engineering personnel in the Russian Federation can only fit a typical life cycle of technologies of traditional industries and is useless in the present-day competitive environment. In turn, the shortage of highly qualified engineering personnel reduces the competitiveness of companies operating in international engineering services markets [6].

3. The underdevelopment of complex engineering, covering all stages of the life cycle of an investment and construction project.

Despite the convenience of work with a turnkey object, integrated engineering is not widespread enough in the Russian Federation. The scale of companies, operating in the domestic market, does not allow for the comprehensive implementation and maintenance of engineering projects. The players that are active on the Russian engineering services market have a narrow focus, limited to one area of activity or a certain stage of the life cycle of an investment and construction project. As a result, the effect of engineering activities on the project as a whole is minimal, due to an increase in costs at the subsequent stages of implementation of an investment and construction project.

4. Insufficient attention is paid to cost engineering in terms of cost reduction at all stages of implementation of an investment and construction project.

Cost engineering is primarily aimed at solving the tasks of managing the cost of an investment and construction project in order to find the optimal balance between the cost, timing and usefulness/quality of assets, products, results of projects, programmes, companies, etc. Despite the fact that cost engineering is aimed at managing the cost of a project at all stages of its life cycle, its implementation without taking into account other types of engineering services, such as technical, technological, organizational and managerial ones, does not allow to take advantage of all opportunities to reduce costs.

5. Insufficient measures taken to support the engineering industry at the federal and regional levels.

In Russia, about 60 % of small engineering companies have difficulties raising debt capital [7]. High tax rates, uncertain market conditions, and the absence of a liability insurance system for engineering companies also have an adverse impact on the activities of small and medium-sized companies. There are no legally binding measures to support the engineering services, which would provide companies with guarantees in terms of taxation, state order, etc.

The authors propose the following measures to stimulate the development of the engineering services market.

1. Using an innovative approach to the professional development of the construction industry personnel.

It is advisable to draft new professional development programmes and update the current ones taking into account an interdisciplinary approach. It is necessary to develop competencies in the field of project management. New specialists, having in-depth knowledge of engineering and economics, will be in demand in the field of integrated engineering, that is, investment design, development of engineering solutions, feasibility study of design solutions, streamlined budgeting, cost control and analysis of actual costs for a construction facility.

2. Development of integrated engineering services at all stages of the life cycle of an investment and construction project.

It is necessary to employ cost engineering as the basis for any other type of construction engineering. To accelerate the propagation of integrated engineering, it is necessary to do away with the consolidation and development of monopolies in this area, and provide mechanisms ensuring interaction between small narrowly specialized companies within the framework of integrated engineering of one investment and construction project.

8 How the engineering services market is changing. Rossiyskaya Gazeta. URL: <https://rg.ru/2021/03/25/kak-menietsia-rynok-inzhiniringovyh-uslug.html> (rus.).

9 Application of engineering and reengineering of the organization. Domestic and foreign experience in the application of engineering. URL: https://vuzlit.com/1569712/primenenie_inzhiniringa_reinzhiniringa_organizatsii (rus.).

- ▶ 3. The issuance of a federal law regulating the development of engineering activities in the Russian Federation, accompanied by the consolidated measures of state support (within the framework of national projects).

It is necessary to keep improving the regulatory framework, governing the activities of enterprises in the field of engineering, and bring it into line with international standards, as well as the legal, economic and organizational mechanisms governing the relationship of participants in engineering activities. As measures of state support, in addition to subsidies, it is advisable to develop an "engineering menu", which would provide gratuitous budget allocations for the development of companies in the field of engineering. In addition, tax benefits should be provided to such organizations and set by the Tax Code of the Russian Federation.

4. Additional mechanisms aimed at promoting unified infrastructure to support engineering activities.

The establishment of consulting companies, licensees, engineering funds, commercial and non-profit organizations that stimulate activities in the field of engineering can be used as a tool to support engineering activities. Representatives of the professional community should be more actively involved as experts to solve a number of urgent problems in the field of engineering.

We can present the case of the Krasnoyarsk Metro project as an example of the effective implementation of integrated engineering: its construction was launched in 1995. However, in 2013, the project was put to a halt due to the lack of funding and resumed as late as in 2018. The initial cost of implementing the metro concept was 126 billion rubles. However, by using the basic principles of integrated engineering, as well as thanks to several stages of the project optimization, a decision was made to build an underground and lightweight aboveground rail line (metro line) that has the following characteristics:

- a larger length of metro lines compared to the original version;
- the main section of the line is closer to the surface to do away with deep stations to avoid time-consuming and expensive methods of construction work;
- it is proposed to place the engineering office and the office for the operational personnel in the depot;
- deep integration of the underground rail transport system in the urban network (development of the concept of RHTC, a high-speed rail transport facility). RHTC has a single network

of rail tracks. The versatility and flexibility of underground trams allow to create a system of lines that will cover the entire city, not just a strip along the metro line, and enable passengers to drive through the whole city, practically without leaving the car;

- reduction in the project implementation period to 4 years.

As a result of the measures proposed by the centre for engineering solutions of Mosproject-3 Group of Companies, the final cost of the project was reduced to 89 billion rubles using integrated engineering tools. Thus, the savings reached about 30 %. The project will be financed using the mechanism of the federal "infrastructure menu" or a budget loan.

Today, engineering services are becoming more and more popular in Russia in compliance with the development trends in the global economy and the increasing competition between industrialized countries in international markets. The development of domestic engineering services in the Russian Federation in the context of sanctions imposed by the Western countries is becoming especially relevant.

REFERENCES

1. Efimov V.S., Sarchenko V.I., Lapteva A.V., Shishatsky N.G., Efimov A.V., Bryukhanova E.A. *City — idea and practice*. Krasnoyarsk, Siberian Federal University, 2019; 522. (rus.).
2. Butler B., Butler D., Johnson B. *A dictionary of finance. From international to personal finance*. Oxford, Oxford University Press, 1992; 378.
3. Gazhur A.A., Lukiyanchuk I.N. *Trends of development of the sphere of services in Russia. Proceedings of the Voronezh State University of Engineering Technologies*. 2018; 80(3):444-450. DOI: 10.20914/2310-1202-2018-3-444-450 (rus.).
4. Zaborovskaya O.V., Degtereva V.A., Baranova I.V. *Trends in the development of the service sector in the post-industrial economy. Scientific and Technical Bulletin of St. Petersburg State Polytechnic University. Economic sciences*. 2008; 3-1(58):60-69. (rus.).
5. Romanovskaya E.V., Andryashina N.S., Nazarkina E.S., Vatiletov D.P. *Domestic and foreign experience in the application of engineering*. Moscow Economic Journal. 2021; 7:534-540. (rus.).
6. Sarchenko V.I., Kategorskaya T.P. *Methodologies for assessing the quality of training of graduates format of competence approach*. *Fundamental Research*. 2015; 8-1:203-209. URL: <https://www.elibrary.ru/item.asp?id=24081389> (rus.).
7. Sarchenko V.I., Starovatov G.F. *General principles and practice of small and medium-sized entrepreneurship in urban planning*. Krasnoyarsk, Sib. feder. un-t, 2014; 220. (rus.).

Сфера инжиниринговых услуг: состояние, проблемы, перспективы

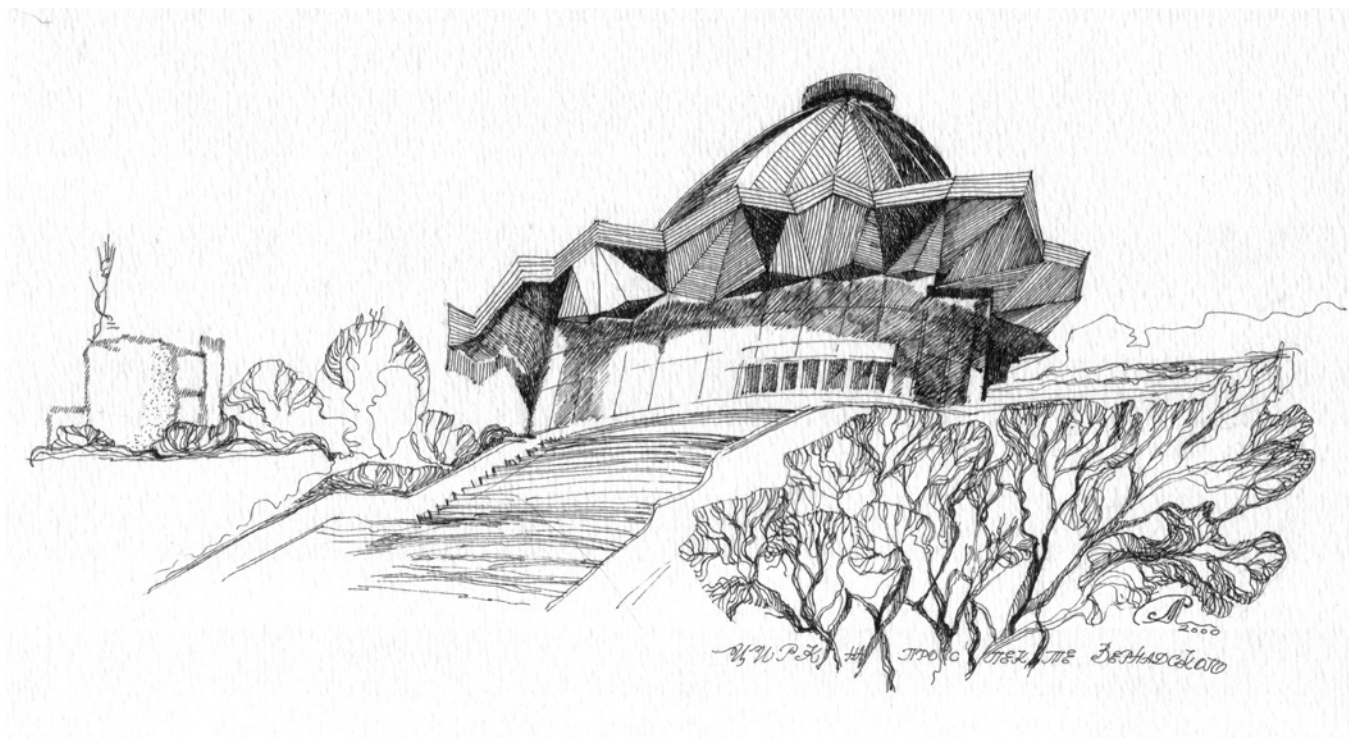
Рассмотрено современное состояние сферы услуг в России, представлены основные специфические свойства услуг, которые отличают их от материальных товаров. Отмечается, что за последние 30 лет доля услуг, оказываемых населению, выросла практически в два раза. Авторы сформировали группы оказываемых услуг, при этом отдельно выделили и раскрыли услуги, оказываемые бизнесу. В процессе анализа инжиниринговых услуг рассмотрены основные нормативные документы, регулирующие инжиниринговую деятельность. Выявлены основные особенности и функции инжиниринга, который подразделяется на: комплексный, строительный, эксплуатационный, международный, компьютерный. Отмечается, что предметом инжиниринга является не продукция, не проектирование и не производство продукции, а интеллектуальный процесс решения творческих (инженерных) задач, связанных с проектированием и организацией процессов производства продукции. Несмотря на то что доля отечественных компаний на российском рынке ин-

жиниринга и строительства составляет в настоящее время 67 % в перспективе прогнозируется снижение данного показателя. Среди основных проблем, сдерживающих развитие рынка инжиниринговых услуг в России, выделяются: 1) слабая институционализация сферы инжиниринговых услуг; 2) недостаточное количество высококвалифицированных кадров; 3) неразвитость комплексного инжиниринга; 4) недостаточное внимание к стоимостному инжинирингу; 5) недостаточные меры государственной поддержки индустрии инжиниринга. Для решения представленных выше проблем авторами предложены меры, стимулирующие развитие рынка инжиниринговых услуг. В качестве примера эффективного инжиниринга приведен проект Красноярского метрополитена, в результате корректировки которого с использованием основных принципов комплексного инжиниринга, а также благодаря нескольким стадиям оптимизации экономия бюджетных средств составила порядка 30 %.

Ключевые слова: инжиниринг, инжиниринговые услуги, кадровый потенциал, комплексный инжиниринг, меры поддержки, управление стоимостью проекта

СПИСОК ИСТОЧНИКОВ

1. Ефимов В.С., Сарченко В.И., Лаптева А.В., Шишацкий Н.Г., Ефимов А.В., Брюханова Е.А. Город — идея и практика. Красноярск : Сиб. федер. ун-т, 2019. 522 с.
 2. Батлер Б., Джонсон Б., Сидуэл Г., Вуд Э., Клаттербак Б. Финансы. Толковый словарь. 2-е изд. / пер. с англ. А.В. Щедрина, Н.Н. Кричигой; под общ. ред. И. Осадчая. М. : ИНФРА-М; Весь Мир, 2000. 493 с.
 3. Гажур А.А., Лукиянчук И.Н. Тенденции развития сферы услуг в России // Вестник ВГУИТ. 2018. Т. 80. № 3. С. 444–450. DOI: 10.20914/2310-1202-2018-3-444-450
 4. Заборовская О.В., Дегтерева В.А., Баранова И.В. Тенденции развития сферы услуг в постиндустриальной экономике // Научно-технические ведомости Санкт-Петербургского государственного политехнического университета. Экономические науки. 2008. № 3-1 (58). С. 60–69.
 5. Романовская Е.В., Андряшина Н.С., Назаркина Е.С., Ватлецов Д.П. Отечественный и зарубежный опыт применения инжиниринга // Московский экономический журнал. 2021. № 7. С. 534–540.
 6. Сарченко В.И., Категорская Т.П. Методический подход к оценке качества профессиональной подготовки выпускников вузов в формате компетентностного подхода // Фундаментальные исследования. 2015. № 8-1. С. 203–209. URL: <https://www.elibrary.ru/item.asp?id=24081389>
 7. Сарченко В.И., Староватов Г.Ф. Общие основы и практика малого и среднего предпринимательства в градостроительстве. Красноярск : Сиб. федер. ун-т, 2014. 220 с.
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- Для цитирования: Сарченко В.И., Хиревич С.А. The engineering services industry: the state of affairs, problems, and prospects // Недвижимость: экономика, управление. 2022. № 3. С. 70–75.



Л.И. Павлова. Москва. Цирк на Проспекте Вернадского. Рисунок, тушь, перо.