

FEDERAL STATE BUDGETARY EDUCATIONAL INSTITUTION
OF HIGHER EDUCATION
«GUBKIN RUSSIAN STATE UNIVERSITY OF OIL AND GAS
(NATIONAL RESEARCH UNIVERSITY)»

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**Methodology and organizational economic mechanisms in refining
and petrochemical engineering centers development**

Specialties: 5.2.3. Regional and sectoral economics
(industrial economics) and
5.2.6. Management

ANNOTATION

of the dissertation for an academic degree of Doctor of Economic Science

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Moscow – 2024

Relevance of the research topic. Development of Russian refining and petrochemical industry engineering is determined by the importance of the issue based on the following provisions:

1. Trends and prospects for industry development, represented by the concentration of promising scientific solutions in the 1990s - early 2000s in vertically integrated companies (VINC), followed by either formation of scientific and design institutes, or engineering competence centers; or organization of independent engineering companies in the 2000s. Creation of joint ventures with foreign participation by domestic holdings in the 2000s, against the background of active development of the Russian market by Western engineering centers, licensors of technologies, equipment and software capable to offer full-cycle EPC solutions, determined the dependence of industry on foreign participants. In 2022 the exit of the latter from the country, against the background of significant increase in engineering services demand, as well as sectoral sanctions since 2014, demonstrated the vulnerability of industry in terms of reliable process and technical equipment and identified the need to implement the concept of domestic, substituting service engineering. In modern conditions, this fact opens a "window of opportunities" for companies of the Russian engineering market of the fuel and energy complex in the areas of design, EPC contracts and support and maintenance of technological processes, as well as import substitution of parts, products and technologies;

2. The importance of development of domestic service engineering concept to achieve technological sovereignty of the country in conditions of unprecedented pressure of sanctions is becoming more acute¹. At the same time, the main obstacles to the successful development of Russian oil and gas engineering include the following: limited access to foreign developments, the need to achieve significant import independence and to create new import-advanced products, technologies and services, lack of investments, high cost of technologies, etc. It is necessary to review the level of strategic development of Russian engineering centers in refining industry

¹ over 15 000 sanctions, including prohibitive restrictions on more than 1,300 products

to ensure full-cycle EPC contracts, managerial approaches to building design processes, and development of innovations and technologies;

3. The role of engineering is significant in the technological restructuring of the Russian energy sector and ensuring the country's energy security, in increasing the competitiveness of industry products. This is confirmed by the regulatory imperatives formed by the Resolutions of Government of the Russian Federation – this is the Energy Strategy of Russia, which has defined the conditions for engineering services development in Russia for the period up to 2035; the National Technological Initiative on Modernization and Development of the Russian Economy, aimed at achieving technological sovereignty in almost all critical technologies; the activities' plan ("roadmap") in the field of engineering design and industrial design, for the development of industrial engineering sector, etc., the achievement of which is possible through the improvement of industry potential, the formation of a modern technological, organizational and economic platform, mechanisms, logistical support for the industry development, acting as a fundamental long-term development strategy of the country;

4. The urgency of creating our own product innovations, large-scale deep processing of oil and gas resources², engineering, integration and standardization of systems, integrated engineering and construction support is becoming more acute, as evidenced by Rosstat (Federal State Statistics Service) data – the volume of the engineering services market increased by 78.9% from 2018 to 2022; issues of improving operational (operational) efficiency being also important³. This requires the development of theoretical and methodological approaches to ensure the concept of domestic engineering, introduction of organizational and economic mechanisms for engineering centers development that ensure modernization and development of the petrochemical industry economy of the Russian Federation;

² the goals announced by Vladimir Putin, President of the Russian Federation, on October 11, 2023 at the plenary session of the International Forum Russian Energy Week (REN-2023) "The new reality of the world energy: creating the future.

³ the total capacity of the engineering market in 2022 is more than 12 trillion rubles and has a growing trend.

5. The problems of development of engineering centers in refining and petrochemistry in the context of need for import substitution of products, technologies and services determine the demand to create efficiently working mechanisms for comparative assessment of their market activity, methods for assessing the quality of engineering services, etc. However, it is difficult to assess the volume, capacity, saturation and dynamics of the engineering market, both due to lack of data on the contracts' cost and the relevant formed methodology for managing the sustainable development of engineering centers;

6. The problems of development of Russian engineering in refining and petrochemical industry determine the orientation towards the formation of effectively working mechanisms for their cooperation with Russian universities to provide the fundamental basis for high-tech, knowledge-intensive, innovative development, formation of key competencies, and development of highly professional expertise of project results. There is a need to ensure the implementation of engineering development in refining and petrochemical industry by key drivers: modernization and capacity growth, production of a highly converted product (deep processing) based on own process solutions, deployment of technology brokerage and venture financing practices, increasing the number of participants in technological business incubators, etc.

The above-mentioned circumstances determine the need to develop theoretical and methodological approaches for development of Russian engineering in refining and petrochemical industry in order to ensure the country's energy security, form its technological sovereignty in this critically important area for the country, increase the competitiveness of industry products at the global level through the development and implementation of its own scientific and technological base on the basis of accumulated knowledge and competencies of Russian engineering centers, implementation of efficient mechanisms for their sustainable development.

The purpose of dissertation is solving of a major scientific problem of great economic importance – the development of methodology as well as organizational

and economic mechanisms for development of Russian engineering centers of fuel and energy complex on the example of industry.

The object of dissertation research is domestic refining and petrochemical engineering centers. **The subject of the dissertation research:** is a set of methodological guidelines and organizational and economic mechanisms for the development of Russian engineering centers on the example of refining and petrochemical industry.

The theoretical and methodological basis of the research are scientific works in the field of industrial engineering; organizational and economic problems of development of engineering centers; the impact of new technologies on the design development of products and technological processes; problems of implementing the concept of sustainable development of industries and companies; improving the operating efficiency of enterprises in various branches of industry.

The information base of the dissertation is: normative legal acts of the Russian Federation, ministries and departments; materials of state statistics bodies, specialized information and analytical agencies; developments of expert analytical centers and institutes; normative documentation of non-profit organizations regulating activities; materials of seminars, round tables, scientific, training and practical conferences; works of Russian and foreign scientists; expert surveys of employees of companies covering the fields of engineering, design, construction, R&D, explorations and surveys; databases of literature references (Elibrary, Scopus, WoS, etc.).

The field of study according to the passports of specialties is:

- 5.2.6. "Management": item 6 "Methods and criteria for evaluating the effectiveness of management systems. Results-based management"; item 14 "Strategic management, methods and forms of its implementation. Business models of organization. Corporate strategies. Strategic resources and organizational abilities of the company)"; item 16 "Theory and methodology of project management. Processes, methods, models and tools for project and program management. Risk

management"; item 26 "Organization management in the context of digital transformation. Strategies and methods of digital business transformation";

– 5.2.3. "Regional and sectoral economics" (industrial economics): item 2.2 "Issues of assessing and improving the efficiency of economic activity at enterprises and industries"; item 2.16 "Tools for intra-company and strategic planning at industrial enterprises, industries and complexes".

The scientific novelty of research is as follows:

1) Categorical and conceptual management apparatus has been developed that characterizes the engineering processes in refining and petrochemical industry and functional phases of the life cycle of engineering projects: a) based on identification of a close relationship between the categories of engineering in refining and petrochemical industry and functional phases of life cycle of engineering projects, which enables to build a set of strategic alternatives, as well as to increase the operating efficiency of development of engineering centers and directions of import substitution in the segment per stages with their priorities; b) a model of the state policy for development of Russian engineering in order to achieve technological sovereignty. A distinctive feature is taking into account the access restriction to global developments, which makes it possible to form a modern technological, organizational and economic platform, mechanisms for the development of the industry.

2) A methodology for strategic planning of development of Russian engineering centers in refining and petrochemical industry has been developed and tested, which differs from traditional approaches by introducing a tool for comparative assessment of the market activity of engineering centers in the industry. The author's methodology for comparative assessment of the market activity of engineering centers of industry, as a tool for planning and forecasting their efficient development, involves the calculation of indices for assessing the current state of the oil and gas industry, followed by the calculation of the integral index of market activity (MAI), which is proposed as a tool for a systematic long-term analysis of competitiveness: firstly, of engineering centers, secondly, of engineering market,

thirdly, of the state of industry, the structure and dynamics of its development. The novelty of the latter is in performing a comparative factor analysis of key parameters – the constituent factors of the market activity index.

3) A conceptual model of sustainable development of engineering projects (engineering centers) in refining and petrochemical companies has been developed, the distinctive feature of which is: a) the including of factors of implementation of directions for development of innovative activities of engineering centers; b) the author's approach to evaluating the effectiveness of engineering projects through the trinity of components of sustainable development: economic, social and environmental, by calculating an integral ecological, socio-economic indicator - the "ESE index", which allows you to determine both the cross-functional interaction between them and the final result of this interaction; c) the mechanism of accounting of the parties' interests (economic, social, environmental) in the context of cross-functional interaction between the functional areas of management.

4) Taking into account the available strategic resources and organizational abilities of engineering centers in refining and petrochemical industry, their strategic alternatives to sustainable development have been identified in conditions of limited access to foreign technologies through the phased implementation of models: "production – service centers", "innovative engineering centers", "niche engineering centers", "consortia", "cooperation of engineering centers and Russian research institutes": at the first stage, ensuring the technological independence of Russian engineering schools, creating of our own developments of a complete technological and production cycle; at the second stage, ensuring the competitiveness of Russian developments at the global level. The author's methodological solutions include: substantiation of the conceptual model of sustainable development of engineering centers; development of mechanisms for prioritizing management directions; development and justification of methods for evaluating ongoing engineering projects. The novelty lies in the combination of methods and forms of strategic management, in the author's evaluation modeling of activity of engineering centers,

the quality of engineering services and level of digitalization of the implemented engineering projects.

5) To enhance the efficiency of engineering centers' management, in the context of the imperative to achieve technological self-sufficiency, a procedure has been developed to prioritize the efforts towards achieving technological self-reliance for both Russian engineering centers and refining and petrochemical facilities. This procedure enables the ranking and scheduling of target dates for the implementation of initiatives in areas such as reverse engineering, research and development, etc., and unlike the existing approaches, it incorporates the author's criteria for assessing the performance of the proposed management systems. This analytical tool helps to: a) identify priority groups of import substitution measures in an operational and tactical way; b) choose comparatively more efficient import substitution measures for each priority group of components (such as reverse engineering, R&D, etc.); plan the target dates for implementing technological sovereignty for these groups.

6) A procedure has been developed for evaluating the quality of engineering services delivered by engineering centers in refining and petrochemical industry, based on assessing discrepancies between customers' expectations and perception of the quality of services and enables to identify negative deviations in the quality characteristics of engineering services from the level determined by the customer expectations. The author's methodology is based on the INDSERV research model and: a) is supplemented with variables in the "quality of execution" category (variables such as: retention within budget, compliance with deadlines, reproducibility of results, etc.) and the "quality of service" category (variables such as: communication efficiency, correctness of information provided, quality of post-project maintenance, etc.); b) the normalization of indicators was carried out and an algorithm for evaluating the quality of services was presented; c) a matrix of managerial decision-making has been developed to improve the quality of engineering services; basic functionality and service competencies have been developed, serving as a justification for results-based management in improving the

quality of engineering services, ensuring the development of basic functionality and service competencies of the centers.

7) A procedure for analyzing and evaluating the digitalization of an engineering project in refining and petrochemistry has been developed and tested, covering a set of digitalization tools (21 tools) used in the approach to evaluating the "Organizational Digital Manufacturing Maturity Model – ODM3" – an analysis of the maturity of a digital manufacturing company. The peculiar feature of the author's solution is in the application of: a) two cumulative evaluation criteria: the intensity and effectiveness of the tool usage; b) the coordinate matrix of decision-making: "efficiency - intensity of digitalization within the framework of the implementation of an engineering project"; c) in a block-by-block gradation of the digitalization tools, which makes it possible to: 1) determine the statuses of digitalization tools in the coordinate matrix of decision-making: "efficiency - intensity of digitalization", depending on whether they fall into the quadrants: "best practices quadrant"; "strategic quadrant"; "non-strategic quadrant"; "false practices quadrant"; 2) identify blockwise, systematically, the problems or the maximum efficiency achieved by an individual tool; 3) based on the result make managerial decisions regarding the use of various digitalization tools within the framework of the implementation of an engineering project.

8) The trend of innovative development of engineering projects is proposed, based on the mechanism of synergetic interaction between engineering centers and Russian universities, their design and process components, and aimed at ensuring that participants complete a full cycle of R&D, enabling them to create a significant density of process and economic managerial solutions for all business entities, operationalize projects through institutional and infrastructural support for effective management, through systematic use of managerial and evaluation tools, and also to provide personnel support of the process.

9) A model of engineering development policy has been developed based on 3 key components: at the basic level - process development, digitalization and import substitution; at the middle level – achieving technological sovereignty; at the upper

level – ensuring sustainable development and energy security within the framework of the national security of the country against the background of the overall growth of the innovative component of the industry products. The trends of ensuring the model implementation are identified, the key drivers of which are: increased investments and competencies in modernization and capacity growth, production of a highly converted product (deep processing) based on proprietary technological solutions (basic projects); a set of regulatory measures (monitoring and evaluation system, transfers, benefits, tariff reductions, PPP (public-private partnership) instruments, cost compensation, etc.), mechanisms of state and non-state support. The author's difference lies in the formation of structure of evaluation indicators of the activities of domestic engineering companies, which can be used both in the regulatory system and in management and stimulation.

The theoretical significance of research lies in the development of theoretical and methodological foundations and terminological apparatus of the field of research, in the generalization of problem areas. The theory and methodology of the formation and development of engineering companies implemented in models, methods, mechanisms and techniques has been substantiated; conceptual frameworks has been formed; methodological approaches have been developed, revealing the potential of the research topic in its managerial and organizational-economic content.

The practical significance of the dissertation research consists in the development and testing of a methodology for comparative assessment of the market activity of engineering centers in the refining and petrochemical industry; in the formation of elements of organizational and economic mechanisms for development of engineering centers in the industry; in the formation of cross-functional business process schemes for improving the activities of organizations, planning and implementing projects for sustainable development of engineering centers; in the development of specialized software: VNP IMAK_ "Asset Information Model" – patent No. RU 2022668348 of the Federal Service for Intellectual Property of the Russian Federation; in the development and testing of partner programs in the field

of engineering in refining and petrochemistry, which is confirmed by the implementation of research results in the activities of enterprises, engineering centers and Russian universities.

Implementation and testing of the work results. Substantive provisions and results of the research:

- reflected in reports at key industry Russian and international scientific, practical and business conferences, as well as at scientific forums: "Business trends: research agenda in innovations and entrepreneurship" at the National Research University of the High School of Economy in Nizhny Novgorod; "Practice Oriented Science: UAE - Russia - India" in Dubai, UAE; "Promising scientific research: experience, problems and prospects of development" in Ufa; the VII International Scientific and Practical Conference "Science and Innovation: prospects and challenges" in Saratov; The Second International Scientific and Practical Conference "BRICS countries: development strategies and mechanisms of cooperation in a changing world" in Moscow, the III International scientific and practical conference "Science, Technology, Innovation in the Era of Global Transformations" in Petrozavodsk;

- have been tested and applied:

- a) when developing and implementing the transformation strategy of the design institute of LLC LUKOIL - Nizhegorodniinefteproyekt and when developing on its basis the integrated engineering center of LLC LINK – LUKOIL Engineering Skills and Competencies - a production and service center in the "Processing and Marketing" segment of the LUKOIL Group;

- b) in the internal local regulatory documents of the Department for the Implementation of Construction Projects of PJSC Tatneft named after V.D. Shashin, responsible for organization and execution of all investment projects in all subsidiaries of the Tatneft Group;

- c) in the innovative and production and economic activities of the Scientific and Research Institute of Oil and Gas "Peton" (NIPI NG "Peton") - the largest

contractor of PJSC Gazprom for the comprehensive implementation of state EPC contracts on a turnkey basis;

d) in expanding the range of services provided by LLC "Lenguiproneftekhim", a scientific, design and research center of PJSC "Surgutneftegaz";

e) when implementing digital solutions and organizing interaction with universities of two independent institutes for the integrated design of oil and gas industry facilities – LLC Nizhegorodneftegazproekt and LLC Volgogradnefteproekt;

f) and were also used in the educational process of the Ufa State Petroleum Technical University.

Publications. Based on the topic of the dissertation research, the author has published 35 publications in journals included in the RSCI: "Problems of economy and management of the oil and gas complex"; "University management: practice and analysis"; "Azimuth of scientific research: economy and management"; "Oil. Gas. Innovations"; "Leadership and management"; "Chemistry and technology of fuels and oils"; "Information technology", including 7 monographs. The list of publications recommended by the RANEPa Academic Council, or the international citation databases (WoS, Scopus), as well as the core of the RSCI, includes 23 publications by the author.

The dissertation structure and scope. The work consists of 412 pages of typewritten text, including an introduction, five chapters, 57 figures and 52 tables with conclusions for each, opinions, a list of references and appendices.