Formation of innovative infrastructure in the context of project-oriented management of the oil and gas industry

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Abstract. Innovative infrastructure of oil and gas enterprises involves the use of modern technologies, systems, and approaches aimed at improving efficiency, safety, environmental sustainability, and competitiveness in the production and operation of oil and gas. This study investigates the creation of a project-oriented supervisory company in the oil and gas industry in the context of innovative development, which is relevant and promising. The key challenges faced by consulting firms in the oil and gas industry and possible strategic directions for their resolution, which will require supervisory firms to be more flexible, innovative, and strategic in their approaches, considering the specifics of the industry and the needs of clients were identified. The study also develops a tree of problems for the creation of a project-oriented supervisory company in the oil and gas industry and determines that this direction is sufficiently relevant and necessary for the formation of innovative infrastructure of oil and gas enterprises. It gives an assessment of the economic efficiency of creating a project-oriented supervisory company based on the analysis of both basic methods – payback period and return on investment. The study's calculations confirm the feasibility of creating a project-oriented supervisory company as an innovative infrastructure that will support the development of oil and gas structures for both the country as a whole and individual enterprises.

1 Introduction

The world has undergone a reorientation of key aspects of economic development. This reorientation reflects a shift in focus towards innovation as a primary driver for achieving national goals [1]. Innovations, encompassing novel ideas, technologies, and methodologies, have become integral to enhancing productivity, fostering competitiveness, and addressing societal challenges [2]. Governments, industries, and institutions worldwide

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are increasingly recognizing the critical role of innovation in driving sustainable growth and prosperity [3]. For the successful implementation of innovations, the establishment and nurturing of an innovation infrastructure are imperative. An innovation infrastructure comprises the institutional frameworks, policies, funding mechanisms, and collaborative networks necessary to support the entire innovation ecosystem [2, 4]. This infrastructure facilitates the translation of ideas into marketable products and services, fosters entrepreneurship and risk-taking, and enables the diffusion of knowledge across sectors and regions [5].

The importance of developing a robust innovation infrastructure stems from profound structural transformations occurring in the global economy [6]. Rapid technological advancements, evolving consumer preferences, and geopolitical shifts are reshaping industries and markets, necessitating agile and adaptable innovation ecosystems [7]. Furthermore, leveraging scientific and technical potential is essential for driving breakthrough innovations that address pressing societal needs, such as healthcare, climate change, and sustainable energy [8].

Moreover, fostering innovation plays a pivotal role in addressing employment challenges and optimizing management processes across diverse sectors of the economy [9 – 11]. Innovation-driven enterprises tend to create high-quality jobs that require advanced skills and expertise, contributing to economic inclusivity and social mobility [12]. Additionally, integrating innovative practices into management processes enhances efficiency, agility, and resilience, enabling organizations to navigate dynamic and uncertain business environments effectively [13, 14].

In summary, the development of an innovation infrastructure is indispensable for harnessing the transformative power of innovations and driving sustainable economic development. By fostering a conducive environment for creativity, collaboration, and experimentation, countries can position themselves at the forefront of the global innovation landscape, driving prosperity and improving quality of life for their citizens.

The implementation of innovation infrastructure is important in the context of sustainable development, which involves the use of environmentally friendly technologies, including renewable energy sources, as was studied in the work [15]. The creation of innovative enterprises is also important [16]. The assessment of the innovative opportunities of manufacturing companies is presented in the work [17]. The search for innovative development strategies for enterprises in a competitive market was carried out in the work [18]. Researchers argue that enterprises are exposed to uncertainty of results and risks. The nature of project risks, uncertainty, and the effectiveness of project management tools were studied in the work [19]. Windapo, Salie & Umeokafor argue that project failure occurred when risk and uncertainty led to litigation, dissatisfaction of stakeholders, and project delays. The work [20] reveals the prospects in the analysis of innovation failures. A systematization of common mistakes has been carried out and the features of strategic management to reduce risks have been indicated.

The assessment of the readiness of enterprises for change is presented in the work [21]. Readiness is necessary for the implementation of new projects in the context of the energy transition, which is also relevant for energy enterprises [22]. The article [23] reveals the problems of research on the effectiveness of project management from the perspective of organizational structures, technical competence, leadership skills, and characteristics of an effective project manager. The results indicate that planning/organizing, networking, and communicating are the most important management practices in the leadership behavior of project managers. This study provides empirical evidence of the effectiveness of project management to promote a better understanding and improvement of project management practices. A methodological approach to assessing the effectiveness of innovative projects is presented in the work [24].

Management of innovative projects in various sectors of the economy requires balancing conflicting effects and considering various circumstances. The work [25] demonstrates the complexities of management, as the number of participants increases, and their roles change. Environmentally safe management of the oil and gas industry using environmental audits was studied in the work [26]. This approach is relevant, as the oil and gas industry have a negative impact on the environment of the region where oil and gas production enterprises operate. Scenarios of innovative use of gas storage infrastructure are considered in the work [27].

The use of a systems approach is important in project management [28, 29]. Analyzing human behavior, the authors argue that the personal qualities of the project team manager and the project environment can ensure success in the implementation of the project. The attention and diligence of the performers are also important in project management. The scientific work [30] reveals such aspects in the example of specific project teams.

The application of project-oriented management is becoming an effective tool in the formation of innovation infrastructure of oil and gas enterprises [31] as well as related gas-oriented enterprises [32]. The implementation of new technologies in oil and gas production, processing, and transportation to reduce costs, increase productivity, and reduce greenhouse gas emissions are key aspects of the development of such enterprises. The processes of capital repair of live wells, in particular snubbing, are of special importance in this context.

For the repair of wells using snubbing, a complex of equipment, including the RDE-340 unit, is utilized. This unit plays a crucial role in facilitating the snubbing process, ensuring efficient and effective well maintenance. Its integration into the equipment complex enhances the overall capabilities and success of well repair operations.

2 The choice of object to study

The oil and gas industry is now defined as one of the fundamental and economically critical industries that requires continuous optimization of management processes to ensure sustainability. This can be achieved through the formation and development of the innovative infrastructure of the industry. Innovative infrastructure can solve the following tasks:

– supporting innovators in the oil and gas industry;

– ensuring the development of oil and gas structures for both the country as a whole and individual enterprises;

– actively applying foreign and domestic scientific and technological developments, and inventions in production;

– providing the transfer of innovations (technologies) and commercialization of scientific developments;

– providing various types of services to innovative businesses, etc.

The innovative infrastructure of oil and gas enterprises involves the use of modern technologies, systems, and approaches aimed at improving the efficiency of business processes, ensuring the safety of enterprises, and competitiveness in the production and operation of oil and gas. Considering the current situation in Ukraine, it is clear that at present there are practically no specialized structures that support innovative projects.

The effective implementation of advanced technologies, optimization of oil and gas field utilization, and transparency in industry procurement require a new approach to project development. This is precisely the approach taken by the DENIMEX group of companies - an American holding company that unites companies under the DENIMEX brand, located in the USA and Ukraine, specializing in innovative development and the creation of new solutions in the oil and gas industry, namely, providing services for the

capital repair of wells under pressure (snubbing). It is this technology that enables minimizing the impact of killing fluids on productive horizons and carrying out work without killing the well.

The effective implementation of advanced technologies, and the optimization of the use of oil and gas fields require a new approach to the management of the development of the oil and gas industry – the introduction of project-oriented management.

3 Research methods

Supervising services for the oil and gas industry require a high level of research, analysis, and process management. Unfavorable impacts on project efficiency can occur at different stages, so it is important to have a systematic and organized approach. Supervising firms should use innovative ideas and methods to provide valuable services and accelerate the assessment process.

The market for service providers in the oil and gas industry is beginning to develop a situation where the quality of a service, along with its cost, determines the success of a service provider overall. An example of this is the situation with the reduction of drilling companies in western Ukraine and the simultaneous engagement of foreign drilling contractors in Ukraine. We can also note the growth of competition between small and medium-sized enterprises providing service to state and private oil and gas companies, while large oil and gas production companies continue to maintain their entire arsenal of equipment and other resources to perform the necessary work themselves.

An example of such a company is the organization “DENIMEX WORKOVER SOLUTIONS”, which provides services for the capital repair of wells under pressure (snubbing). The installation diagram of the RDE-340 snubbing unit is presented in Fig. 1.

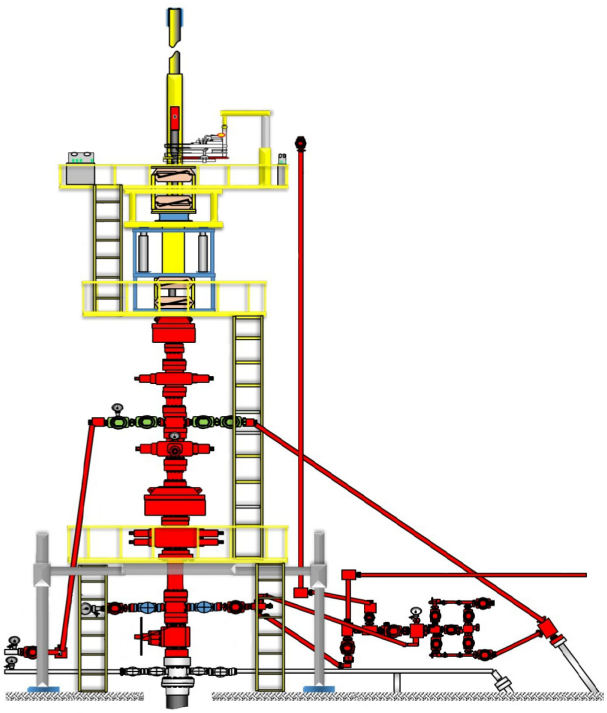

Fig. 1. RDE – 340 Snubbing unit installation diagram.

It is the capital repair of wells using this technology that becomes a key stage in the operation and maintenance of oil and gas wells. Managing innovative business processes in this context is strategically important for achieving efficiency, safety, and stability.

Key aspects of managing innovative business processes in the capital repair of live wells:

1. Increased Work Efficiency: Implementing innovative processes such as snubbing significantly enhances the efficiency of well capital repair, ensuring quicker and more effective restoration of their productivity.
2. Ensuring Personnel Safety and Health: Innovative business processes incorporate improved safety and health protection methods aimed at preventing injuries and accidents.
3. Cost Minimization and Product Value Enhancement: Effective management of innovative business processes enables minimizing costs for well capital repair and maintenance, including rational resource and personnel utilization.
4. Adaptation to Changing Conditions: Advanced processes like snubbing provide flexibility in adapting to changing well operation conditions, necessitating constant improvement and adaptation to new technological challenges and market conditions.
5. Increased Well Lifecycle: Through advanced technologies in well capital repair, the lifecycle of wells can be significantly extended, making them more durable and efficient.
6. Development of Personnel and Competencies: Implementing advanced technologies requires training and development of personnel. Therefore, innovation management includes establishing a personnel training system and supporting their competency.

If we consider the activities of service companies together with the activities of drilling contractors as a continuous supply and use of appropriate resources for well construction in the technological cycle, then the primary role in shaping the quality will belong to project organizations, since it is at the project stage that the technical level of drilling is laid down, and therefore a certain level of excellence of these services.

Consulting (supervising) firms specializing in project-oriented services in the oil and gas industry play an important role in addressing challenges and improving efficiency in this strategic sector. Changes in the economy and technological progress are making this industry even more demanding and competitive. We have identified the following key challenges faced by consulting firms in the oil and gas industry and developed possible strategic directions for addressing them:

1. Change in the Approach of Customers: In the oil and gas industry, customers of consulting services are becoming more demanding and efficient in their use of resources. They not only need high-quality consulting, but they also want transparency in costs and faster processes. Consulting companies must adapt to these changes by offering fixed fees and more innovation in their solutions.
2. Competition and Availability of Information: Competition in the oil and gas consulting industry is increasing, as is the availability of information. This is putting a strain on consulting firms, which traditionally have had a monopoly on expert knowledge. Companies should work to improve the efficiency of their consulting services and provide a unique experience.
3. Increased Transparency and Accountability: In light of the financial crisis and cost containment, clients are demanding a higher level of transparency and accountability from consulting firms. It is important to provide accurate and substantiated information on costs and consulting outcomes.
4. Geopolitical Risks and Digital Innovations: Companies need to be adaptable to geopolitical changes and the rapid adoption of digital technologies. Consultants should offer strategies that address these challenges and help clients integrate new technologies.
5. Changes in Personnel Requirements: The growing number of graduates with economics and technical backgrounds is making smaller, specialized organizations as well

as large consulting firms competitive. Companies need to study the market and adapt their teams to its new requirements. It is also necessary to involve workers with the appropriate qualifications and accreditation in this process, which includes additional cost risks in terms of finding and providing qualified personnel.

Solving these challenges will require oil and gas supervisory firms to be more flexible, and innovative, and have strategies that take into account the specifics of the industry and the needs of clients.

Based on the above, we have developed a tree of problems for the creation of a project-oriented supervisory company in the oil and gas industry, as shown in Fig. 2.

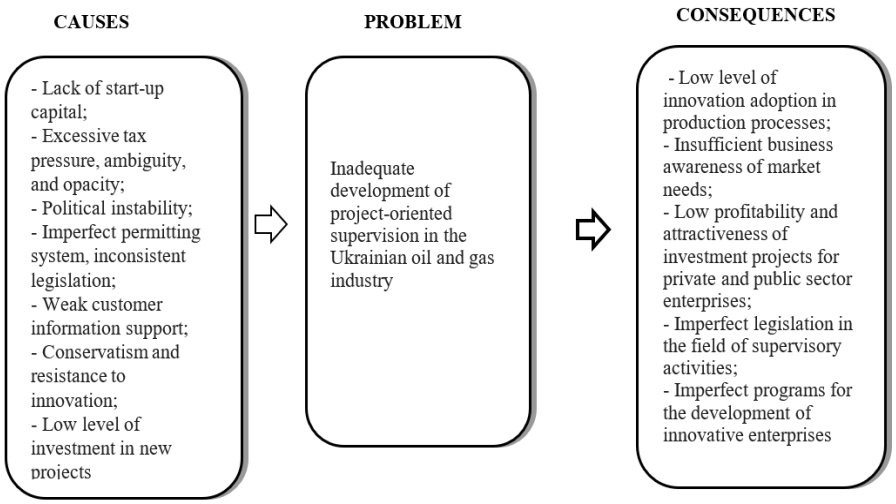

Fig. 2. Tree of problems for the creation of a project-oriented supervisory company in the oil and gas industry.

Analyzing the information presented in the figure, we conclude that the development of project-oriented supervision in the oil industry is inadequate. However, we believe that this direction is quite relevant and necessary for the formation of an innovative infrastructure for oil and gas enterprises. Therefore, we propose to assess the economic efficiency of creating a project-oriented supervisory company in the oil and gas industry. For this, we will use two analysis methods - payback period and return on investment. These are quick first-level methods that allow us to conduct an initial screening and determine the profitability of the project without significant capital investments. However, it is important to note that these methods do not take into account all aspects of the life cycle and do not allow discounted valuation of the cost throughout the entire operating period.

For a more complete analysis of the project's efficiency in the context of the oil and gas industry, it is recommended to use additional methods that correspond to the life cycle costing (*LCC*) approach and include such analysis modes as total life cycle cost, profitability index, net present value, and internal rate of return. These methods allow us to take into account all costs and benefits throughout the entire life cycle of the project and discountedly evaluate them on a time basis.

When analyzing projects in the oil and gas industry, it is important to consider the concept of the discount rate, which determines the cost of capital and is used to calculate discounted values. *ROI* (return on investment) can be used to assess the profitability of investments and compare the efficiency of different projects in the oil and gas industry.

The payback period formula is a key tool in analyzing the profitability of investments in project-oriented management of innovative business processes in the oil and gas industry. This method compares the amount and timing of returns from investments with investment costs.

A high return on investment indicates that the investments are profitable compared to their costs. In the oil and gas industry, where competition for resources is always high, it is important to select projects with higher returns. By comparing returns on investment, decisions can be made about which innovative business processes should be prioritized for implementation.

It is important to note that the calculation of returns on investment can be adapted depending on the specific situation. For example, a marketer may consider the profitability of an oil and gas project by dividing gross profit by marketing costs, while a financial analyst may calculate returns by dividing net profit by the cost of all resources used to project and implement a new business process.

The payback period method has limitations such as the lack of consideration of cash flows and the possibility of manipulating calculations. In the oil and gas industry, where long-term perspectives and accuracy of estimates play a key role, it is important to consider these limitations when using the payback period method in strategic decision-making.

The advantages of the return on investment method include the simplicity of calculations and significant use in the business environment. In the context of project-oriented management of innovative business processes in the oil and gas industry, this method provides the ability to compare the profitability of different innovations and projects.

Understanding that future money has a present value (*PV*) is important in the analysis of oil and gas industry investments. This reflects the concept that the value of money decreases over time, and profitability calculations should take into account this time value. Making a payment in the future (future value) can cost less if viewed in today's values (present value), and this is an important factor in making strategic decisions about innovative projects.

Factors that determine the present value of oil and gas industry projects include the amount of investment, future payment dates, and the ability to earn money during this period. A high amount of investment can increase the present value, but it decreases with the increase of the distance of future payments. In addition, the level of discounts, which is determined by the interest rate, has an impact on the present value.

Understanding the present value in oil and gas industry projects allows one to make rational choices between different innovative business processes, taking into account their efficiency and profitability in the long term.

To calculate the present value (*PV*) in project-oriented management of innovative business processes in the oil and gas industry, where future cash flows are considered, the following formula can be used:

$$PV = \frac{FV}{(1+i)^n}, \tag{1}$$

where *PV* is the present value, *FV* is the future value, *i* is the discount rate, *n* is the number of periods.

For example, if an investment in an innovative business process in the oil and gas industry is being considered, where profit is expected to be received in several years, the present value of that profit is calculated using the following formula:

$$NPV = \sum_{t=0}^{N} \frac{CF_t}{(1+i)^t}. \tag{2}$$

In research on project-oriented management of innovative business processes, where it is important to consider the time value of money, the following key criteria are considered: net present value (*NPV*), benefit-cost ratio (*BCR*), profitability index (*PI*), payback period (*PB*), and discounted payback period (*DPB*):

$$BCR = \frac{\sum_{t=0}^{N} CF_t}{I}; \tag{3}$$

$$PI = \frac{\sum_{t=0}^{N} \frac{CF_t}{(1+i)^t}}{I}; \tag{4}$$

$$parensPB = \min_S \left(\sum_{t=1}^{S} CF_t \geq 0 \right); \tag{5}$$

$$DPB = \min_S \left(\sum_{t=0}^{N} \frac{CF_t}{(1+i)^t} \geq 0 \right), \tag{6}$$

where CF_t is the net cash flow at time t, I is the initial investment, N is the number of periods.

These criteria allow one to evaluate the acceptability and efficiency of innovative projects in the appropriate context, taking into account time and financial parameters.

In the context of project-oriented management of innovative business processes in the oil and gas industry, financial performance analysis and investment evaluation can be carried out using several criteria.

4 Research results

At first glance, it is important to determine the present value (*PV*) and future value (*FV*) of innovative projects to effectively use available funds. Formulas for calculating *PV* and *FV* can be adapted to the specific characteristics of the industry and type of investment.

In particular, the internal rate of return (*IRR*) can serve as an important indicator for determining the economic acceptability of innovative projects. Taking into account the discount rate, *IRR* can serve as a benchmark for evaluating the rate of growth of the profit that an investment will generate. Following the rules of evaluation, the higher the *IRR*, the more desirable the investment.

However, other key criteria can also be used in project-oriented management of innovative business processes, such as net present value (*NPV*), benefit-cost ratio (*BCR*), profitability index (*PI*), and payback period (*PB*). They allow us to consider the time value of money and provide a comprehensive approach to the evaluation of innovative investments in the oil and gas industry.

In conclusion, it is important to use financial criteria for rational management of innovative business processes and ensuring the success of projects in the long term in the context of this industry.

When projecting operating costs, it is very important to distribute them into semi-fixed and variable costs (Tables 1 – 4). When projecting working capital, it is advisable to determine the volume of current assets as the ratio of costs to the corresponding turnover ratio. If necessary to attract a loan, a repayment scheme is developed.

Variable costs per unit of goods (with a total area of 1000 m^2) are 214.29 UAH per m^2.

Table 1. Projected Revenue, UAH.

Source of revenue	Measurement unit	Number of units	Unit price	Total per month	Total per year
Rent of office space	m^2	700	120	84000	1008000
Rent of conference rooms, meeting rooms	days per month	22	5000	110000	1320000
Profit from coworking tenants	days per month	22	300	6600	79200
Provision of information and consulting services	number of resident firms	25	2000	50000	600000
Promotion and advertising	units	25	1000	25000	300000
Total				250600	3007200

Table 2. Variable costs.

Expense category	Measurement unit	Number of units	Unit price, UAH per month	Total amount per month, UAH	Total amount per year, UAH
Salary of contract manager	workers	1	10000	10000	120000
Unified social tax	22%	1	2200	2200	26400
Office supplies and small consumables	amount	–	–	300	3600
Garbage removal for coworking tenants	paid on their own, according to the meter readings				
Lighting for coworking tenants	paid on their own, according to the meter readings				
Heating for coworking tenants	paid on their own, according to the meter readings				
Water supply for coworkig tenants	paid on their own, according to the meter readings				
Total				12500	150000

Table 3. Semi-fixed costs.

Expense category	Measurement unit	Number of units	Unit price, UAH	Total amount per month, UAH	Total amount per year, UAH
Salary of administrative staff	UAH per month	3	12500	37500	450000
Unified social tax	22%		2750	8250	99000
Security of premises and adjacent territory	number of services, UAH per month		6000	10000	120000
Banking services	number of services, UAH per month		500	500	6000
Materials for current repairs	number of services, UAH per month		1000	1000	12000
Garbage removal (own)	number of services, UAH per month		100	500	6000

Continuous of the **Table 3**

Expense category	Measurement unit	Number of units	Unit price, UAH	Total amount per month, UAH	Total amount per year, UAH
Lighting (of administrative premises)	kW	600	1.68	1008	12096
Heating (of administrative premises)	a cubic meter of gas	200	8.5489	1709.784	20517.41
Water supply (of administrative premises)	cubic meter	15	15	225	2700
Utilities	square meter	1000	6.84	6840	82080
Office supplies and small consumables	amount			500	6000
Depreciation				11125	133500
Total				79157.8	949893.6

Table 4. Depreciation.

Expenses	All Years				Service life, years	Annual service cost
	Unit	Number of Units	Unit cost, UAH	Total cost, UAH		
Furniture, computer equipment	per object	10 sets	300000	300000	5	60000
Creation of project documentation	per object	–	150000	150000	20	7500
Cost of building work	per object	–	792000	792000	20	39600
Cost of building materials	per object	–	528000	528000	20	26400
Total, year				1470000		133500
Total, month						11125

In the first year of the post-projection period, cash flow is 1 293 400 UAH.
The reversal cost is:

$$V_{rev} = NCF_{\tau_{pr}} \cdot \frac{1-(1+R)^{-(\tau-\tau_{pr})}}{R} = 1293.4 \cdot \frac{1-(1+0.124)^{-(20-5)}}{R} = 9\ 000\ 800\ \text{UAH}.$$

The present value of the reversal is: 9 000 800 · 0.645099 = 5 806 400 UAH.
Performance indicators:

$$NPV = 5\ 806\ 400 + (-652\ 600) = 5\ 153\ 800\ \text{UAH}.$$

$$IRR = 30\%.$$

$$DPI = \frac{2040 + 5153.8}{2692.5} = 2.67\ \text{times}.$$

$$PBP = 4.75 + (5.75 - 4.75) \cdot \frac{0 - 89.7}{750.1 - 89.7} = 4.65 \text{ year.}$$

The projected revenue is 3 007.00 UAH per year, variable costs are 150.000 UAH per year, and semi-fixed costs are 949893.6 UAH per year. Depreciation is estimated at 133.500 UAH per year. Financial and economic analysis of the project confirms its profitability with indicators of NPV 5 153 800 UAH per year, IRR 30%, DPI 2.67 times, and a payback period of 4.65 years.

Risk analysis indicates the main threats, such as schedule non-compliance, budget overruns, currency fluctuations, and political influence. However, the main risks are controlled within the center itself.

5 Conclusions

The oil and gas industry is one of the key sectors of the energy sector. It is characterized by the complexity of technical tasks, a high level of risk, and the need for effective project management to achieve strategic goals. The use of project-based management in this industry can optimize production processes, improve energy efficiency, and ensure the safety of operations. This is what actualizes the issue of creating an innovative infrastructure – a project-oriented supervisory enterprise that will provide consulting services to oil and gas companies. This study identified and highlighted the key problems faced by consulting firms, and developed directions for addressing them, namely: change in the approach of customers, competition, and availability of information, increased transparency and accountability, geopolitical risks and digital innovations, and changes in personnel requirements. Solving these challenges will require supervisory firms to be more flexible, and innovative, and implement strategies that consider the specifics of the industry and the needs of clients. Considering all this, the tree of problems with which the process of creating such a company in the oil and gas industry may face was formed and possible directions for their solution were proposed. The feasibility of creating a project-oriented supervisory company was justified. The economic efficiency was assessed using both basic methods – payback period and return on investment, as well as additional ones that correspond to the approach to costs depending on the life cycle. The total life cycle cost, profitability index, net present value, and internal rate of return were considered. The calculations have confirmed the profitability of the proposed infrastructure project.

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