Research article

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FORMATION OF INNOVATIVE-INDUSTRIAL CLUSTER STRATEGY BY PARALLEL AND SEQUENTIAL REAL OPTIONS

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Abstract

The subject of this study is the strategy of the innovative-industrial cluster. The purpose of this work is to form a cluster strategy using parallel and sequential real options. The method proposed for this involves applying a parallel real option when justifying the prospect of acquisition, and a sequential real option to assess the prospect of individual development. A parallel option involves assessing risky forms of financing as part of the cluster strategy presented by the core company. In this case, the operation "management buyout" (MBO) is considered, for example, from the managers of the parent organization. A sequential option implies the stage of cluster strategy implementation. In this case, we consider two options that make up the sequence of possible adjustments to the strategy of the core company. This is an option to develop experience in the cluster and an option to switch the cluster strategy. As an example of the implementation of the presented method, the process of forming a strategy for the development of a pilot electric power cluster, was considered. Here, a sequential option allows us to obtain a slightly higher net present value than the net present value of a parallel option. Therefore, the managers must themselves decide whether to negotiate on the acquisition or to independently develop further based on the stage of implementation of the cluster strategy. The second choice will allow the preservation and development of the pilot innovative-industrial cluster of the electric power industry in the region in accordance with the priorities of the region in which it is located. This will make it possible to further realise the innovative potential in the region.

Keywords: innovative-industrial cluster, compound real option, innovations, cluster strategy

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ФОРМИРОВАНИЕ СТРАТЕГИИ ИННОВАЦИОННО-ИНДУСТРИАЛЬНОГО КЛАСТЕРА МЕТОДОМ ПАРАЛЛЕЛЬНЫХ И ПОСЛЕДОВАТЕЛЬНЫХ РЕАЛЬНЫХ ОПЦИОНОВ

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Аннотация

Предметом исследования является стратегия инновационно-индустриального кластера. Цель работы - формирование стратегии кластера методом параллельных и последовательных реальных опционов. Предложенный для этого метод предполагает при обосновании перспективности поглощения применять параллельный реальный опцион, а для оценки перспективности индивидуального развития – последовательный реальный опцион. Параллельный опцион подразумевает оценку рискованных форм финансирования в рамках стратегии кластера, представленного компанией – ядром. В данном случае рассматривается операция “management buyout” (MBO), например, от менеджеров головной организации. Последовательный опцион подразумевает стадийность осуществления стратегии кластера. В данном случае рассматриваются два опциона, составляющие последовательность возможной корректировки стратегии компании – ядра. Это опцион на развитие опыта в кластере и опцион на переключение стратегии кластера. В качестве примера реализации представленного метода рассмотрен процесс формирования стратегии развития пилотного кластера электроэнергетики в Нижегородской области, который представлен компанией – ядром ПАО «ТНС энерго НН». Для него последовательный опцион позволяет получить чистый приведенный доход незначительно больше чистого приведенного дохода параллельного опциона. Поэтому менеджеры должны сами принять решение: договариваться с ПАО ГК «ТНС энерго» о выкупе ПАО «ТНС энерго НН» или развиваться дальше самим на основе стадийности осуществления стратегии кластера. Второй вариант позволит сохранить и развивать пилотный инновационно-индустриальный кластер электроэнергетики в Нижегородской области в соответствии с приоритетами региона, в котором он находится. Это позволит в дальнейшем реализовать имеющийся в регионе инновационный потенциал.

Ключевые слова: инновационно-индустриальный кластер, составной реальный опцион, инновации, стратегия кластера

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1. Introduction

Bringing the socioeconomic values of innovative-industrial clusters in line with the value system of a large region is an integral part of the development and subsequent correction of the cluster development strategy. Often, the core company of a pilot cluster has to make a choice between the strategy of its acquisition and the strategy of individual development in accordance with the priorities of the region in which it is located. Such priorities include, primarily, social traditions, as well as innovative potential, expressed by the availability of production, financial, labour, and other resources for the successful development of the region (Yashin et al., 2019).

Nowadays, clustering is one of the most effective ways to overcome systemic challenges and crisis phenomena in the economy. For example, Polyanin et al. (2020) created a methodology for assessing the economic security of a cluster, which is characterized by a comprehensive approach that takes into account all possible risks and threats in the functioning of individual components of the cluster structure.

Kudryavtseva et al. (2020) developed a methodology for assessing and monitoring cluster structures. The method proposed by the authors allows us to assess the level of development of the cluster structure by analysing the cluster transformation in the information and communication sectors of the regional economy, the prerequisites for the formation of the cluster, as well as the current level of development of the digital cluster in the region. To assess the prerequisites for the formation of a digital economy cluster, an integral indicator is calculated, and a multiparameter approach is used to assess the effectiveness of the cluster. The proposed methodology allows researchers to compare clusters from different regions and monitor their development.

Moeis et al. (2020) studied the dynamics and sustainability of the Tanjung Priok port cluster. System dynamics are used to study the problem, and the stability of the port cluster is assessed by modelling the dynamics of the system over a 20-year period. This study further examines the impact of an alternative port cluster development programme (namely, free trade policy) and shore power system (SPS) programme policies on the sustainability of the port cluster. The model points out that when free trade policies and the SPS programme are implemented in tandem to maximise the economy and reduce environmental damage, they provide additional benefits.

Significant attention is drawn to the issues of digitalization of industrial enterprises and clusters in the formation of the "Industry 4.0". For instance, Tashenova et al. (2020) developed a method for assessing the digital potential of the main innovatively active industrial clusters. The method is developed on the basis of existing methods and approaches to assessing the innovative potential of industrial clusters and the digital potential of industrial enterprises, and allows calculation of the final integral assessment, which includes calculations for each of the seven subpotentials of the parameters that experts have identified as important.

Considering the formation of the cluster strategy, it is necessary to note that strategic decisions should be based on a correct understanding of the results of the systematic analysis conducted by managers to form sustainable competitive advantages. For example, Bogdanova and Karlik (2020) consider the following aspects: sectoral and regional conditions within the strategic directions of activities and interests of organizations, the prevailing forms and types of strategic interactions, the level of innovative potential of the industry and the region, and specific influencing factors of macro- and micro-levels. However, what is really important is not only the socioeconomic significance (efficiency and rationality) of the decision itself but also the speed, and even more so the timeliness of its implementation, predetermined by the dynamics of industry factors.

A cluster is a group of geographically adjacent interrelated companies (suppliers, manufacturers, intermediaries) and related organizations (educational institutions, government bodies, infrastructure companies) operating in a certain area and complementing each other (Porter, 2008).

The allocation of pilot clusters that bring the greatest benefit to the population of the region, taking into account its historical traditions as well as the types of production in the region, is a strategically important task for the executive authorities. To develop an innovative strategy for state-defined pilot clusters, it is important to apply technologies that allow flexible management decisions to be made. Taking into account the wide range of opportunities and threats to clusters, such a technology can be compound parallel and sequential real options. This technology has not been previously used by anyone to develop a strategy for an innovative-industrial cluster.

Speaking about the innovative-industrial cluster, it is necessary to start by singling out the situation in which the pilot cluster is formed around a single company, the core of the cluster. Such a development of events is possible only if there is, first, a sufficiently significant production capacity of such a company. In the opposite situation, for example, when we consider a tourist cluster, the presence of a single company, the core, will kill the nascent cluster, since there will be no internal competition in the region that could contribute to the harmonious development of the territory.

In this manner, the development of a pilot innovative-industrial cluster in a region is largely due to the activities of the core company of the cluster. To justify the strategic choice between acquisition and individual development of the core company of the pilot cluster, it is necessary to conduct an appropriate monetary assessment of such management decisions. However, in practice, such an assessment cannot always give an unambiguous answer about the choice of strategy. In this case, it is advisable to focus on the socioeconomic needs of the region in which the pilot innovative-industrial cluster is located. This will facilitate further realisation of the innovative potential available in the region.

To solve this problem, it is possible to use the method of compound real options, where a parallel real option can be used to justify the acquisition strategy, and a sequential real option is used to assess the individual development strategy (Mun, 2002; Kodukula and Papudesu, 2006).

2. Literature Review

Recent advances in real options cover a wide range of solvable business, governmental, and banking issues.

For example, Locatelli, Mancini, and Lotti (2020) presented a method based on a systematic simulation of several scenarios generated according to the exercise thresholds of relevant investment parameters. An exercise threshold gives the investors the exercise right of making some decision, for instance, building a power plant. An exercise threshold is, therefore, a rule to decide whether to exercise or not a certain option on the basis of the values of one or more state variables.

The work of Lai and Locatelli (2021) is aimed at implementing and testing an algorithm based on real options analysis to quantify the "option to prototype" in the energy sector. First, the interrelated research areas of prototyping, energy systems, and real options analysis are considered. A new algorithm is then introduced and applied to an innovative integrated generation energy storage site system, i.e. wind-driven thermal pumping, to demonstrate the efficiency of prototype selection and the main parameters affecting this decision. The results show that the key parameters are the cost of the prototype and the size of the market (the number of identical systems to build).

Tan and Trimidad (2018) applied the real options theory to banking operations among the actively traded Philippine Universal Banks. Scientists study the option premiums of loan portfolios, which reflect managerial flexibility with investment strategy. The real options model, which takes into account both lending and idling strategies, shows that smaller credit institutions value loans higher than their larger competitors. Based on the model, the need to maintain smaller deviations in the profitability of the loan portfolio limits the flexibility of managers' decisions. Option premiums in the Philippines demonstrate sensitivity to information asymmetry.

Tan (2018) found that variables that expand real options models provide interfaces through which entrepreneurs can view promising ventures or resources. Factors affecting the real value of options stem from the external environment of the enterprise and are forms of various business conditions between entrepreneurs, the venture, and the external environment. Interface identification increases the final value of a real option and provides entrepreneurs with information with which to structure businesses that derive value from arbitrage and innovation opportunities.

The already classic compound real options for options are divided into sequential and parallel. The sequential connection option exists when the project has several phases, and the last phases depend on the success of the previous phases (Mun, 2002).

The compound option may be sequential or parallel, also known as simultaneous. If it is necessary to exercise it to create another option, it is considered sequential. For example, before starting to create a factory, one must complete the design phase. In a parallel option, however, both options are available at the same time. The term of an independent option is greater than or equal to the lifetime of the underlying option. A television broadcaster can simultaneously build an infrastructure for digital transmission and apply for the required broadcast spectrum but cannot complete infrastructure testing without a spectrum license. The acquisition of spectrum, i.e. the option itself, gives the broadcaster the opportunity to complete the infrastructure and launch a digital broadcasting service (Kodukula and Papudesu, 2006).

First we consider in more detail a number of scientific achievements in the field of sequential real options. Hauschild and Reimsbach (2015) proposed a binomial approach to modelling sequential investments in R&D. More specifically, they presented a comprehensive approach to real options, simplifying the existing valuation methodology. The authors demonstrated the applicability of their approach to a real-world example of evaluating new drug use.

Martins and Silva (2005) developed a real option model with uncertain and consistent investments and time to build. The model includes options for entering and exiting activities and solves the problem of maximizing the value of the company, taking into account the possibility of investment.

Leiblein and Ziedonis (2006) considered the application of real options theory to sequential investment decision-making. They presented a conceptual model that explains technological implementation as a sequence of built-in options. After implementing each generation of technology, a company can either postpone investment and wait for the arrival of the next generation, or invest now and gain experience that provides the preferred approval for the adoption of subsequent generations.

Baranov and Muzyko (2015) concluded that the value of a compound real option increases the total cost of an innovative project due to the factor of phased investment and the possibility of termination of financing.

Claire and Guise (2019) evaluated different types of compound options and ultimately applied this estimate to real options to assess a biotechnology firm's successive investment in R&D. Scientists have found that for a compound option with multiple execution periods, transaction costs may need to be paid on each execution. The total transaction costs cannot be insignificant, and the estimated value of the option may be higher than the actual value of the option.

Tavakkolnia (2016) developed an intuitive and practical method for evaluating multi-stage strategic or investment projects. Within it, specific volatility is assigned to each stage of the project and is assessed in a fuzzy framework using data from previous similar projects and expert knowledge. These fuzzy volatilities are then incorporated into a multi-stage model of the binomial tree valuation. Finally, the presented model is implemented using an R&D project as an example. The advantage of the model is that it can be easily extended through the use of different types of options built into multi-stage projects.

Konstandatos (2015) evaluated a multi-stage mining solution in which mining operators have the option to delay the start of a project, as well as options to phase out production and expand production to a new rock formation if conditions improve.

Cassimon, Engelen, and Yordanov (2011) obtained an extended model through a case study evaluating real options of a multi-stage software application project by a major mobile operator and showed how project managers can estimate volatility depending on the phase.

Xu, Zhou, and Phan (2010) studied how firms in emerging markets solve their information problems during acquisitions. One strategy is to complete the acquisition sequentially rather than as a one-time trade. Unlike companies in developed countries, which have relatively easy access to information, emerging market firms face different access to information on target firms due to institutional weaknesses and constraints in these markets. Sequential acquisitions are conceptualized as a strategy based on real options whereby a sequential acquirer resolves the uncertainty of valuation through information gathering and post-purchase learning. The value of a successive acquisition strategy increases for information-disadvantaged firms.

Parallel real options are most often used to assess risky forms of project financing. A typical example is the LBO (leveraged buyout) scheme. If the LBO project is carried out by the top managers of the company, then it is called MBO (management buyout).

For example, the work of Renneboog and Vansteenkiste (2017) developed a theoretical justification for potential sources of value creation from private ones: a distinction is made between reducing the costs of agencies associated with shareholders, transfers of stakeholder wealth, tax incentives, savings of operating costs, takeover defence strategies, and corporate undervaluation. The paper then examines and summarises how these theories have been empirically tested in four different lines of literature in LBO research. These lines of literature are classified by phase in an LBO transaction: intent (buyout), impact (LBO on various stakeholders), process (restructuring after buyout), and duration (retention of private status).

Demiroglu and James (2010) investigated whether the reputation of the acquisition of private equity groups (PEG) was linked to the financing structure of the LBO. They found that reputable PEGs are more active in the LBO market when credit risk spreads are low and lending standards in credit markets are weak. The authors also found that reputable PEGs pay narrower banking and institutional spreads on loans, have longer loan repayment terms, and rely more on institutional loans. In addition, although the scientists found that a PEG’s reputation is positively related to buyout leverage (i.e., LBO debt divided by profits before the LBO before interest, taxes, amortisation, and depreciation (EBITDA) of the target), and leverage is significantly positively related to buyout pricing, the authors found no direct relationship between PEG reputation and buyout estimates. The data suggests that a PEG's reputation is tied to the LBO's funding structure, not only because reputable PEGs are more likely to take advantage of market terms in credit markets, but also because a PEG's reputation reduces the agency costs of LBO debt.

Private equity investors have traditionally used innovative financial techniques to structure their leveraged buyout (LBO) transactions. In recent years, they have often resorted to securitization to raise funds from the operating assets of their acquisitions. A distinctive feature of these transactions is that they aim to strengthen the securitizing solvency of the LBO through a set of structural improvements, including operational debt obligations. The results of a study by Bouvier and Nisar (2015) showed that under the operating system adopted by Hertz LBO, securitization improved the ability to service the debt of the transaction.

A debt buyout entails the purchase of a corporation or division, financing the purchase primarily through debt. Management buyout (MBO) is most often understood as a leveraged buyout in which the managers of a corporation or division take ownership of an enterprise. Buyouts by management can change the ownership structure and operational and financial image of the firm and therefore cover all relevant aspects of the company's restructuring activities. Tax incentives are a common source of value creation through both buyouts and acquisitions using borrowed funds, and through buyout by management. Additional sources of value creation resulting from the purchase of management services include reorganized management incentives and increased budgetary discipline, which contribute to improved performance (Wehrly and Shen, 2016).

3. Materials and Methods

We will consider both options for the possible formation of the cluster strategy represented by the core company. Initial and projected data on its cash flows are provided on the Conomy website by the company "M3" (https://old.conomy.ru).

1. Evaluation of risky forms of financing within the framework of the cluster strategy (parallel real option). In this case, the MBO operation is considered, for example, by the managers of the parent organisation. By making such a transaction, managers will receive a real call option on the company's shares, which are themselves an option. Thus, we are dealing with an option for an option. In this case, the basis and derivative options exist at the same time, so the option is parallel.

The value of the basis option, i.e. the shares of the acquired company, the core of the cluster (Fig. 1), will have the value

$$C_0 = \frac{(S_{1,\text{opt}} - K_1)p_{\text{opt}} + S_{1,\text{pes}} \cdot p_{\text{pes}}}{1 + \text{WACC}} = \frac{(S_{1,\text{opt}} - K_1)p_{\text{opt}} + 0 \cdot p_{\text{pes}}}{1 + \text{WACC}} \quad (1)$$

where $S_{1,opt}$ and $S_{1,pes}$ are the optimistic and pessimistic values of the future monetary earnings of the acquired firm, adjusted for the beginning of the next year (rub.);

K_1 are investments in the implementation of the company's strategy in the next year (rub.);

p_{opt} and p_{pes} are the probabilities of optimistic and pessimistic scenarios; and

WACC is the weighted average cost of capital of the firm (%).

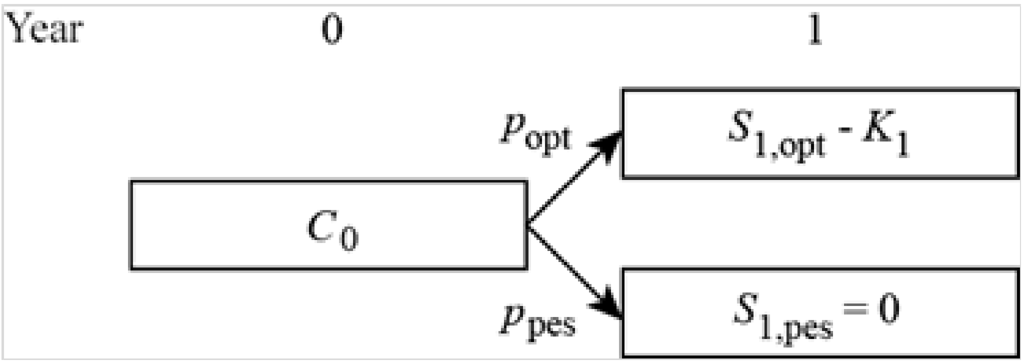

Figure 1. 100% Option Value Tree

To check whether there will be 0 in the 2nd component of the numerator of the formula (1), the own debt of the acquired company, the core of the cluster, $D_1 = D_0$ (1 + WACC) is compared with the value of $S_{1,pes}$. If $S_{1,pes} < D_1$, executing the call option becomes unprofitable, so there will be 0 in the numerator.

Next, the managers of the parent organization take a long-term loan D_0 to carry out the MBO transaction, which partially covers the value of the underlying option C_0. The rest of the value of C_0 is financed by the own and other capital of the acquiring company, i.e. $CS_0 = C_0 - D_0$.

Then, using the projected MBO credit rate, the value $S_{1,opt} - K_1$ required to estimate the value of the derivative option C_0, i.e. the option managers get on the shares of the acquired firm, is estimated. The investment K_1 in this case is a loan for the MBO operation with interest after a year.

After that, the value of the derivative of the C_0 option is calculated according to the formula (1) with the only difference that here the WACC rate for the parent organization is used, since the profitability of this operation is estimated for it (Fig. 2).

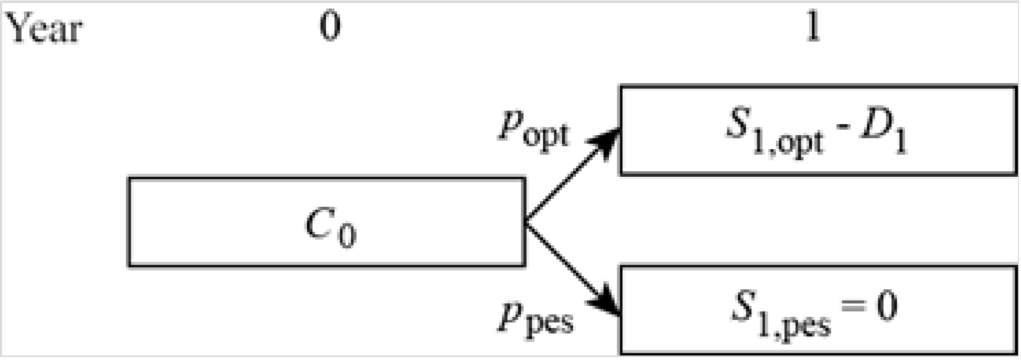

Figure 2. Parallel Option Value Tree

Finally, based on the value of the derivative option C_0, the net present value for managers from the MBO transaction is estimated as NPV = C_0 - CS_0.

2. Evaluation of options for the staged implementation of the cluster strategy (sequential real option). In this case, two options are considered that make up the sequence of the possible formation of the strategy of the core company of the cluster. These are the cluster experience development option and the cluster strategy switch option. That is, as soon as the possibilities for cluster experience development are thoroughly exhausted, it is assumed that the cluster will switch to a new, more progressive technology that will increase the value of the core company's business.

The value of the underlying (Fig. 3) and derivative (Fig. 4) options, as well as the net present value of the staged implementation of the firm's core strategy, can be estimated using the following formulas:

$$C_1 = \frac{(S_{2,\text{opt}} - K_2)p_{\text{opt}} + 0 \cdot p_{\text{pes}}}{1 + \text{WACC}},\ C_0 = \frac{(S_{1,\text{opt}} - K_1)p_{\text{opt}} + 0 \cdot p_{\text{pes}}}{1 + \text{WACC}},\ \text{NPV} = C_0 - K_0 \quad (2)$$

where K_0 and K_1 are the present values (PV) of costs at the beginning of each stage of the implementation of the cluster strategy (rub.).

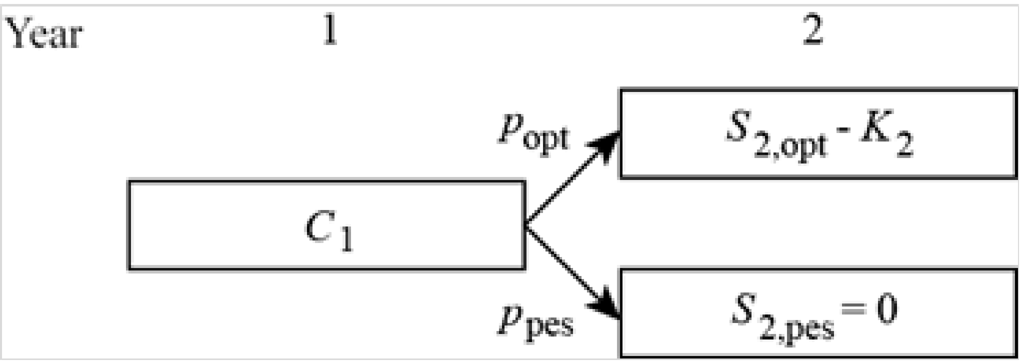

Figure 3. Cluster Strategy Switch Option Value Tree

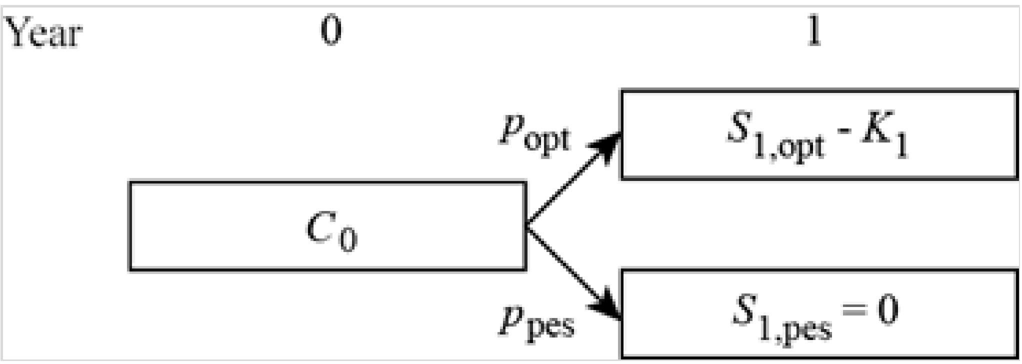

Figure 4. Cluster Experience Development Option Value Tree

4. Results

As an example of the implementation of the proposed method, we will consider the process of forming a development strategy for a pilot electric power industry cluster in the Nizhny Novgorod region. It was found that it is more profitable for the Nizhny Novgorod innovation and industrial cluster to develop in the "Electric Power Industry" direction (Yashin et al., 2019). For this, the Nizhny Novgorod region has the necessary innovative potential, i.e. enough production, financial, labour, and other resources for the successful evolution of the cluster.

This pilot cluster is represented by the core company of the TNS energo NN PJSC cluster. The TNS energo Nizhny Novgorod PJSC is the largest energy supply company in the Nizhny Novgorod region, with the status of a guaranteeing supplier. It was founded in 2005 as Nizhny Novgorod Sales Company OJSC. Ten years later, it received its modern name. It occupies a share of about 60% of the regional electricity sales market. It belongs to the GC TNS energo PJSC (https://old.conomy.ru). Initial and forecast data on its cash flows are provided in previous research (Yashin et al., 2021).

Further, we will compare two options for the formation of a development strategy for a pilot cluster of the electric power industry, using the corresponding compound real options for this purpose. In the first case, it is assumed that TNS energo NN PJSC will be acquired by the parent organisation GC TNS energo PJSC. In the second case, independent individual development of PJSC TNS energo NN is expected.

The second case will allow the preservation and development of a pilot innovation and industrial cluster of the electric power industry in the Nizhny Novgorod region in accordance with the priorities of the region in which it is located. Such priorities include social traditions, as well as innovative potential, expressed by the availability of production, financial, labour, and other resources for the successful development of the region.

The parent organization GC TNS energo PJSC does not need a pilot electric power cluster in the Nizhny Novgorod region. It only wants to assess the possibility of increasing the market value of its business through MBO operation with the shares of TNS energo NN PJSC.

On the contrary, the pilot electric power industry cluster represented by its core company TNS energo NN PJSC wants to assess which of the two options under consideration will give the highest cost of its strategy, that is, the effect of its implementation by the core company of the cluster.

GC TNS energo PJSC is the parent company of the eponymous largest Russian energy supply holding, which includes 10 companies: TNS energo Veliky Novgorod LLC, TNS energo Voronezh PJSC, TNS energo Karelia JSC, Kubanenergosbyt JSC, TNS energo Mari El PJSC, TNS energo NN PJSC, TNS energo Penza LLC, TNS energo Rostov-on-Don PJSC, TNS energo Tula JSC, and TNS energo Yaroslavl PJSC. Registered in 2013 in Moscow as GC TNS energo JSC, in 2014, it received its public status (https://old.conomy.ru).

1. Evaluation of risky forms of financing within the framework of the cluster strategy (parallel real option). The MBO operation is expected from the managers of the parent organization, i.e. GC TNS energo PJSC.

Loans and borrowings of TNS energo NN PJSC for 2020:

$$D_1 = D_0(1+\mathrm{WACC}) = 4\ 558\ 531 \cdot 1{,}1256 = 5\ 131\ 082 > 2\ 358\ 870 = S_{1,\mathrm{pes}}$$

Therefore, in a pessimistic scenario, all the assets of the core company of the cluster will be allocated for paying off its debts, and the managers of the parent company (GC) will not receive anything.

The value of the basis option, i.e. the shares of the acquired core company of the cluster according to the formula (1) will equal

$$C_0 = \frac{(8\,770\ 806 - 5\ 131\ 082)\cdot 0,5 + 0\cdot 0,5}{1,1256} = 1\ 616\ 793 \text{ (thousand rubles).}$$

Managers of the GC in 2019 can take a long-term loan for MBO in the amount of

$$D_0 = 1\ 547\ 149 \text{ (thousand rubles).}$$

Own and other capital of the GC:

$$\mathrm{CS}_0 = C_0 - D_0 = 1\ 616\ 793 - 1\ 547\ 149 = 69\ 644 \text{ (thousand rubles).}$$

The projected loan rate is 13%. Then,

$$S_{1,\mathrm{opt}} - K_1 = 3\ 639\ 724 - 1\ 547\ 149\cdot 1,13 = 1\ 891\ 446 \text{ (thousand rubles).}$$

The value of the derivative option, i.e. the managers' option on the shares of the acquired firm, taking into account   for the GC according to the formula (1) will be

$$C_0 = \frac{1\ 891\ 446\cdot 0,5 + 0\cdot 0,5}{1,1152} = 848\ 030 \text{ (thousand rubles).}$$

The net present value for GC managers from an MBO transaction is:

$$\mathrm{NPV} = C_0 - \mathrm{CS}_0 = 848\ 030 - 69\ 644 = 778\ 386 > 0 \text{ (thousand rubles),}$$

i.e. the MBO operation is beneficial for the managers of the GC.

2. Evaluation of options for the staged implementation of the cluster strategy (sequential real option). To do this, two options are used that make up the sequence of possible formation of the strategy of the core company of the cluster. At the same time, each stage of the formation of the cluster strategy lasts for one year.

Cluster experience development option. Short-term investments in 2019 will amount to 489,948 thousand rubles, and in the optimistic scenario, they will increase the cash flow (CF) by 13.5% by reducing losses of the network companies (https://old.conomy.ru):

$$S_{1,\mathrm{opt}} = 1\ 225\ 461 + (8\ 770\ 806 - 1\ 225\ 461)1,135 - 551\ 486 = 9\ 237\ 942 \text{ (thousand rubles),}$$

$$\Delta S_{1,\mathrm{opt}} = 9\ 237\ 942 - 8\ 770\ 806 = 467\ 136 \text{ (thousand rubles).}$$

Cluster strategy switch option. A year after the successful reduction of losses of the network companies, i.e. in 2020, it is implied that TNS energo NN PJSC will switch to the new technology of TNS energo Rostov-on-Don PJSC. Initial and forecast data on the cash flows of TNS energo Rostov-on-Don PJSC are provided in previous research (Yashin et al., 2021).

Taking into account the effect of the previous stage, i.e. the execution of the cluster experience development option, in an optimistic scenario, the present value (PV) of costs at the beginning of the stage of switching to a new technology in 2020 will be

$$\Delta K - \Delta S_{1,\mathrm{opt}} = 3\ 876\ 628 - 467\ 136 = 3\ 409\ 492 \text{ (thousand rubles).}$$

As a result, we can collect data on the two stages of forming the cluster strategy in Table. 1.

Table 1. Data on the Stages of Implementation of the Cluster Strategy

Stage	Term (years)	PV of costs at the beginning of the stage (thousand rubles)	Probability of success
Reducing losses of network companies	1	489 948	0.5
Switching to a new technology	1	3 409 492	0.5

Then, the value of the underlying and derivative options, as well as the net present value of the staged implementation of the firm's core strategy, will be evaluated using the formulas (2):

$$C_1 = \frac{14984\ 536 \cdot 0,5 + 0 \cdot 0,5}{1,1256} = 6\ 656\ 244 \text{ (thousand rubles)},$$

$$C_0 = \frac{(6\ 656\ 244 - 3\ 409\ 492) \cdot 0,5 + 0 \cdot 0,5}{1,1256} = 1\ 442\ 232 \text{ (thousand rubles)},$$

$$\text{NPV} = 1\ 442\ 232 - 489\ 948 = 952\ 284 > 0 \text{ (thousand rubles)},$$

That is, staging the implementation of the cluster strategy is beneficial.

The final conclusion for the pilot cluster of the electric power industry will be that in the process of forming the cluster strategy, the sequential option allows us to obtain slightly higher NPV than the NPV of the parallel option. Therefore, the managers of TNS energo NN PJSC must make their own decisions: to negotiate with GC TNS energo PJSC on the acquisition of TNS energo NN PJSC or to develop further on the basis of the staged implementation of the cluster strategy. The second option will allow the preservation and development of a pilot innovation and industrial cluster of the electric power industry in the Nizhny Novgorod region in accordance with the priorities of the region in which it is located. Such priorities include social traditions, as well as innovative potential, expressed by the availability of production, financial, labour, and other resources for the successful development of the region.

5. Discussion

The allocation of pilot clusters that have the greatest benefit for the population of the region, taking into account its historical traditions as well as the types of production in the region, is a strategically important task for the executive authorities.

Comparing the results obtained with the experience of other scientists, Polyanin et al. (2020) created a methodology for assessing the economic security of the cluster, which is characterized by a comprehensive approach that takes into account all possible risks and threats in the functioning of individual components of the cluster structure.

Kudryavtseva et al. (2020) developed a methodology for assessing and monitoring cluster structures. To assess the prerequisites for the formation of a digital economy cluster, an integral indicator is calculated, and a multiparameter approach is used to assess the effectiveness of the cluster. The proposed methodology allows researchers to compare clusters from different regions and monitor their development.

Moeis et al. (2020) studied the dynamics and stability of the Tanjung Priok port cluster. System dynamics are used to study the problem, and the stability of the port cluster is estimated by modelling the dynamics of the system over a 20-year period of time.

Tashenova et al. (2020) developed a method for assessing the digital potential of the main innovatively active industrial clusters. The method is developed on the basis of existing methods and approaches to assessing the innovative potential of industrial clusters and the digital potential of industrial enterprises, and it allows calculation of the final integral assessment, which includes calculation for each of the seven subpotentials of the parameters that experts have identified as important.

However, in order to develop an innovative strategy for the pilot clusters defined by the state, it is important to apply technologies that allow flexible management decisions to be made. Taking into account the wide range of opportunities and threats to clusters, such a technology can be compound parallel and sequential real options. They make it possible to turn the future risks of the innovative-industrial cluster strategy into advantages due to the preliminary calculation of the effect of changing the strategy to account for future adverse situations as well as tactical opportunities for the development of the cluster.

The results obtained can be useful to public authorities in the processes of planning the development of innovative-industrial clusters and the harmonious development of the country's territories.

6. Conclusion

In the end, we will formulate the most important theoretical and practical conclusions.

1. To justify the choice between the acquisition strategy and the individual development of a pilot innovative-industrial cluster, it is necessary to conduct an appropriate monetary assessment of such management decisions. However, in practice, such an assessment cannot always give an unambiguous answer about the choice of strategy. In this case, it is advisable to focus on the socioeconomic needs of the region in which the cluster is located. This will allow further realization of the innovative potential available in the region.

2. To solve the indicated problem, it is possible to use the method of compound real options, where a parallel real option is applied when justifying the acquisition strategy, and a sequential real option is applied to assess the strategy of individual development.

3. As an example of the implementation of the presented method, the process of forming a strategy for the development of an electric power industry pilot cluster in the Nizhny Novgorod region, which is represented by the core company TNS energo NN PJSC, is considered. Here, the sequential option allows us to obtain slightly higher NPV than the value of the NPV of the parallel option. Therefore, the managers of TNS energo NN PJSC must make their own decisions: whether to negotiate with GC TNS energo PJSC on the acquisition of TNS energo NN PJSC or to develop further on the basis of the staged implementation of the cluster strategy. The second option will allow the preservation and development of a pilot innovation and industrial electric power industry cluster in the Nizhny Novgorod region in accordance with the priorities of the region in which it is located.

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