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GEOMETRIC-ANALYTICAL ASSESSMENT OF THE STRATEGIC POTENTIAL OF CONSTRUCTION COMPANIES USING QUALITATIVE METHODS

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ABSTRACT. Many years of experience show that in most cases the company's development strategies, which are an essential condition for their competitiveness, have been unsuccessful. The main reason for this situation is that the possibilities of implementing such strategies have not been properly assessed. This is a difficult task, as it includes both internal and external situations of the company, which are reflected by many indicators. The company's ability to properly evaluate them can be described by the concept of its strategic potential. By its very nature, it is a complex phenomenon, so multi-criteria methods are suitable for quantitative assessment of its condition. Today, they are all based on linear estimation, i.e. the importance of the indicator does not depend on its value. In real life, everything happens non-linearly, so it is appropriate to integrate such an approach into the assessment of the state of socioeconomic phenomena or processes. In this case, the transformed value of the indicator follows a double exponential distribution, which is one of the three limiting cases of the distribution of statistics, corresponding to the curve. The assessment of the strategic potential of four construction companies was carried out based on the known four linear multi-criteria evaluation methods, both those that do not require and those that do require knowledge of the weights of the indicators – sum of places, geometric mean, SAW, TOPSIS and PROETHEE. Non-linear evaluation was carried out in a geometric-analytical way. The obtained results, expressed in ratings, are the same when evaluated by PROMETHEE II and the geometric-analytical method and are equally different compared to the SAW and TOPSIS methods. On the other hand, compared to the PROMETHEE II method, the geometric-analytical method is much simpler and therefore easily automated. In addition, it can be applied in cases where some of the indicator values are negative.

JEL Classification: F63, E17

Keywords: company's strategic potential, linear and non-linear geometric-analytical multi-criteria assessment

Introduction

Strategic planning, the main function of strategic management, becomes the basis for the successful long-term operation of companies in the conditions of the development of international markets and intensifying competition. This is not by chance. Today, companies operate in a constantly changing environment, so insightful strategy becomes a key tool for their competitiveness. Competitiveness is an integral result of their development. It is reflected by both domestic and foreign markets. The company can maintain or increase them only by being able to adapt to their constantly changing requirements. These requirements call for the necessity of timely internal changes, especially when forming the company's production program. Adaptation cannot be passive, partial, i.e. seeking only to maintain the available positions in the market. A similar situation is characteristic not only of companies, but also of the state in which they operate. It also has the problem of constantly increasing competitiveness, i.e. the problem of maintaining and increasing positions in international markets. For this to happen, its economic entities, companies, must constantly increase the scale of their activities in order not to lose their positions and not go bankrupt. Only in this case, i.e. maintaining development rates not lower than the growth of the common market, they can increase or at least maintain their positions in the market. In this context, the strategic management of companies' activities takes on special importance. It is he who helps predict what needs to be done in order to take advantage of the available opportunities and to protect himself from what can hinder success, the achievement of the set goals, even from extinction.

Despite the importance of strategic planning, the main part of strategic management, more than 20 years ago in the USA it was found that only 10% companies were able to successfully implement their strategy (Hunger, Wheelen, 2005). The same challenges are faced today, and attempts are made to identify the reasons for the failed implementation of strategies. The following main ones emerged (Hunger, Wheelen, 2005). First, inadequate strategic communication. Only 5 percent company employees understand their organization, the place of its development strategy and its importance for long-term performance results. Secondly, the salaries and motivation of the managers of most companies are not related to strategic goals. Third, even 85 percent top-level company managers spend less than 1 hour on strategy implementation. Fourth, in most companies (over 60%) the resources necessary for the implementation of strategies are not planned, i.e. strategic planning and budget preparation processes are not linked. From all this, it can be seen that the failures of strategic planning largely depend on its implementation. The question arises whether the reasons for such a situation lie solely in the strategy implementation stage. For that purpose, it is necessary to remember the essential components of the company's strategy indicated in the literature: description of activities, analysis of environmental factors, mission, vision, values, map of strategic goals, financing program, strategy evaluation, improvement, support. The strategy integrates the company's aspirations, goals, and decisions reflecting the methods of their achievement. On the other hand, the essential condition for the successful implementation of the strategy is missing – the identification of strategic opportunities. Meanwhile, the adequacy of all plans, goals, and means of their implementation, integrated into the strategy, largely depends on their knowledge. These strategic opportunities can be described by the concept of the company's strategic potential (Gliadov, 1999). This category is much broader compared to the company's production capacity, as it includes not only quantitative and qualitative aspects of production processes, i.e. the quantitative and qualitative possibilities of production release, which are limited by the available material-technical and labor resources, but also its abilities to adequately assess the changing external environment, i.e. markets, the situation and, on that basis, to promptly respond to these changes in terms of the quantity and range of output. Thus,

the company's strategic potential (SP) shows to what extent, looking into the future, the company is able to satisfy the needs of the market in which it operates in terms of the quantity, quality and nomenclature of the output (services) issued. From this understanding of SP, it follows that the company must be able to adequately assess both the internal and external situation and, based on this assessment, to reorganize the production (service provision) process in a timely manner in order to be able to constantly supply competitive products to the markets. The immediate process of strategic planning should begin precisely with these possibilities, i.e. SP, setting. It also follows from the understanding of strategic potential that by its nature it is a complex phenomenon that manifests itself in many aspects in reality. All of them can be classified into two groups. One of them reflects the company's ability to assess the external situation, the other – the ability to ensure its internal flexibility in order to meet constantly changing external needs.

The purpose of the article is to propose and approve a methodology for the quantitative assessment of the strategic potential of construction companies.

1. Literature review

It is appropriate to examine the company's strategic potential in the context of strategic management. This is a new concept, significantly broader compared to the widely known and studied category of production capacity. Meanwhile, SP is an essential condition for effective strategy formation and implementation. The importance of strategic management has long been understood. His ideas began to be applied by scientists who worked in the field of game theory (von Neumann, Morgenstern, 1947). They were further developed by Drucker (Drucker, 1954). He emphasized that the strategy must be formed primarily based on the analysis of the company's current situation, the essential aspect of which is the assessment of opportunities. The modern scientific definition of strategy was given by Chandler (Chandler, 1962). According to him, it includes three main elements: goals, organizational activities and resources necessary to achieve the goal. According to Andrews, strategy is a set of goals, tasks, plans and policies to achieve these goals (Andrews, 1969). Ansoff, one of the first strategic management methodologists, understands strategy as a common thread that connects all the organization's activities with its markets (Ansoff, 1965). A similar perception can be seen in other later literary sources (Hofer, Schender, 1978; Hussain et al., 2024).

From the reviewed literature sources, it can be seen that the most famous management classics (Drucker, Ansoff, etc.) emphasized the knowledge of the company's possibilities as an essential condition for strategic success. Over time, the basic model of strategic management became established (Hunger, Wheelen, 2005).

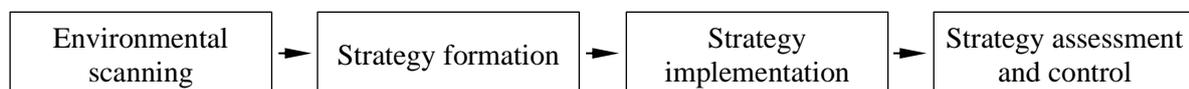


Figure 1. Basic model of strategic management (source: Hunger, Wheelen, 2008)

As can be seen from Figure 1, the successful implementation of the strategy depends on how it was formed, whether the plans “put into it” corresponded to the company's strategic capabilities. In turn, it depends on the results of the environmental scan, which should show the company's strategic potential.

The content of environmental scanning is widely disclosed in the literature – it includes the assessment of the company's opportunities and emerging risks. Research has revealed an

elastic relationship between environmental scanning and successful strategy implementation (Thomas et al., 1993; Feng et al., 2024; Mishchuk et al., 2023).

A wide variety of environmental scanning models for strategic planning can be found in the literature. The main ones are:

1. Porter's five competitive forces (Five forces diagram) model (Porter, 2008). It is a non-formalized, descriptive model that can be the "ideological" basis of strategy formulation.

2. BCG (Boston Consulting Group matrix and BCG II) model. This is also a qualitative assessment of the company's situation. It is criticized for this (Wensley, 1982; Armstrong, Brodic, 1994; Ionescu, 2011; Pearce, Robinson, 2007).

3. General Electric / McKinsey model. It is based on the matrix of the multi-criteria portfolio (multifactor portfolio matrix) (GE – McKinsey Matrix, mckinsey.com, 2014) This is already a more formalized model, as it is based on criteria that have been given importance. The advantage of the model is the ability to thoroughly analyze the company's strengths and the attractiveness of the potential market. On the other hand, this model is also characterized by shortcomings: like the BCG model, it incorrectly assesses the company's current position, weights are assigned subjectively (O'Shangnessy, 2014; Weitrich, 1982).

4. SWOT analysis model. This is the basic way of scanning the environment. Its main advantage is that it is a simple but conceptual way to focus on the most important internal and external factors (Everett, 2014). On the other hand, this model receives a lot of criticism. Its main disadvantages are the following (Hill, Westbrook, 1997; Wheelen, Hunger, 1995):

- The number of elements necessary for this analysis can be very large;
- Underestimates the importance of factors that reflect priorities;
- Uses very broad wording in its content;
- The same factors can be classified into two categories, i.e. the company's strengths can be its weaknesses at the same time;
- Analysts are not obliged to confirm their opinion with the results of the analysis.

5. PEST (Policy, Economy, Social Technology) model. Its purpose is to assess the company's environment as a whole (Evans, 2013). The model is more theoretical, it does not provide opportunities to determine the importance of criteria.

In addition to these main ones, there are many other models of scanning the company's environment for strategic planning purposes (Linkov, Ramadan, 2004; Evans, 2013; Bartuseviciene & Butkus, 2024; Bocken et al., 2015).

Summarizing the proposed methods of scanning the company's environment, the authors highlight their fundamental shortcomings – it is emphasized that they may be correct in theory, but the practical possibilities of application are vague and unclear (Rumelt, 1994), they pay attention to the macro environment, it is not possible to determine the impact on the company's activities (Bradfield et al., 2006). It is concluded that all these methods assess the company's situation only partially and do not cover the whole (Henry, 2006). A more detailed strategic analysis covering this whole can be done on the basis of multi-criteria evaluations, which enable the evaluation of a set of indicators.

Studies on the assessment of potential opportunities for the implementation of corporate strategy using multi-criteria methods. One of these can be attributed to the methodology that solves this problem, which consists of three parts (Hill, Westbrook, 1997). One of them evaluates and summarizes the external factors of the company. It is named as EFAS (External Factors Analysis Summary) methodology. The basis of the analysis is the scanning of the company's social and operational environment. Thanks to it, the most significant factors are clarified. Summarization is done taking into account the importance of each such factor to the implementation of the strategy. The most important factors are the five that are most representative of the company's opportunities and potential threats. The importance of the

factors is assessed in a five-point system, with the most important being given a score of 5, the least important being given a score of 1. The generalization of the impact is carried out based on a multi-criteria assessment using the SAW method:

$$G_E = \sum_{i=1}^n \omega_i^{ex} q_i^{ex}, \quad (1)$$

here G_E – the meaning of the generalized assessment of the impact of external factors of the implementation of the company's strategy; ω_i^{ex} – the importance of the i -th external factor; q_i^{ex} – value of the i -th external factor, in points; n – the number of analyzed external factors ($i = \overline{1, n}$).

In the same way, the analysis of the impact of the company's internal factors on the implementation of the strategy is carried out. It is designated as IFAS (Intensl Factor Analysis Summary) methodology. Calculations are performed as follows:

$$G_I = \sum_{i=1}^m \omega_i^{in} q_i^{in}, \quad (2)$$

here G_I is the meaning of the generalized assessment of the impact of the internal factors of the implementation of the company's strategy; ω_i^{in} – the importance of the i -th internal action; q_i^{in} – the importance of the i -th internal factor; m – the number of analyzed internal factors ($m = \overline{1, m}$).

In the third stage, a summary matrix of the most important external and internal factors is created, on the basis of which a generalized assessment of the company's situation is carried out. This analysis is called SFAS (Strategic Factor Analysis Summary) methodology. The matrix includes those external and internal factors that were evaluated with the highest scores in the EFAS and IFAS analysis. Calculations are made according to the formula:

$$G_S = \sum_{i=1}^k \omega_i^s q_i^s, \quad (3)$$

here G_S is the meaning of the summary assessment of the impact of the external and internal key factors of the company's strategy implementation; ω_i^s – the importance of the i -th factor; q_i^s – value of the i -th factor; (transferred from valuation based on EFAS and IFAS methodologies); k – number of factors ($i = \overline{1, k}$).

All three methodologies (EFAS, IFAS and SFAS), the condition is observed when determining the importance of factors $\sum = 1.0$.

Analysis of the application of these methodologies to specific companies revealed their weaknesses. First, a fixed number of factors (five) was established without any justification; secondly, the factors included in the matrices are of a very general nature, i.e. does not reflect the company's capabilities, but the country's macro situation (internationality, integration processes, demographic situation, accessibility of Eastern European countries, global stability, company culture, financial situation, etc.). The named factors basically do not reflect the potential possibilities of strategy implementation, as they do not demonstrate its ability to analyze, evaluate and use both the internal and external situation.

The EFAS, IFAS, and SFAS methodologies for assessing the company's strategy implementation opportunities were created in order to specify the results of the SWOT analysis, the essence of which is the scanning of the external and internal environment, since it is characterized by a whole series of shortcomings. They are manifested in the following aspects (Hill, Westbrook, 1997):

- Unclear elements that are necessary to perform such an analysis;

- The importance of factors is not underestimated;
- Very vague wording is used;
- The same factors can be assigned to two categories, i.e. the company's strengths can be treated at the same time as its weaknesses;
- Analysts are not obliged to confirm their opinion with the results of the analysis;
- The analysis is not related to the implementation of the strategy.

Another methodology that assesses the company's strategic opportunities largely eliminates the shortcomings of the EFAS, IFAS and SFAS methodologies. It can be abbreviated as the ESPE'n methodology (Ginevičius, Pdvezko, 2004). This study introduces the concept of the company's strategic potential, which can be formulated as its ability to use the external and internal situation for the successful implementation of the formed strategy. Based on literature sources (Gliadov, 1999), a system of indicators was created, reflecting the company's ability to evaluate and use specific external and internal opportunities for the implementation of the company's strategy. After that, the indicators are combined into one summarizing value – the indicator of strategic potential. Calculations were made based on various multi-criteria evaluation methods: AHP (Ginevičius, Podvezko, 2004), geometric mean of the sum of places, SAW, TOPSIS and PROMETHEE (Ginevičius et al., 2010). All these methods are characterized by the fact that the multi-criteria evaluation is performed linearly, i.e. the importance of indicators does not depend on their meaning. Meanwhile, in real life, all processes, especially socio-economic ones, take place non-linearly. In this situation, it makes sense to look for the possibilities of non-linear multi-criteria evaluation and apply them to the solution of such tasks as determining the strategic potential of construction companies.

2. Research methodology

Due to its nature, the company's strategic potential is classified as a complex phenomenon. Such phenomena manifest in reality in many different aspects. The indicators reflecting them may differ in their dimensions, change in different directions, and also be of unequal importance in relation to the considered phenomenon (NR). In this situation, in order to get a generalized picture of his condition, all these indicators should be combined into one summarizing value. In recent decades, multi-criteria methods have been widely used to solve such problems (Khosro et al., 2021; Naji et al., 2022; Procházková et al., 2021). Their nature, philosophy, is reflected by SAW (Simple Additive Weighting) method, the expression of which is as follows (Hwang, Yoon, 1981):

$$K = \sum_{i=1}^n \omega_i \tilde{q}_i, \quad (4)$$

here K – the significance of the multi-criteria assessment of the state of the considered phenomenon by the SAW method; ω_i – the importance of the i -th indicator; \tilde{q}_i – the normalized value of the i -th indicator; n – number of indicators ($i = \overline{1, n}$).

As can be seen from formula (1), such a multi-criteria evaluation is linear in nature. This means that the importance of the indicator is a constant value, i.e. it does not change from the values of the indicator. Practically all multi-criteria evaluation methods used today are based on this point of view. This is not the case in real life. In it, all processes develop non-linearly. In our case, this means that the importance of the indicator depends on the situation. For example, if the value of the unemployment rate is close to zero, then its slight increase will have practically no effect on the general situation of the country, no one will feel it. In the same way, if the value of this indicator is very high, then if it increases slightly, instead of a bad situation, we will have a slightly worse one, i.e. the situation will essentially remain the same. However,

if unemployment is high enough, its further increase can significantly worsen the economic and social situation of the country. All this can be summarized by the following curve (Fig. 2).

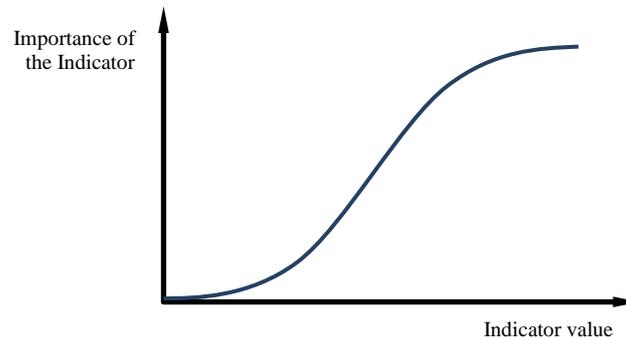


Figure 2. Dependence of the importance of the indicator on its value
Source: compiled by the author, based on (Ginevičius et al., 2021)

Figure 2 the displayed curve is typical for all indicators reflecting the development of socioeconomic systems. This presupposes the idea that it is appropriate to move from the current multi-criteria methods based on linear evaluation to the next, higher level stage – nonlinear multi-criteria evaluation. For this purpose, the principles of the science of qualimetry can be applied. They are successfully applied to the quantitative assessment of the quality of products, production processes, services and other types of objects. In qualimetrics, determining the importance of an indicator is viewed as an important and complex problem. This is not accidental, since the results of multi-criteria evaluation depend to a large extent on the adequate determination of the values of the indicators.

In order to apply qualitative methods, it is necessary to know the nature of the dependencies between the weights and values of the indicators, as well as to transform the methods of combining the values into a summarizing quantity. The non-linear evaluation model reflecting Fig. 2 the displayed curve looks like this (Harrington, 1965):

$$F(x) = \exp(-\exp)(-x), -\infty < x < \infty, \quad (5)$$

here $F(x)$ – the estimate of the indicator in the dimensionless OX scale; x is the real value of the indicator.

Model (2) represents the lowest values of the statistical sample of the data. We will get the model reflecting the highest values $F(x)$ by subtracting from the unit:

$$\tilde{F}(x) = 1 - \exp(-\exp(x)), -\infty \times \infty, \quad (6)$$

Dependencies (2) and (3) are characterized by the principle of symmetry. This means that many new dependencies can be created in the range between them at no additional cost. For example, get a dependency that splits the range between them in two. Its expression will be:

$$F(x) = \frac{(\exp(-\exp(-x))+1-\exp(-\exp(x)))}{2} \quad (7)$$

In this way, not a discrete but an interval evaluation is obtained. By selecting one or another dependency in the dimensionless scale, the OX evaluation values can be increased or decreased. Figure 3 shows an overview of the dependencies (2) and (3).

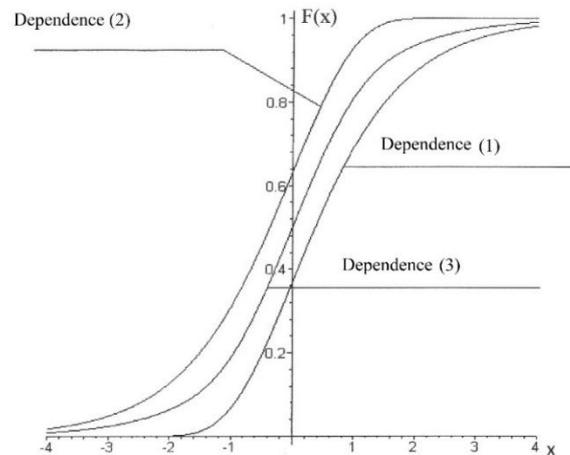


Figure 3. Dependencies $F(x)$ and $\tilde{F}(x)$ graphical representation (source: compiled by authors)

It can be seen from Figure 3 that based on the asymptotic distribution, interval evaluation of the indicators is possible at their fixed values x , and their averages – based on the discrete evaluation. The size of the interval L depends on the value of the indicator:

$$L = [\exp(-\exp(-x))] - [1 - \exp(-\exp(\bar{x}))].$$

The graphical representation of the relationship between interval size L between (2) and (3) is given in Figure 4.

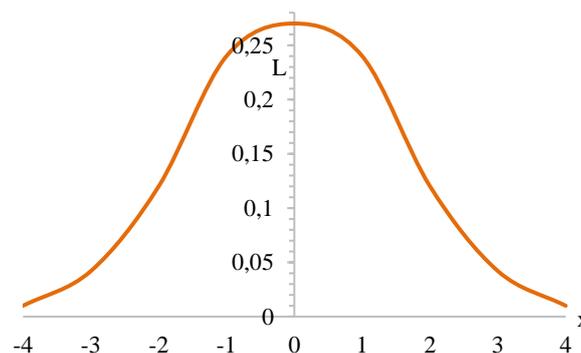


Figure 4. Graphic representation of the dependences of the interval size between (2) and (3) (source: compiled by the author)

Dependencies (2) and (3) are also characterized by the fact that the values of the indicator x vary from -3 to 3 , and the indicators of each considered phenomenon are characterized by various scales and evaluation ranges. The scale of the indicator must be aligned with the axis OX. For that purpose, it is proposed to apply the method of dividing the segment by given proportions.

Determining the dependencies between the weights and values of the indicators, as well as transforming these values based on these dependencies, is the first stage of multi-criteria

evaluation using qualitative methods. The second stage is the merging of the transformed values of the indicators into one summarizing quantity. In our study, we will use five linear estimation methods. The first two indicators do not require knowledge of weights. It is the sum of places and the geometric mean (Podvezko, 2008). The other three require knowledge of indicator weights. These are SAW, TOPSIS and PROMETHEE II (Brans, Mareschal, 1992; Bedranian et al., 2009; Hwang, Yoon, 1981; Opricovic, Tzeng, 2004). For comparison, the same tasks are solved based on the proposed non-linear evaluation methodology.

The criterion of the sum of places method V_j is calculated according to the formula:

$$V = \sum_{i=1}^n n, \quad (8)$$

here V is the value of the multi-criteria sum of places method; i – the rank of the indicator.

Despite the simplicity of this method, the results of the calculations are close to the results obtained by applying complex multi-criteria methods.

Geometric mean criterion P calculated according to the formula:

$$P = \sqrt[n]{\prod_{i=1}^n \tilde{q}_i}, \quad (9)$$

here P is the meaning of the geometric mean method of multi-criteria evaluation.

The TOPSIS method of multi-criteria evaluation looks like this:

$$C^* = \frac{D}{D^* - D}, \quad (10)$$

Here C^* – the value obtained by the TOPSIS method of multi-criteria evaluation; D^* – total NR distance to the best values of the indicators; D – the same, until the worst.

The multi-criteria evaluation method PROMETHEE is used less often compared to the ones discussed. Instead of the normalized values of the indicators, it applies the values of the so-called priority function (d), whose argument is the difference between the values of the two compared alternative indicators, i.e. the distance between them. This function depends on two parameters – indifference and preference limits. A decision-maker or his representative participates in the selection of the priority function of each indicator and in setting its parameters (limits).

3. An empirical study

Based on the above methodology, the strategic potential of four construction companies was determined. In the first stage, a system of indicators was formed, which reflects the company's internal and external capabilities (Table 1).

RECENT ISSUES IN ECONOMIC DEVELOPMENT

Table 1. System of indicators of the strategic potential of a construction company

Well	Strategic potential constituents (possibilities) of production system's managing subsystem
1	Ability to analyze macroeconomic situation in host and foreign countries
2	Ability to determine in time the main needs of potential clients
3	Ability to analyze demand for products and services, enabling to provide market with qualitative products in time
4	Ability to analyze factors of success and activity of rival groups in the market
5	Ability to generate new ideas in the field of developing and organizing production and providing new competitive products and services
6	Ability to implement other new contestable ideas in the fields of producing new goods and providing new services
7	Ability to guarantee the development of productive system of enterprise and its flexibility
8	Ability to maintain the competitive status of the enterprise
9	Ability to maintain inner flexibility in terms of providing adaptive technologies and other means
10	Ability to maintain inner flexibility of productive system by forming human potential adequate to changing objectives
11	Ability to maintain competitive ability in the perspective markets
12	Ability to produce and supply products and services in volumes corresponding to the potential of the enterprise and targeted market share
13	Ability to have effective functioning of enterprise by rational use of investment possibilities
14	Ability to plan and implement efficiently a strategic program of technical and social development of enterprise

Source: compiled by the authors based on Ginevičius, Podvezko, 2004

Table 2. Values of indicators of the strategic potential of the considered construction companies on a ten-point scale

Well	Indicators	Unit of measurement	Companies			
			first	second	the third	fourth
1	Ability to analyze macroeconomic situation in host and foreign countries	scores	7.2	6.4	5.8	6.1
2	Ability to determine in time the main needs of potential clients	scores	3.8	2.4	3.5	3.8
3	Ability to analyze demand for products and services, enabling to provide market with qualitative products in time	scores	3.8	3.2	3.6	3.9
4	Ability to analyze factors of success and activity of rival groups in the market	scores	3.3	4.3	4.6	4.4
5	Ability to generate new ideas in the field of developing and organizing production and providing new competitive products and services	scores	2.4	4.4	3.1	2.9
6	Ability to implement other new contestable ideas in the fields of producing new goods and providing new services	scores	2.0	4.5	3.9	2.0
7	Ability to guarantee the development of productive system of enterprise and its flexibility	scores	7.2	7.3	7.9	7.1
8	Ability to maintain the competitive status of the enterprise	scores	6.5	4.8	5.9	6.8
9	Ability to maintain inner flexibility in terms of providing adaptive technologies and other means	scores	6.6	7.0	6.4	6.2
10	Ability to maintain inner flexibility of productive system by forming human potential adequate to changing objectives	scores	7.5	7.5	7.3	7.4
11	Ability to maintain competitive ability in the perspective markets	scores	4.2	5.1	4.5	5.2
12	Ability to produce and supply products and services in volumes corresponding to the potential of the enterprise and targeted market share	scores	5.1	4.3	5.2	5.1
13	Ability to have effective functioning of enterprise by rational use of investment possibilities	scores	8.1	6.4	7.7	6.2
14	Ability to plan and implement efficiently a strategic program of technical and social development of enterprise	scores	7.9	7.0	8.0	7.1

Source: compiled by the authors based on Ginevičius, Podvezko, 2004

As we can see, all indicators given in Table 1 belong to those that are difficult to formalize, so their values can only be compiled by experts of the companies in question. Meanwhile, the weights of indicators can also be determined by a joint team. The values of the

indicators of the four considered companies are presented in Table 2, and the weights are presented in Table 3.

Table 3. Weights and priorities (places) of strategic potential possibilities

No of index	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Weights	0.018	0.280	0.033	0.086	0.066	0.049	0.014	0.156	0.037	0.123	0.078	0.026	0.019	0.014
Places	12	1	9	4	6	7	14	2	8	3	5	10	11	13

The data in Tables 2 and 3 are fully sufficient to determine the strategic potential of construction companies based on linear multi-criteria evaluation methods. For its non-linear evaluation, the section between estimates (1) and (2) (Figure 3) should be divided into 14 parts. In this way, 14 dependencies were obtained.

Each dependency depicted in Figure 5 corresponds to a certain indicator depending on its value. The criterion with the highest importance, i.e., the one with the highest importance rank corresponds to the lowest dependence curve, i.e. on the right side of Figure 5, analogously, the criterion with the lowest importance and rank corresponds to the highest curve, i.e. located on the left side of Figure 5. Depending on the value and importance of other indicators Fig. 5. all other curves are laid out.

Based on formulas (2)–(4), the values of the transformed indicators, i.e. evaluating not only the real values, but also the importance of the indicator, are given in Table 4.

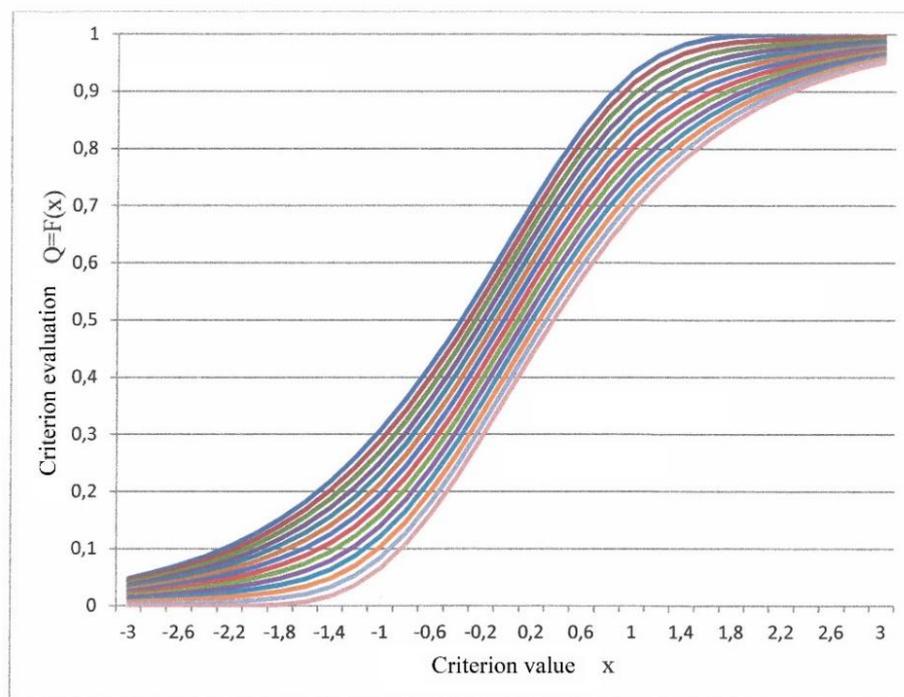


Figure 5. The set of functional dependencies of the strategic potential of construction companies
Source: compiled by the authors

Table 4. The transformed values of the strategic potential indicators of the companies under consideration

Construction company	Indicators													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
First	0.93	0.55	0.51	0.37	0.33	0.32	0.96	0.7	0.82	0.8	0.48	0.7	0.95	0.97
Second	0.88	0.23	0.46	0.47	0.53	0.56	0.97	0.50	0.85	0.8	0.6	0.59	0.86	0.94
Third	0.82	0.32	0.50	0.51	0.39	0.48	0.99	0.64	0.8	0.78	0.52	0.71	0.94	0.97
Fourth	0.85	0.55	0.52	0.49	0.37	0.32	0.96	0.73	0.79	0.79	0.61	0.7	0.84	0.94

Source: compiled by the authors

Figure 6 shows the values of SP indicators of companies graphically, and Figure 7 shows them in the form of a pie chart.

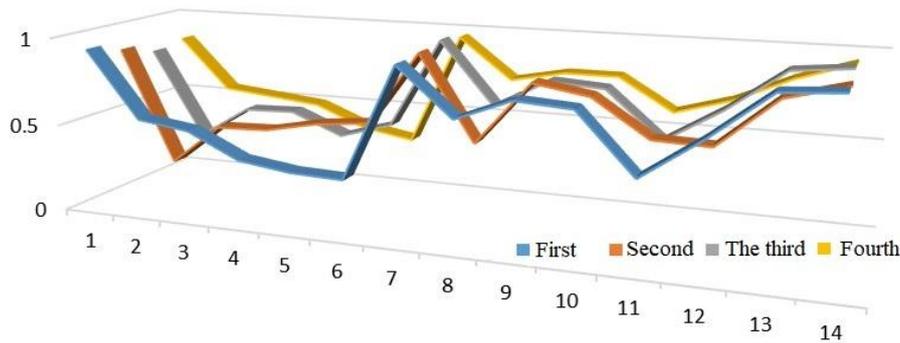


Figure 6. Graphic representation of the transformed value of the indicators of the strategic potential of the construction companies under consideration

Source: compiled by the authors

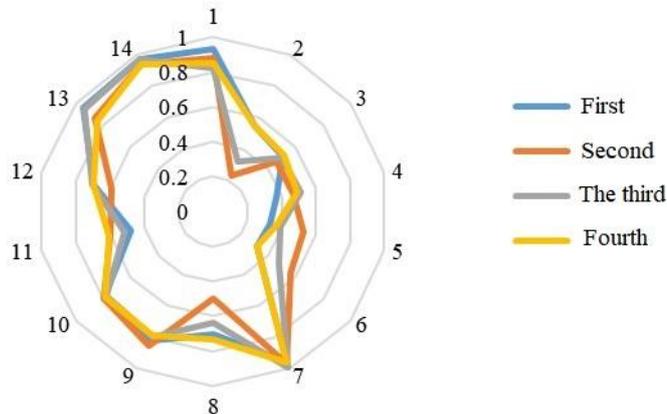


Figure 7. A pie chart of the transformed values of the indicators of the strategic potential of the construction companies under consideration

Source: compiled by the authors

It is now possible to determine the strategic potential of construction companies both linearly and non-linearly. The results of linear estimation are given in Table 5.

Table 5 shows that the traditional multi-criteria assessment methods – SAW, TOPSIS, PROMETHEE II – are applied to the assessment of the strategic potential of companies. In addition to these, other, non-traditional methods, such as graphic-analytical multi-criteria evaluation methods are also possible (Gnevičius, Podvezko, 2008). One of them is based on the summation of indicators reflecting the areas of trapezoids. The summarizing value of the strategic potential in this case is obtained based on the integration of the approximate areas of

the trapezoids. Such an approach makes sense when there is no possibility to find the original function and calculate the integral based on it. In addition to this, the trapezoidal method, other approximate integration methods can be applied, e.g. based on rectangles, parabolas, etc.

Table 5. The results of the assessment of the strategic potential of the construction companies under consideration

Evaluation method	Evaluation methods	Construction company				
		first	second	the third	fourth	
Linear	SAW	value	0.250	0.234	0.256	0.260
		hand	3	4	2	1
	TOPSIS	value	0.671	0.317	0.696	0.726
		hand	3	4	2	1
	PROMETHEUS II	value	0.152	-0.750	-0.032	0.629
		hand	2	4	3	1
Non-linear	UMD	value	0.673	0.665	0.671	0.679
		hand	2	4	3	1

Source: compiled by the authors

The essence of the method is revealed by the graphical representation of the transformed values of all fourteen indicators of one of the considered construction companies (Figure 8).

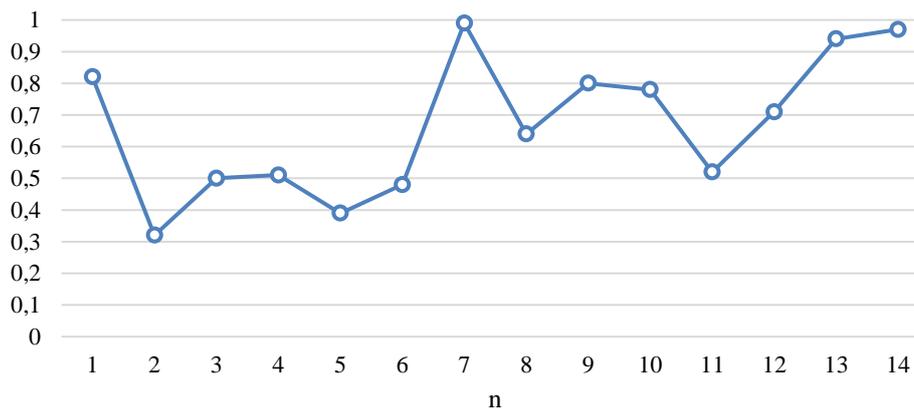


Figure 8. Graphic representation of the transformed values of the indicators of the strategic potential of the construction company

Source: compiled by the authors

To obtain a summary value of a company's strategic potential, it is necessary to find the area under the curve. For this purpose, first of all, the area of all 13 trapezoids is determined:

$$\Delta x_i = \frac{b_i - a_i}{n-1}, \quad (11)$$

here Δx_i – the area of the i -th trapezoid; b_i and a_i – values of the start and end of the i -th trapezoidal integration interval; n – number of indicators.

Based on formula (11), discrete values are obtained. For the convenience of further calculations, we equate the length of each segment to a unit: $b - a = 1$. We get that $\Delta x = 0.077$. In this case, the area of the i -th trapezoid S_i will be equal to:

$$S_i = 0.077 \frac{Y_{i-1} + Y_i}{2}, \quad (12)$$

here S_i – the area of the i -th trapezoid; Y_i – the transformed value of the i -th indicator in the OX axis.

The results of the strategic evaluation of all four construction companies are given in Table 5. Based on them, linear and non-linear estimation can be compared. They fully agree with the results of the PROMETHEE II application and are equally different compared to the SAW and TOPSIS methods. It is possible to indicate the following advantages of the proposed multi-criteria evaluation method in comparison with the PROMETHEE method. First, it is computationally simple, so it can be easily formalized and turned into a computer program. Meanwhile, the PROMETHEE method is complex, complicated in calculations. In addition, it is characterized by a large “dose” of subjectivity, since a person participates in the selection of the indicator’s priority function and its parameters. Thus, the adequacy of evaluations depends to a large extent on one’s competence. Second, the proposed method can be applied in cases where some of the indicators are negative, since the area is always a positive quantity. The PROMETHEE method relies only on positive indicator values.

Conclusions

Market economy conditions are characterized by competition, so the strategic management of companies’ activities, the essential function of which is planning, acquires special importance. Long-term experience shows that only in a few cases are the strategies formed by the company successfully implemented. The reasons for such a situation are mentioned, but too little attention is paid to what is perhaps the main one. The strategy will be real and successfully implemented if the possibilities of its implementation are adequately assessed beforehand. Determining these opportunities is a difficult task, because in market conditions they include both the internal and external situation of the company. The internal situation reflects its ability to produce and timely supply products to markets in such a volume and range that ensures the company's competitiveness. The external situation reflects the ability to analyze the changing market situation, the activities of competitive forces, customer needs, etc. All these abilities can be described by the concept of the company’s strategic potential.

The company’s strategic potential is by its nature a complex phenomenon, so it can only be adequately reflected by a system of indicators. They can be expressed in different dimensions, change in different directions and have different importance in relation to the phenomenon under consideration. Multi-criteria methods are widely used to solve such problems. They all have a linear approach built into them. This means that the importance of the indicator is not specific, i.e. it does not depend on the value of the indicator. Such an approach is limited, since in real life processes do not follow a logarithmic double exponential distribution, which belongs to one of the three marginal statistic distributions corresponding to the shape of the curve.

The principle of qualimetry is suitable for solving such problems.

In the article, the results of the assessment of the strategic potential of four construction companies based on linear multi-criteria methods are compared with the non-linear assessment of indicator values, which was carried out in a graphical-analytical way. The obtained results expressed in ranks do not differ from the evaluation by the PROMETHEE II method. On the other hand, compared to the proposed one, this method is too complicated and subjective. In addition, it cannot be applied when the values of some indicators are negative. The proposed method is easy to understand and can be easily converted into a computer program.

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