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Study of the Sustainable Functioning of Construction Companies in the Conditions of Risk Factors

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Abstract: The risk factors that arise during the implementation of investment and construction projects differ in nature, degree of influence, and other characteristics. Ignoring these factors and measures to manage them often leads to critical consequences in the form of disruptions in the timing of work. The article discusses the risk factors arising at the construction stage, their classification, as well as the measures and strategies necessary to manage these factors. A methodology has been developed that includes conducting a survey in the form of a questionnaire in order to collect information about risk factors that affect the implementation of investment and construction projects. The fuzzy TOPSIS technique was used to compare the sustainable functioning of three construction companies (alternatives) on the basis of its application of measures and strategies necessary to deal with risk factors (criteria). Experts with experience in the construction sector were involved in the survey. The results showed that financial, technical, legal, economic, managerial, and natural factors have the greatest impact on investment and construction projects. It is recommended to pay special attention to the listed factors when developing measures aimed at preventing risks and their consequences. The methodology described in the study can be used by construction companies in strategic planning. The analysis of the stability of construction companies, depending on their use of various ways to counteract risk factors, allowed us to develop a number of practical recommendations to reduce the impact of the studied factors on achieving the goals of investment and construction projects.

Keywords: construction production; construction companies; sustainability; sustainable functioning; risk factors; TOPSIS

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1. Introduction

Sustainability is a characteristic manifested in the ability to maintain the necessary level of functioning for construction companies when risk factors arise during the implementation of investment and construction projects. Risk is a combination of the probability and consequences of the occurrence of adverse events [1,2]. The article considers the concept of risk as a potential possibility of the occurrence of adverse situations and related consequences when exposed to these factors.

The sustainable functioning of a construction company is ensured by its ability to withstand risk factors and achieve the final goals of construction.

Risk management in the implementation of investment and construction projects is necessary for companies operating in the construction sector, as it represents a clear and applicable strategy to ensure their survival in the market [1,2].

Construction companies need reliable and easy-to-implement procedures to achieve the goals of investment and construction projects (compliance with estimated cost standards, proper quality of the construction object, and completion of construction and installation works on schedule). In most cases, construction companies are exposed to a large

number of risk factors, which are often the result of incompetent management decisions, entailing uncertainty in achieving the final result of an investment and construction project and the loss of sustainable functioning [3–5]. The uncertainty that has appeared during the implementation of the investment and construction project creates the possibility that the final result of the project will exceed the desired expectations or the other way around [6].

The need to assess the effective functioning of construction companies is due to market competition, when each business entity strives to improve its performance. The development of algorithms for assessing the sustainability of construction companies in order to improve technical and economic indicators in conditions of risks and uncertainty should be carried out on the basis of system engineering principles for the construction and development of complex systems [4,7,8].

In modern theoretical studies, the issues of risks of the organization and management of construction are considered, as well as methods of assessing and improving the efficiency of construction processes; the capacity of individual elements of construction production and the system as a whole; methods of identifying, assessing, and managing risks in construction; and problems of the effectiveness of the functioning of construction companies in conditions of uncertainty [9–13].

An algorithm for increasing the sustainability of construction companies in order to improve their technical and economic indicators in the implementation of investment and construction projects should include the following stages [14,15]:

- Attracting the attention of participants of investment and construction projects to the problem of risks and uncertainty.
- Determination and assessment of the degree of influence of risk factors on the activities of companies implementing investment and construction projects.
- Development of a structure for the implementation of compensatory measures to exclude or reduce the impact of risk factors on the activities of construction companies.
- Providing contractors with a risk factor management structure and demonstrating the impact of these factors on achieving the goals of the investment and construction project.

The main objective of this study is to identify, classify, and evaluate the risk factors that affect the sustainable functioning of the construction companies and thus the objectives of the construction project (time, cost, and quality), as well as to develop and identify the necessary measures and strategies to reduce or limit the impact of these factors, in addition to comparing and choosing the sober construction companies. It has the programs required to manage risk factors, which makes it easier for stakeholders to choose such companies to implement their construction projects and achieve their goals.

To achieve the goal of this study, it is necessary to solve the following tasks:

1. Identification of potential risk factors in the process of implementing the construction projects.
2. Identification and assessment of the main measures to reduce or limit the impact of these risk factors.
3. Assessing the risk management mechanism in construction companies implementing projects for the construction projects using the TOPSIS method (method of measuring similarity with the optimal solution). The essence of this method lies in the fact that alternative solutions are located on the coincidence scale with a positive optimal solution and a negative optimal solution. The best solution is the one that is closest to the optimal.

Two types of risk factors were selected for the study:

1. Anthropogenic factors.
2. Natural factors.

The difference between anthropogenic and natural risk factors is that anthropogenic factors arise as a result of human actions, while natural factors arise as a result of various natural disasters [10,11,16–22]. The description of the considered risk factors is presented in Table 1.

Table 1. Types of risk factors.

Anthropogenic Factors	Natural Factors
Financial factors. These risk factors are mainly related to the financing of construction projects, when local and global events can lead to unexpected changes in interest rates, the degree of solvency, an increase in inflation, additional costs, and so on.	Adverse weather conditions. Floods, sudden temperature fluctuations, and precipitation have a significant impact on the final indicators of investment and construction projects. So, if there is continuous rain during construction for a month, the delivery of a construction object on time can be significantly difficult.
Social factors. The commission of crimes such as vandalism, arson, destruction, or theft of construction equipment and various acts of sabotage are risk factors that threaten the implementation of construction projects. Construction work may be suspended for an extended period of time while the trials related to the listed criminal actions last.	Pollution. In addition to adverse weather conditions, pollution is another risk factor when considering natural disasters, because harmful gases and waste have a negative impact on the environment, which, in turn, may affect the quality of construction.
Legal factors. Some legal risks in the construction sector may be related to the terms of contracts. For example, contracts often stipulate the obligation of contractors to pay fines in the case of non-compliance with the deadlines for completion of construction.	Geological processes. The intensification of dangerous geological processes, such as earthquakes or geological faults, similar to those that have occurred in recent years in different regions of the world, is another type of natural risk factor faced by the construction sector.
Health factors. Viral and infectious diseases can spread among construction site workers, as well as in any labor collective. The occurrence of an epidemic or even a pandemic as long-lasting as COVID-19 poses a serious danger to the health of construction site workers. The health of workers may suffer as a result of accidents related to errors or negligence in the operation of construction machinery and equipment. The loss of employees' ability to work for the above reasons may lead to interruptions in the company's activities.	
Technical factors. These factors include design errors and lack of resources. For example, a shortage of qualified personnel or issues related to the difficulty of access to the construction site, as well as failures in the operation of machinery and equipment leading to undesirable consequences during the implementation of an investment and construction project.	

Owing to the complex nature of the construction risk management process, we can judge its effectiveness from the decisions made by construction companies, which include many criteria and a limited number of possible options. Possible solutions are proposed to be assessed using the decision-making method based on several criteria. The scientific literature provides a large number of examples of the use of such methods (AHP, TOPSIS, VIKOR, and PROMETHEE). These methods are characterized by varying degrees of complexity and the ability to solve certain problems.

The principle behind TOPSIS is simple: the chosen alternative should be as close as possible to the positive optimal solution (POS) and as far as possible from the negative optimal solution (NOS). The optimal solution is formed as a set of the best performance values (in the decision matrix) for any alternative for each criterion.

Given the fact that the TOPSIS method aims to rank alternatives based on their distance from the POS and the NOS, these two points must be identified first. Further, the distance of each alternative from the POS and NOS is measured, and the option with the smallest distance from the POS and the largest distance from the NOS is considered the best.

According to studies [5,7,19,23], risk factors are present in every project and, in order to prevent their negative consequences, it is necessary to conduct a timely risk assessment and take measures to prevent them. The researcher also interviewed workers in the construction industry; identified critical factors influencing construction projects and established their relationship; and singled out technological risks, construction risks, socio-political risk, community risk, and management risk.

Bashary A.M and others [24] noted the need to provide a framework to identify and evaluate the risk factors in building demolition operations. These risk factors were assessed using a combination of fuzzy logic with fault tree analysis (FTA), criteria importance through inter-criteria correlation (CRITIC), and technique for order preference by similarity to ideal solution (TOPSIS). The results of this study helped demolition project managers to manage the risks in their projects properly.

Using the fuzzy extension of the technique for order of preference by similarity to the ideal solution (TOPSIS), Koulinas G.K. and others [25] proposed a safety risk assessment process for allocating priorities to risks in workplaces in order to promote worker health, safety, and well-being, issues that are embedded within the concept of sustainability, specifically belonging to the social sphere of sustainability. This integrated multi-criteria method can be used by risk managers as a tool for assessing safety risks and for making educated decisions about how to allocate a finite budget in order to maximize health and safety at work.

2. Materials and Methods

Qualitative and quantitative measures were used in this study; the risk factors affecting the objectives of construction projects were identified and classified through the previous literature and field visits, and the necessary strategies and measures were developed to deal with these factors. The TOPSIS method was used to compare construction companies based on their application of risk factor management strategies. Figure 1 shows the flowchart of the study model.

During the analysis of the scientific literature, data from various studies and factors influencing the sustainable functioning of construction companies were selected.

To assess the degree of influence of various risk factors on the activities of construction companies and identify the most significant factors, the expert survey method was used [26–28].

In order to conduct an expert survey, a questionnaire was developed. Each indicator of the impact of a specific risk factor was obtained by summing up the actual scores set by experts. The degree of influence of risk factors was assessed by experts on a scale from 1 to 18, where 1 point was assigned to the least influential factor and 18 points to the most influential [28,29].

According to the applied methodology [30], it was determined that the minimum number of experts for the study is 4. However, in order to increase the reliability of the survey results, the authors decided to increase the number of experts to 5. Thus, the expert group consisted of 5 experts, including managers and specialists of construction companies.

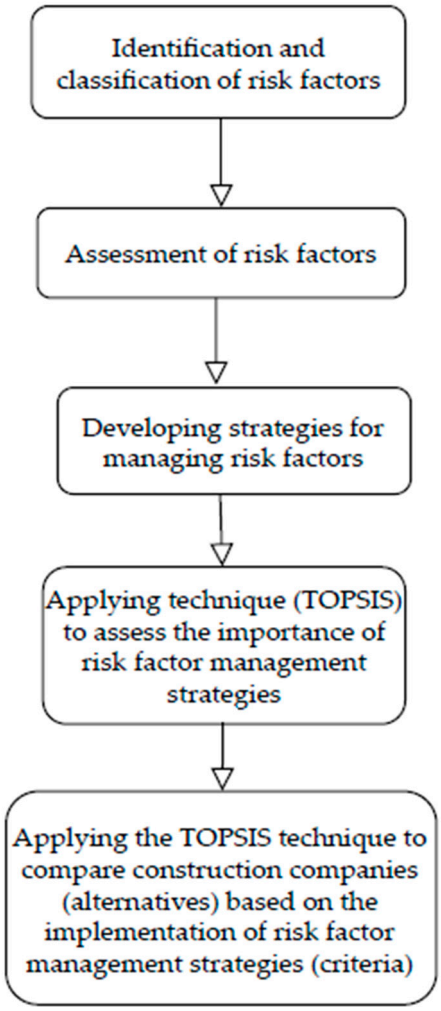


Figure 1. Flowchart of the study.

To assess the consistency of the results of the expert survey using the concordance coefficient (W), the closeness of the relationship between the ranked factors was determined:

$$W = \frac{12 \times S}{m^2 \cdot (n^3 - n) - m\sum T_i}, \quad (1)$$

where S is the summarization of the squared deviations of the sum of ranks from the arithmetic mean of the sum of ranks.

$$S = \frac{1}{n}\sum_{i=1}^{n}(x_i - \mu)^2, \quad (2)$$

$$T_i = \frac{1}{12}\sum\left(t_i^3 - t_i\right), \quad (3)$$

where t_i is the number of repeating elements in the estimates i of one expert;

m is the number of experts;

n is the number of ranked factors;

μ is the arithmetic mean.

The risk factors of construction projects are diverse in nature and causes of occurrence. However, in theory, four main strategies for managing them have been developed, which are often followed in practice [31–33]:

- Avoidance (exclusion) of the occurrence of risk factors.

- Transfer of risk factors.
- Reduction or limit of the influence of risk factors.
- Acceptance of the occurrence of risk factors.

After identifying and assessing risk factors, construction industry specialists can take the necessary decisions and possible administrative and technological measures. These procedures are designed to contain risk factors by reducing the likelihood of occurrence or minimizing their impact [34,35].

TOPSIS technology allows evaluating the effectiveness of construction companies depending on their chosen risk management strategies. The strategies listed above serve as criteria for reducing or limiting the impact of risk factors of construction companies. The sub-criteria used for this assessment are identified in the process of analyzing data from various studies and interviews with specialists of construction companies. Using the results of the assessment, those who manage risk factors in the company can choose the most preferable solution from several alternatives [36–39], as shown in Figure 2.

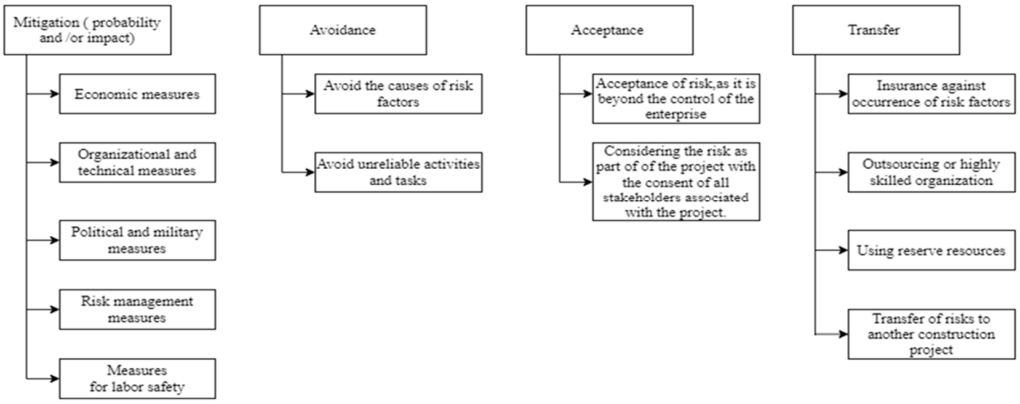


Figure 2. Measures to reduce or limit the impact of risk factors in construction companies [33].

The basic principle of the TOPSIS method is that the alternative should have the shortest distance from the positive ideal solution and the furthest distance from the negative ideal solution [40,41].

The study assessed the sustainability of the functioning of three construction companies depending on the application of different strategies for managing risk factors. To facilitate calculations, the first company was designated C_1, the second C_2, and the third C3; criteria (applied measures) were designated as K_1, K_2,. . ., K_p. Table 2 presents the results of the evaluation of each alternative for companies by criteria (applied measures) on a scale from 1 to 10, in accordance with the results of the expert survey [42,43].

Table 2. Matrix of solutions for the evaluation of criteria.

AAA	AA	A	BBB	BB	B	CCC	CC	C	D
10	9	8	7	6	5	4	3	2	1

Here, AAA is the highest rating for the criteria, which is 10, and the same for the rest of the symbols.

If we assume that there is a solution to a multi-criteria problem with (m) alternatives and (n) criteria, then the matrix of solutions $(m_{ij}) = m \times n$ will have the following form:

$$M = \begin{array}{c} \\ C_1 \\ C_2 \\ \dots \\ C_m \end{array} \begin{array}{c} \begin{array}{ccc} k_1 & k_2 & k_3 \end{array} \\ \begin{bmatrix} \kappa_{11} & \kappa_{12} & \kappa_{13} \\ \kappa_{21} & \kappa_{22} & \kappa_{23} \\ \dots & \dots & \dots \\ \kappa_{m1} & \kappa_{m2} & \kappa_{mn} \end{bmatrix} \end{array} \quad (4)$$

The assessment of the effectiveness of the functioning of companies from the point of view of risk factors management is carried out using the TOPSIS method and consists of the following stages:

1. After summarizing the results of the survey of experts in accordance with Table 2, the importance of the criteria is calculated as follows:

$$B_{ij} = \frac{\kappa_{ij}}{\sum_{i=1}^{m} \kappa_{ij}} \quad (5)$$

where B_{ij} is the relative importance of each criterion.

After that, the entropy value of each criterion is calculated using the following formula:

$$e_j = \frac{-1}{\ln m} \sum_{i=1}^{m} B_{ij} \ln B_{ij} \quad (6)$$

where e_j is the entropy value of each criterion from 0 to 1 and m is the number of alternatives.

Then, the weights $w_1, w_2, \ldots, w_n$ for the evaluated criterion are calculated using the following formula:

$$W_j = \frac{1 - e_j}{\sum_{i=1}^{n} (1 - e_j)} \quad (7)$$

2. The matrix of normalization solutions for criteria (measures to reduce or limit the impact of risk factors) is calculated:

$$R_{ij} = \frac{\kappa_{ij}}{\sqrt{\sum_{i=1}^{m} \kappa_{ij}^2}} \quad (8)$$

where R_{ij} is a matrix of normalization solutions for criteria;

i—1, 2,. . ., m;

j—1, 2,. . ., n.

Then, the weighted matrix of normalization solutions for the criteria is calculated as follows:

$$V_{ij} = w_j \times R_{ij} \quad (9)$$

where (w_j) is the weight of the criterion and the sum of the weights of the criteria is 1 according to the following formula:

$$\sum_{i=1}^{n} w_j = 1 \quad (10)$$

3. Positive and negative ideal solutions are determined:

$$A^+ = \max v_{ij}, j = 1, 2, \ldots\ldots, n \quad (11)$$

$$A^- = \min v_{ij}, j = 1, 2, \ldots\ldots, n \quad (12)$$

4. The distance of the alternative from the positive ideal solution is determined:

$$= \left(V_{ij} - v^+ j\right)^2 \quad (13)$$

5. The distance of the alternative from the negative ideal solution is determined:

$$= \left(V_{ij} - v^- j\right)^2 \quad (14)$$

6. The distance scale (Oi^+) is calculated using the Euclidean distance (n). The distance for each alternative of a positive ideal solution is determined by the following formula:

$$Oi^+ = \sqrt{\left\{\sum_{i=1}^{n} \left(V_{ij} - v^+ j\right)^2\right\}} \quad (15)$$

7. The distance scale (Oi^{-}) is calculated using the Euclidean distance (n). The distance for each alternative of a negative ideal solution is determined by the following formula:

$$Oi^{-} = \sqrt{\left\{\sum_{i=1}^{n} \left(V_{ij} - v^{-}j\right)^{2}\right\}} \quad (16)$$

8. The relative proximity to the positive ideal solution is calculated using the following formula:

$$C_i = \frac{Oi^{-}}{Oi^{-} + Oi^{+}} \quad (17)$$

9. The evaluation of the sustainability of the functioning of the studied companies from the point of view of risk factors management is carried out, depending on the value of the proximity coefficient (C_i) on the scale presented in Table 3 [42–44].

Table 3. Gradation of the Harrington desirability scale.

No.	Gradation of the Harrington Scale	Desired Rating
1	1.00–0.81	Very good
2	0.80–0.64	good
3	0.63–0.38	Satisfactory
4	0.37–0.21	Bad
5	0.20–0.00	Very bad

3. Results

Table 4 shows the weight of each risk factor based on the opinion of five experts in the field of construction.

Table 4. Ranking of the impact of risk factors.

Risk Factors	No.	Description of the Risk Factor	Experts					∑ Ranks	Factor Weight
			1	2	3	4	5		
Financial factors	1	Low liquidity of the company contractor	16	14	13	12	13	68	0.047921
	2	Late transfer of funds by the customer to the contractor	11	12	10	10	14	57	0.040169
	3	Late payment of payments by the general contractor to subcontractors	15	17	12	16	15	75	0.052854
Technical factors	4	Non-compliance with norms and standards	9	11	9	8	12	49	0.034531
	5	Change of project documentation	14	13	15	13	16	71	0.050035
	6	Lack of local skilled labor	17	15	14	17	18	81	0.057082
	7	Lack of experience working with technical resources	10	8	11	9	7	45	0.031712
	8	Non-compliance with material storage standards	7	5	8	4	9	33	0.023256
	9	Delay in laboratory results	3	3	5	6	4	21	0.014799
	10	Lack of material resources	13	16	16	11	10	66	0.046512
Legal factors	11	Contractual disputes arising between the general contractor and subcontractors	8	9	10	7	11	45	0.031712
	12	Changing the terms of the contract by the customer	12	14	13	12	9	60	0.042283
	13	Lack of licenses and the difficulties that arise in obtaining them	10	10	8	13	12	53	0.03735
	14	The need to take into account local laws	3	5	2	6	4	20	0.014094

Table 4. *Cont.*

Risk Factors	No.	Description of the Risk Factor	Experts					∑ Ranks	Factor Weight
			1	2	3	4	5		
Economic factors	15	Currency exchange rate instability	11	13	9	10	13	56	0.039464
	16	Inflation	14	15	11	16	17	73	0.05145
	17	Instability of the market economy	6	7	5	9	8	35	0.024665
	18	Delayed arrival of shipments of materials to the local market	2	3	6	7	3	21	0.014799
	19	Difficulties with the delivery of materials to workplaces	9	8	12	8	9	46	0.032417
	20	Risks of bank transfers	12	12	8	11	10	53	0.03735
Management factors	21	Software difficulties	4	6	7	4	5	26	0.018323
	22	Weakness of the contractor's administrative staff	8	13	10	12	13	56	0.039464
	23	Lack of managerial experience	10	11	9	14	14	58	0.040874
	24	Inefficient planning	4	9	3	5	7	28	0.019732
	25	Slow decision-making mechanism by the customer	2	4	1	6	6	19	0.01339
	26	Low level of communication between contractor and customer, general contractor and subcontractors	7	10	12	10	11	50	0.035236
Natural factors	27	Sudden temperature fluctuations	13	9	13	15	12	62	0.043693
	28	Natural and geological disasters (earthquakes, floods, droughts)	15	16	14	16	12	73	0.051445
	29	Contamination of the work site	5	2	4	6	2	19	0.01339

Figure 3 shows the ranking of risk factors, taking into account their significance, depending on the weight measured for each of them, according to an expert survey.

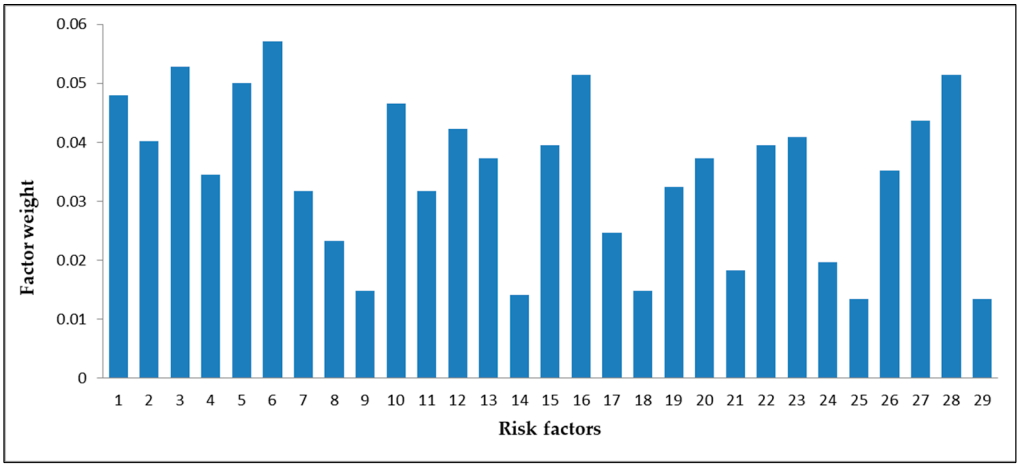


Figure 3. Ranking the significance of risk factors.

The consistency of the results of the expert survey is checked using the concordance coefficient (W), as in Formula (1):

$$W \frac{12 \times 42166.5}{(5)^2 \cdot (29^3 - 29) - 5 \times 53} = 0.84$$

Because W > 0.5, the consistency of expert opinions exists. The coefficient value is 0.84, which indicates a high degree of consistency of expert opinions.

The degree of consistency is also estimated by calculating the Pearson correlation coefficient using the equation below:

$$X_p^2 = w \times m \times (n - 1) = 0.84 \times 5 \times (29 - 1) = 117.6$$

The calculated Pearson coefficient is compared to the tabular value for the number of degrees of freedom n − 1 = 28, at a given significance level $\alpha = 0.05$.

As X_p^2 is calculated − 117.6 > tabular − 41.3, then W = 0.84 is not a random value; therefore, the results obtained by their degree of significance make sense and can be used in further research.

For the purpose of evaluating risk factor management strategies (criteria) among three construction companies (alternatives), the results of the survey conducted among experts of construction companies were analyzed in accordance with Table 5.

Table 5. Decision matrix for criteria (applied measures).

Construction Companies	Criteria			
	Avoiding (Excluding) the Occurrence of RF	**Transfer of RF**	**Acceptance of the Occurrence of RF**	**Reduction in or Limit of the Influence of RF**
C_1	6.5	6.3	8.1	7.7
C_2	8.9	8.5	7.6	6.9
C_3	8.1	7.2	6.4	5.4
$\sum_{i=1}^{m} M_{ij}$	23.5	22	22.1	20

The importance of the criteria (applied measures) is calculated using Formulas (5)–(7) in accordance with Tables 6–9.

Table 6. Calculations of the importance of criteria (applied measures), stage 1—($B_{ij}=\frac{\kappa_{ij}}{\sum_{i=1}^{m}\kappa_{ij}}$).

Construction Companies	Criteria			
	Avoiding (Excluding) the Occurrence of RF	**Transfer of RF**	**Acceptance of the Occurrence of RF**	**Reduction in the Influence of RF**
C_1	0.277	0.286	0.367	0.385
C_2	0.379	0.386	0.344	0.345
C_3	0.345	0.327	0.290	0.270

Table 7. Calculations of the importance of criteria (applied measures), stage 2—($B_{ij} \ln B_{ij}$).

Construction Companies	Criteria			
	Avoiding (Excluding) the Occurrence of RF	**Transfer of RF**	**Acceptance of the Occurrence of RF**	**Reduction in the Influence of RF**
C_1	−0.355	−0.358	−0.368	−0.367
C_2	−0.368	−0.367	−0.367	−0.367
C_3	−0.367	−0.366	−0.359	−0.354

Table 8. Calculations of the importance of criteria (applied measures), stage 3—($e_j = \frac{-1}{\ln m}\sum_{i=1}^{m} B_{ij} \ln B_{ij}$), m = 3 (number of companies studied).

	Criteria				
	Avoiding (Excluding) the Occurrence of RF	**Transfer of RF**	**Acceptance of the Occurrence of RF**	**Reduction in the Influence of RF**	
e_j	0.992	0.993	0.996	0.990	
$1 - e_j$	0.008	0.007	0.004	0.01	$\sum 1 - e_i = 0.029$

Table 9. Calculations of the importance of criteria (applied measures), stage 3—($W_j = \frac{1-e_j}{\sum_{i=1}^{n}(1-e_j)}$).

	Criteria			
	Avoiding (Excluding) the Occurrence of RF	**Transfer of RF**	**Acceptance of the Occurrence of RF**	**Reduction in or Limit of the Influence of RF**
W_j	0.276	0.241	0.138	0.345

Using data obtained at the stages of application of the TOPSIS method and Formulas (8)–(13), a matrix of normalization solutions was calculated for the criteria (applied measures) to reduce or limit the influence of risk factors (Tables 10 and 11).

Table 10. Matrix of normalization solutions for criteria (applied measures), stage 1.

Construction Companies		Criteria			
		Avoiding (Excluding) the Occurrence of RF	**Transfer of RF**	**Acceptance of the Occurrence of RF**	**Reduction in or Limit of the Influence of RF**
	C_1	6.5	6.3	8.1	7.7
	C_2	8.9	8.5	7.6	6.9
	C_3	8.1	7.2	6.4	5.4
$\sum_{i=1}^{m} \kappa_{ij}^2$		187.07	163.78	164.33	136.06
$\sqrt{\sum_{i=1}^{m} k_{ij}^2}$		13.68	12.8	12.82	11.66

Table 11. Matrix of normalization solutions for criteria (applied measures), stage 2—($R_{ij} = \frac{\kappa_{ij}}{\sqrt{\sum_{i=1}^{m} \kappa_{ij}^2}}$).

Construction Companies		Criteria			
		Avoiding (Excluding) the Occurrence of RF	**Transfer of RF**	**Acceptance of the Occurrence of RF**	**Reduction in or Limit of the Influence of RF**
	C_1	0.475	0.492	0.632	0.660
	C_2	0.651	0.664	0.593	0.592
	C_3	0.592	0.563	0.499	0.463

Using the obtained values W_j (see Table 9) and R_{ij} (see Table 11), a weighted matrix of normalization solutions is calculated for the criteria (applied measures) (see Table 12).

Table 12. Weighted matrix of normalization solutions for criteria (applied measures), ($V_{ij} = w_j * R_{ij}$).

Construction Companies		Criteria			
		Avoiding (Excluding) the Occurrence of RF	**Transfer of RF**	**Acceptance of the Occurrence of RF**	**Reduction in or Limit of the Influence of RF**
	C_1	0.131	0.119	0.087	0.228
	C_2	0.179	0.160	0.082	0.204
	C_3	0.163	0.136	0.069	0.159

Thus, we obtain the values of the positive ideal solution and the negative ideal solution:

$$A^+ = 0.179, 0.160, 0087, 0.228,$$

$$A^- = 0.131, 0.119, 0.069, 0.159.$$

Then, the distance of the alternative from the positive ideal solution and the negative ideal solution is calculated (see Tables 13–16).

Table 13. The distance of the alternative from the positive ideal solution, stage 1—$(V_{ij} - v^+j)$.

Construction Companies		Criteria			
		Avoiding (Excluding) the Occurrence of RF	**Transfer of RF**	**Acceptance of the Occurrence of RF**	**Reduction in or Limit of the Influence of RF**
	C_1	−0.048	−0.041	0.000	0.000
	C_2	0.000	0.000	−0.005	−0.024
	C_3	−0.016	−0.024	−0.018	−0.069

Table 14. The distance of the alternative from the positive ideal solution, stage 2—$(V_{ij} - v^+j)^2$.

Construction Companies	Criteria					
	Avoiding (Excluding) the Occurrence of RF	**Transfer of RF**	**Acceptance of the Occurrence of RF**	**Reduction in or Limit of the Influence of RF**	**Total**	$O_i^+ = \sqrt{\text{Total}}$
C_1	0.0023	0.0017	0.0000	0.0000	0.004	0.063
C_2	0.0000	0.0000	0.000025	0.00058	0.0006	0.024
C_3	0.00026	0.00058	0.00032	0.0048	0.006	0.077

Table 15. The distance of the alternative from the positive ideal solution, stage 3—$(V_{ij} - v^-j)$.

Construction Companies		Criteria			
		Avoiding (Excluding) the Occurrence of RF	**Transfer of RF**	**Acceptance of the Occurrence of RF**	**Reduction in or Limit of the Influence of RF**
	C_1	0.0000	0.0000	0.018	0.069
	C_2	0.048	0.041	0.013	0.045
	C_3	0.032	0.017	0.000	0.000

Table 16. The distance of the alternative from the positive ideal solution, stage 4—$(V_{ij} - v^{-}j)^2$.

Construction companies	Criteria				Total	$O_i^- = \sqrt{\text{Total}}$
	Avoiding (Excluding) the Occurrence of RF	Transfer of RF	Acceptance of the Occurrence of RF	Reduction in or Limit of the Influence of RF		
C_1	0.0000	0.0000	0.00032	0.0048	0.0051	0.071
C_2	0.0023	0.0017	0.00017	0.002	0.0062	0.079
C_3	0.001	0.0003	0.0000	0.0000	0.0013	0.036

The coefficient of relative proximity to the optimal solution is calculated in accordance with Table 4 as follows:

$$C_i \text{ (company}_1\text{)} = 0.071/(0.071+0.063) = 0.53 \text{ (Satisfactorily);}$$

$$C_i \text{ (company}_2\text{)} = 0.079/(0.079+0.024) = 0.77 \text{ (good);}$$

$$C_i \text{ (company}_3\text{)} = 0.036/(0.036+0.077) = 0.32 \text{ (Bad).}$$

4. Discussion

In [37,39,42,45–54], the prioritization technique was used by analogy with the ideal solution to assess the impact of various risk factors on the construction project objectives (time, cost, and quality) as a multi-criteria approach to evaluate those factors for the purpose of making the necessary decisions to reduce or limit the impact of risk factors in the various stages of the project life cycle. In this study, the main risk factors affecting the activities of construction projects were evaluated using expert evaluation, and then the necessary measures were developed to reduce the impact of these factors. The TOPSIS method associated with the entropy method was applied to identify the four main strategies to reduce the impact of risk factors (criteria) according to three construction companies (alternatives) for the purpose of selecting the optimal alternative from these companies, as well as to have an integrated risk management program by implementing the four strategies.

The case study data were subjected to an examination and evaluation process and showed the following characteristics:

- Diversity of measurement methods and tools.
- Multiple criteria for comparison.
- The difference in the relative importance between the criteria.

From the other side, the TOPSIS method, its working mechanism, and the mathematical basis on which it is based were reviewed and examined, as it was found to be completely dependent on quantitative data and mathematical processors.

The main characteristics that distinguished the study from other studies was that it not only evaluated the impact of various risk factors on the activities of construction projects using different methodologies (expert evaluation), but also studied and identified the necessary strategies to reduce or limit the impact of these factors, as well as evaluated the sustainable functioning of specialized construction companies during the implementation of these strategies to deal with the various risk factors.

5. Conclusions

Experts have assessed a large number of factors that can affect the sustainable functioning of a construction company. The results of the survey showed that financial, technical, legal, economic, managerial, and natural factors have the greatest impact. When developing a risk management strategy, construction companies are recommended to take into account the significance of the identified factors.

Through the application of the expert assessment methodology, it was found that the Lack of local skilled labor factor was ranked first, with a relative importance of 0.057082, which obliges companies to invest skilled labor for the purpose of avoiding the risks arising as a result of this factor. This is followed by the risk factor of Late payment of payments by the general contractor to subcontractors, with a relative importance of 0.052854, followed by Inflation, with a relative importance of 0.05145, and so on for the rest of the factors, which necessitates the construction companies and stakeholders to implement appropriate strategies for the purpose of dealing with the various risk factors.

The information obtained can be used by persons responsible for the sustainable functioning of the construction company in the development and planning of measures to counteract risk factors. This will ensure the timely adoption of balanced, well-thought-out decisions and help to identify specific responses aimed at resolving risky situations.

The sustainable functioning of a construction company is ensured by its ability to withstand risks and achieve the final goals of construction; in this regard, the heads of construction companies now often face the difficult task of choosing optimal solutions in the field of risk management. In such cases, it is necessary to resort to the use of special methods of multi-criteria analysis of decision-making, such as the TOPSIS method. With the help of this method, the stability of functioning was assessed depending on the application of different strategies for managing the risk factors of three construction companies.

The study showed that the risk factor management programs developed in the analyzed construction companies do not take into account the influence of some significant factors and modern scientific data about them. Consequently, the measures provided for such programs to minimize risks are not relevant and cannot lead to highly effective results in preserving such an important property of construction companies as sustainability.

The results of the study show that, by using the TOPSIS technique, risk factor management strategies (criteria) can be compared. The importance of the criterion Strategy to reduce or limit the impact of the risk factor was 0.345, meaning it can be considered the optimal strategy, followed by the criterion Avoiding (excluding) the occurrence of risk factors, with a score of 0.276, and then the criteria Transfer of risk factors (0.241) and Acceptance of the occurrence of risk factors (0.138); Table 9. Therefore, it can be said that construction companies must adopt measures and procedures to reduce or limit risk factors in the event that projects are exposed to such factors, or at least avoid the occurrence or influence of these factors by applying an integrated management program to deal with risk factors from the beginning of the life of the project for the purpose of promoting sustainable functioning of construction companies.

The results also showed that, by comparing three construction companies (alternatives) by identifying and evaluating the four main strategies (criteria) using the technology (TOPSIS), company 2 has implemented measures and strategies to deal with risk factors effectively and obtained good value (0.77), while company 1 has implemented strategies to manage risk factors in an satisfactorily manner (0.53), with the presence of some obstacles and difficulties produced by the company itself or outside its control. Company 3 did not have a specialized program, and its implementation of risk factor management strategies was unsatisfactory or bad (0.32).

It is recommended to include several important aspects in the plans for managing risk factors in a construction company:

1. Conducting advanced training courses that teach participants of an investment and construction project the skills of managing risk factors at all stages of the project.
2. Optimization of administrative and legal work related to obtaining licenses for construction activities (development of relevant instructions, regulations).
3. Checking the quality of building materials and their compliance with specifications at each stage of the project.
4. Study and application of ways to improve the effectiveness of the use of technical resources.
5. In light of the foregoing, the researchers recommend the preparation of future studies in order to determine and arrange the relative importance of the risk factors affecting

construction projects using the TOPSIS technique, as well as to evaluate risk factor management strategies using decision-making methods such as AHP, VIKOR, SAW, and others, and to compare the relative importance and the coefficient of relative proximity to those strategies using decision-making methods.

The development of an effective decision-making mechanism aimed at preventing or reducing the impact of risk factors significantly increases the stability of the functioning of construction companies, allowing them to respond in a timely manner to undesirable deviations from the normal course of implementation of investment and construction projects.

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