SUPPORT OF TOPSIS AND DEMATEL METHODS IN THE PREPARING AND USING FINANCIAL REPORTS OF TEXTILE INDUSTRY IN THE BUSINESS DECISIONS PROCESS

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Abstract

Structured or defined problems represent the most important characteristics relevant to the choice of methods and decision support procedures in this specific problem. The textile industry is specific because of the inputs used in production. The principle of structuredness deals with the possibility of solving problems and knowing the theoretical and practical implications of problems. Given that there are a large number of semi-structured principles that deal with the problem in the area of the relevance of financial reports of economic entities, the only possibility to solve the problem is to use the principles of financial reporting. The principle of financial reporting is a decision support system that helps to properly use generally accepted international accounting standards.

Keywords*: DEMATEL method, TOPSIS methods, financial report, textile industry, make a decision.*

Introduction

The application of the appropriate decision support system in the procedures for drawing up valid financial statements includes several parts. T he subsystem of the database will contain the appropriate data obtained by analyzing the experts in the compiled financial report.

Special attention in this work is focused on the DEMATEL method and the TOPSIS method. These methods are used in the decision-making process, by helping top managers to make decisions for complex tasks with numerous problems. It is characteristic that these methods are also used in organizations where there are more managers.

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The DEMATEL method is intensively used in the analysis of the interdependence of multiple factors in complex systems, where uncertainty and risk dominate, in order to make timely decisions (Liu, Chen, 2020); Yazdi et al., 2020). This method helps in deriving interdependence information from a very small amount of data. In this paper, the DEMATEL method is used to investigate the interdependence between individual hazards and specifically calculate their impact on specific activities of the organization. After the procedure of determining the interdependence of the criteria, the TOPSIS method will be used to rank alternatives, which will serve decision makers in future strategic decision-making (Zhang, Su 2019).

Starting from the basic characteristics of the DEMATEL and TOPSIS methods, the authors tried to integrate them in order to establish a comprehensive assessment of the quality of financial reports when making decisions. The aim of this work is to make a comprehensive assessment of the significance of the application of the principle of balancing in the preparation of financial reports in the textile industry. Choice of applicable standards between IFAC, GAAS, GAAS British or national financial reporting standards on an IFAC or GAAS basis (Nobes, C., Parker, R. 2000).

Literature preview

Work on improving evaluation teams to decide on mutual inconsistencies in the management process and reducing the time period for verification of corrective measures to a minimum are the main advantages of using a decision support system. A higher degree of reliability, accuracy and relevance in decision-making and a shorter period of time make automated decision support, which helps the managers of the organization to expeditiously solve the problem and make a relevant decision, while analyzing more existing alternatives. In this way, mutual communication between users in the process of decision-making and problem clarification is facilitated in the analysis, the model of successive learning is approached and decisions are made based on the experience of other users in the process of managing inconsistencies (Vidovič & Milunović, 2017).

According to Milojević, I. and Zekić, M. (2015) accounting values historical values (historical prices), are used to compile financial statements in most countries and they mean at the purchase price for acquired parts of the property, or at the cost price when it comes to parts of the property realized in the production process, except assets (real estate, plant and equipment, investments) that can be revalued. In the world of economics, there are legal entities that present financial statements based on current value. This means that financial statements contain the effects of price changes in asset values (paragraph 6). In both situations, the financial statements have a direct or indirect impact on the price change resulting from the reasons given for the reasons.

Lazić, S. (2018) stated that the general purpose of balancing is to look at the business activity, the structure of the property and the capital of a specific budget user. There are several balancing goals depending on what the balance displays (Novaković, Jovićević, & Simin, 2018). Balancing objectives are achieved by applying different, formal and material balancing rules, based on which an annual account is obtained which will be understandable, reliable, comparable and which contains all the relevant information that is necessary for making decisions in the following business period (Kostić, 2020).

Existing literature in the field of financial reporting is primarily focused on defining, determining functions, goals and its implementation (Lantto, 2020; Hellmann, Patel, 2021). Therefore, there is a lack of research on the optimization of the preparation and use of financial reports. Finance professionals are dependent on accounting information provided in annual reports and other both formal and informal information sources (Hellmann et al., 2020). In this regard, decision-making based on financial reports is widely used in the financial and banking sector, IT systems, supply chain management, etc. (Vinodh, Swarnakar, 2015). The Enron Event (Scandal) case is considered a difficult economic case, and it refers to accounting decisions regarding the quality of the organization's financial statements, that is, the quality of the information contained in them. The quality of information in financial reports is not only related to the internal reporting process, but is influenced by a large number of external factors. (Zhong, et al., 2015; Gigović et al., 2016).

Based on the fact that accounting standards, state audit, etc. affect directly or indirectly the quality of financial reports, modern research changes its course and moves from the internal processes of the organization to external influences, and in order to assess the quality of financial reporting (Zhong et al., 2015; Pourahmad et al.., 2015). They recommend undertaking practical activities in the implementation of management of the process of preparing financial statements that contain information of suboptimal quality. The preparation of financial reports and the reporting process itself is becoming more and more important in various researches and practical actions over time. (Etezazian, Kharazi, Barati, 2015).

Methods

The problem in general terms is shown by choosing one of the *m* alternatives ($A_i, i = 1, 2, ..., m$), which are evaluated and compared among themselves based on *n* criteria ($X_j, j = 1, 2, ..., n$) whose values we know. Alternatives are shown to the vectors $x_{i,j}$, where the $x_{i,j}$ is value of the *and* alternatives accordingly *j* ciretirion. Since the criteria vary in varying degrees on the final estimates of the alternatives, we assign each weight to a weight coefficient $w_{j,}\ j = 1, 2, ...n$ (where the $\sum_{j=1}^{n} w_j = 1$) which reflects its relative importance in evaluating alternatives.[132]

[132]Kashi, K., Franek, J.: Utilizing DEMATEL Method in Competency Modeling, *Forum Scientiae Oeconomia,* Vol. 2, No. 1 (2014), pp. 95-106.

The identification of the criteria and the calculation of the weight of the criteria to be implemented using the DEMATEL method include the following steps:[133]

Step 1: Gathering the opinions of experts and calculating the average matrix Z.

In this step, a group of experts and n factors is observed. Each expert should see the degree of direct impact between two factors on the basis of pairing. The influence of the factor *and* on the factor j is expressed by the degree $z_{i,j}$. For each expert a nonnegative matrix is formed $Z^e = \left[z_{ij}^e \right]$, where the e is a number of experts who take part in evaluating the factors and it is placed in the interval $1 \le e \le k$. In this way, the matrices are made $Z^1, Z^2, ..., Z^k$ for m experts. By merging all expert grades, the final matrix $Z^e = \left[z_{ij}^e \right]$ has a shape

$$z_{ij} = \sqrt[k]{\prod_{i=1}^{k} z_{ij}^e} \quad (4.1)$$

where z_{ij}^e is preference of the e expert, and k is the total number of experts.

Step 2: Calculate the initial normalized direct-link matrix D.

After normalizing the initial matrix of a direct connection $D = \left[d_{ij} \right]$ the value of each element in the matrix D moves in the interval [0, 1]. This matrix is expressed by the following relation:

$$D = \begin{bmatrix} d_{11} & d_{12} & ... & d_{1n} \\ d_{21} & d_{22} & ... & d_{2n} \\ ... & ... & ... & ... \\ d_{n1} & d_{n2} & ... & d_{nn} \end{bmatrix} \quad (4.2)$$

where the matrix elements are obtained from a relation:

$$d_{ij} = \frac{Z_{ij}}{R} \quad (4.3)$$

$$R = \max\left(\sum_{j=1}^{n} Z_{ij} \right) \quad (4.4)$$

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[133] Pamučar, D., Ćirović, G.: The selection of transport and handling resources in logistics centers using Multi-Attributive Border Approximation area Comparison (MABAC), Expert Systems with Applications, Elsevier, 42 (2015), pp. 3016-3028.

where n is the total number of factors.

Step 3: Perform a complete relationship matrix T.

The total impact T matrix is obtained by using the equations (4.5) and (4.6) where *I* is $n \times n$ unit matrix. If the element t_{ij} represents the indirect effects of the factor *i* on the factor *j,* then the matrix *T* reflects the interdependence of each pair of factors.

$$T = \lim_{m \to \infty}(D + D^2 + ... + D^m) = \sum_{m=1}^{\infty} D^i \quad (4.5)$$

where

$$\begin{aligned} \sum_{m=1}^{\infty} D^i &= D + D^2 + ... + D^m = \\ &= D(I + D^1 + D^2 + ... + D^{m-1}) \\ &= D(I - D)^{-1}(I - D)(I + D^1 + D^2 + ... + D^{m-1}) \quad (4.6) \\ &= D(I - D)^{-1}(I - D^m) \\ &= D(I - D)^{-1} \end{aligned}$$

Based on the above, the following matrix is obtained

$$T = \begin{bmatrix} t_{11} & t_{12} & \cdots & t_{1n} \\ t_{21} & t_{22} & \cdots & t_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ t_{n1} & t_{n2} & \cdots & t_{nn} \end{bmatrix} \quad (4.7)$$

where t_{ij} is the assessment of the decision maker for each alternative *i* and in relation to the criterion *j*.

Step 4: Calculating the sum of the rows and columns of the matrix T.

The following relations will serve to show the total impact in the T matrix:

$$D_i = \sum_{i=1}^{n} t_{ij,} \; i = 1, 2, ..., n \quad (4.8)$$

$$R_i = \sum_{j=1}^{m} t_{ij,} \; j = 1, 2, ..., m \quad (4.9)$$

where n represents the number of criteria.

When $i = j,$ then the sum (+) shows the total effect of factors on other factors and other factors on the factor *i.* Therefore, (+) indicates the degree of importance of the factor *and* for the whole system. In contrast, the difference (-) indicates the individual *i* factor influence on the system. If the difference (-) is positive then the factor *i* affects other factors, and if (-) is negative, then other factors affect the factor *i.*

Step 5: Determination of the limit value (α)

The limit value (α) is obtained using the formula:

$$\alpha = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n}\left[t_{ij}\right]}{N} \quad (4.10)$$

should allow for the elimination of some minor effects of elements in the matrix *T.*

Step 6: Creating a causal relationship diagram.

A causal relationship diagram is developed to visually represent complex relationships and provide information to draw conclusions as to which factors are most important and how they affect one another.

Step 7: Determination of weight coefficients of criteria. The weighting coefficients of the criteria can be determined by the expression

$$W_i = \sqrt{(G_i + R_i)^2 + (G_i - R_i)^2} \quad (4.11)$$

Step 8: The weight coefficients are normalized using the expression

$$w_i = \frac{W_i}{\sum_{i=1}^{n} W_i} \quad (4.12)$$

where w_i express the definitive weight of the criteria used in the decision-making process.

After gaining weight coefficients, the conditions for representing the mathematical formulation of the TOPSIS method have been created.

The TOPSIS method has its advantages and disadvantages. The main advantages of this method are the simplicity of its use, the precise definition of possible alternatives and the possibility for the user to express his preferences by assigning weighting coefficients to the decision criteria, eg determination of relative weight.

The disadvantages of this method are reflected in the linear character of the criteria and the dependence of the solution on the input values.

The process of implementing the TOPSIS method consists of 6 steps:[134]

First, define the terms that will be used. Here, the decision matrix *R* is used, where each row of the matrix corresponds to one alternative, and each column is one criterion; element r_{ij} represents the performance of the alternative A_i in relation to the criterion C_j. For *m* criteria ($C_{1,} C_{2,} ..., C_m$) and *n* alternatives ($A_{1,} A_{2,} ..., A_n$) the matrix *R* has the form

$$R = \begin{matrix} A_1 \\ A_2 \\ . \\ A_3 \end{matrix} \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ r_{n1} & r_{n2} & \cdots & r_{nm} \end{bmatrix} \quad (4.13)$$

and the values ($w_{1,} w_2, ..., w_m$) represent the weight values of the criteria obtained in the previous procedure of applying the DEMATEL method.

Step 1: Normalize the value of the decision matrix;

$$x_{ij} = \frac{r_{ij}}{\sqrt{\sum_{i=1}^{n} r_{ij}^2}} \quad (4.14)$$

$$X = \begin{matrix} A_1 \\ A_2 \\ . \\ A_3 \end{matrix} \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix} \quad (4.15)$$

Step 2: The product of the weight coefficients of the criteria and the normalized values of the decision matrix. The normalized performance matrix is represented by a weight. $V = (v_{ij})$ is determined by the ratio of the normalized performance of the product alternative v_{ij} and the corresponding weight coefficient of the criteria.

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[134] Balli, S., Korukoglu, S.: Operating System Selection Using Fuzzy AHP and TOPSIS methods, *Mathematical and Computational Applications,* Association for Scientific Research, Vol. 14, No. 2, 2009, pp. 119-130.

$$V = \begin{matrix} A_1 \\ A_2 \\ . \\ A_3 \end{matrix} \begin{bmatrix} v_{11} & v_{12} & ... & v_{1m} \\ v_{21} & v_{22} & ... & v_{2m} \\ ... & ... & ... & ... \\ v_{n1} & v_{n2} & ... & v_{nm} \end{bmatrix} = \begin{matrix} A_1 \\ A_2 \\ . \\ A_3 \end{matrix} \begin{bmatrix} w_1x_{11} & w_2x_{12} & ... & w_mx_{1m} \\ w_1x_{21} & w_2x_{22} & ... & w_mv_{2m} \\ ... & ... & ... & ... \\ w_1x_{n1} & w_2x_{n2} & ... & w_mx_{nm} \end{bmatrix} \quad (4.16)$$

Step 3: Determine Ideal Solutions. The perfect solution A^* and the Negative ideal solution A^- are determined by means of relations:

$$A^* = \left\{ (\max v_{ij} \mid j\varepsilon G), (\min v_{ij}, j\varepsilon G'), i = 1,..,n \right\} = \left\{ v_1^*, v_2^*, ..., v_m^* \right\} \quad (4.17)$$

$$A^- = \left\{ (\min v_{ij} \mid j\varepsilon G), (\max v_{ij}, j\varepsilon G'), i = 1,..,n \right\} = \left\{ v_1^-, v_2^-, ..., v_m^- \right\} \quad (4.18)$$

where

G={j=1,2,...,m| j belongs to the criteria that are maximized}

G'={j=1,2,...,m| j belongs to the criteria that are minimized}

Step 4: The following relations are used to determine the distance of the alternatives from the ideal solutions

$$S_i^* = \sqrt{\sum_{j=1}^{m} (v_{ij} - v_j^*)^2}, i = 1,...,n \quad (4.19)$$

$$S_i^- = \sqrt{\sum_{j=1}^{m} (v_{ij} - v_j^-)^2}, i = 1,...,n \quad (4.20)$$

to calculate the n dimensional Euclidean distance of all possible alternatives from the ideal and non-ideal solution.

Step 5: Determining the relative distance of the alternative from the ideal solution

$$Q_I^* = \frac{S_i^-}{S_i^* + S_i^-}, i = 1,...,n \quad (4.21)$$

where $0 \le Q_I^* \le 1$.

Step 6: Ranking alternatives. Alternatives are ranked by decreasing values Q_I^*.

Alternative 1 - IFAC standards, Alternative 2 - GAAS American standards, Alternative 3 - GAAS British standards, Alternative 4 - national standards based on IFAC and Alternative 5 - national standards based on GAAS.

Recently, the preparation of financial reports represents a significant and important part of the activities of modern business. In order for the managers of the organization to make an effective business decision, it is necessary for the financial reports to be credible and to be based on accounting principles (the principle of security, fairness, etc.). In order to ensure that accounting principles are respected when preparing financial reports, it is necessary to organize and prescribe instructions and procedures for preparing financial reports.

Results and discussion

Based on earlier research carried out by Vukša S. and Milojević I. [135], the criteria for the selection of the principle of regular balancing were selected (Table 1)

Table 1: Balancing principles

Principle name and symbol	Principle description
Cost principle (S_{1})	In accordance with the cost principle, the record of business events must be based on the purchase value, that is, the purchase cost. The monetary cost expressed in the national currency is the basis for determining costs.
Objectivity principle (S_{2})	The principle of objectivity implies that when compiling financial reports, one must take into account the objectivity and documentation of the information contained there in.
Realization principle (S_{3})	The realization principle requires that revenues are recorded when they are actually incurred, when they are earned, and not when the money is actually received. There are two important conditions to be respected: that the goods are actually delivered to the customer, that is, a certain service has been performed and that there is no uncertainty in the collection.
Matching principle (S_{4})	When determining business results, it is necessary to use the matching principle. Given that the business result represents the difference between income and expenses, it is necessary to compare these two categories, taking into account that they refer to the same accounting period.
Materiality principle (S_{5})	The materiality principle requires respect for all principles that play a significant role in creating a real image of an enterprise. On the other hand, it allows for deviation from those principles whose implementation is difficult, but they do not significantly affect the level of the achieved business result and with the obligatory statement of reasons and the effect of deviation.

[135]Vuksa, S., Milojević, I. (2009). *Balance analysis.* Braća Karić University: Faculty of Management.

Full-disclosure principle (S 6)	The full-disclosure principle requires that the financial statements contain all the relevant information necessary for the assessment of the company's business. This does not mean that reports must and should be dedicated to detail, but that no significant information should be omitted.

In the first step of the DEMATEL method, the Saaty scale was used to compare the criteria (Table 2). The scale shown is used to obtain the criterion matrix criteria $Z = \left[z_{ij} \right]$.

Table 2: Saaty Values Scale

Importance	Definition	Explanation
1	Same importance	Two elements are identical in meaning to the goal
3	Poor dominance	Experience or reasoning slightly favors one element over another
5	Hard dominance	Judgment or experience greatly favors one element over another
7	Demonstrated dominance	The dominance of one element is confirmed in practice
9	Absolute dominance	Dominance of the highest degree
2,4,6,8	Between values	Compromise needed or further division

The data in Table 3 represent the starting basis for obtaining the initial normalized direct coupling matrix D. By applying the expressions (4.3) and (4.4) we obtain the matrix D (Table 3).

Table 3: Normalized direct-link matrix

	C_1	C_2	C_3	C_4	C_5	C_6
C_1	0.06	0.03	0.13	0.18	0.02	0.42
C_2	0.12	0.06	0.20	0.17	0.17	0.28
C_3	0.02	0.02	0.06	0.07	0.18	0.12
C_4	0, 02	0.02	0.05	0.06	0.18	0.07
C_5	0.15	0.03	0.02	0.02	0.06	0.08
C_6	0.01	0.01	0.02	0.05	0.04	0.06

Based on the elements of the matrix D and applying the expressions (4.5) and (4.6), the matrix elements of the total relation T are determined. The overall relationship matrix is shown in Table 4.

Table 4: The overall relationship matrix

	C_1	C_2	C_3	C_4	C_5	C_6
C_1	0.1105	0.0561	0.1952	0.2708	0.1473	0.5705
C_2	0.2125	0.0995	0.2971	0.2961	0.3387	0.5112
C_3	0.0732	0.0385	0.0984	0.1195	0.2509	0.2146
C_4	0.0703	0.0369	0.0848	0.1038	0.2424	0.1561
C_5	0.1894	0.0471	0.0689	0.0847	0.1147	0.2086
C_6	0.0274	0.0171	0.0360	0.0709	0.0708	0.0971

In order to create a diagram of the causative-consequence relations, using the expressions (4.8) and (4.9) the factors of mediate and im mediate interaction of the factor system are determined (table 5).

Table 5: Sum of mediate (M) and immediate (I) interaction of the factor

	M	I
C_1	1.35	0.68
C_2	1.76	0.30
C_3	0.80	0.78
C_4	0.69	0.95
C_5	0.71	1.16
C_6	0.32	1.76

Based on the expression (4.10), a diagram of cause-effect relationships has been developed with the aim of visual representation of complex relationships, Figure 1.

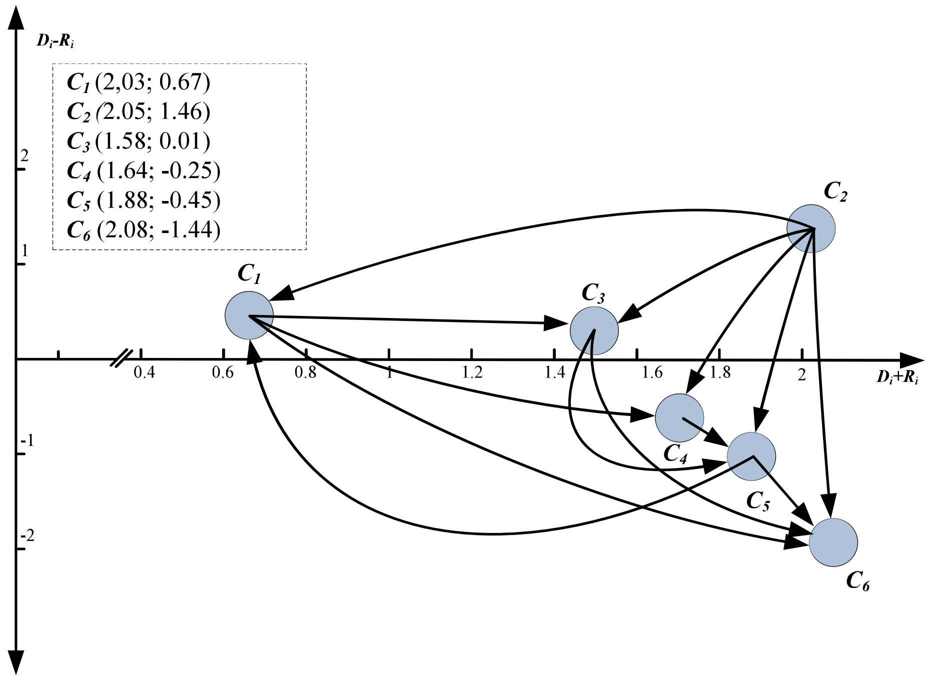

Figure 1: Diagram of causal relationship

The presented diagram provides information on the importance of the factors on the system and on the interrelationship of the displayed factors. Factors of overall relation, matrix character and value higher than the threshold α ($\alpha = 0.16$) are taken into account due to the cause-effect relationships between them.

The weighting coefficients of the criteria (Table 6) are determined after determining the interdependence of the criteria (factors) using expressions (4.11) and (4.12).

Table 6: Critical criteria criterion (w)

	M+I	*WE*	*W*	*w*
C_1	2.03	0.67	2.14	0.173
C_2	2.05	1.46	2.52	0.204
C_3	1.58	0.01	1.58	0.128
C_4	1.64	-0.25	1.66	0.134
C_5	1.88	-0.45	1.93	0.156
C_6	2.08	-1.44	2.53	0.205

In addition to the initial decision matrix (4.13), the weight coefficients of the criteria represent the input parameters for the application of the TOPSIS method (Table 7).

Table 7: Home matrix of decision making

	C_1	C_2	C_3	C_4	C_5	C_6
A 1	2.11	3.03	0.42	0.22	0.20	1.05
And 2	1.83	2.87	0.33	0.28	0.16	1.20
A3	2.60	4.11	0.51	0.15	0.08	0.92
A4	1.68	2.43	0.23	0.30	0.22	1.53
A5	2.23	2.75	0.47	0.17	0.11	1.13
w_i	0.173	0.204	0.128	0.134	0.156	0.205

After calculating the weight coefficients of the criteria (w_i)conditions for evaluation and selection of optimal alternatives with the TOPSIS method have been acquired. Using the expression (4.14), the elements of the initial decision matrix are normalized. By multiplying the normalized elements of the matrix (4.15) with weight coefficients (w_i) a difficult noramylated matrix (4.16) is obtained, as shown in Table 8.

Table 8: Weighted normalized matrix

	C 1	C 2	C 3	C 4	C 5	C 6
A 1	0.077	0.089	0.059	0.057	0.086	0.081
And 2	0.067	0.085	0.047	0.0 73	0.069	0.093
A3	0.095	0.121	0.072	0.039	0.034	0.071
A4	0.062	0.072	0.032	0.078	0.095	0.118
A5	0.082	0.081	0.066	0.044	0.047	0.087

Using the expressions (4.17) - (4.21), the final rank of the alternative is obtained, which is shown in Table 9.

Table 9: The final ranking alternatives

	S_{and}^+	With $_{and}^-$	Q_i	Rank
A1	0.0581	0.0661	0.5321	2
A2	0.0642	0.0564	0.4679	3
A3	0.0858	0.0717	0.4555	4
A4	0.0717	0.0858	0.5445	1
A5	0.0784	0.0458	0.3686	5

By using the combination of DEMATEL and TOPSIS, the solution is that the safest financial statement, under number 4, achieves the highest ranking among all alternative balancing principles. However, it should be emphasized that in this way, the resulting result is only a possible variant, because the application of multi-criteria optimization does not mean a rigorous solution, but an option that can only be checked by comparing several different methods and scales of assessment.

Conclusion

Pointing out the importance of criteria in the process of compiling a financial report is covered in detail by certain processes and principles. The goal of significance is to respect the principle of balance and express an optimal attitude towards that principle.

In order for an organization to survive in today's world, it must first of all have an adequate organizational structure. The organizational structure consists of three mutually conditioned and connected elements. First, competitive analysis provides a detailed overview of industry branches by profitability, shows why some organizations are more attractive than others and why they have more value. Second, the organizational structure as well as its strategic characteristics have the ability to significantly influence the value of the company and its competitive advantage. The third and final element is to use value chain analysis to identify sources of competitive advantage. Increasing the value of the organization by generalizing these factors by applying different methods and procedures in determining the market position. In the decision-making and ranking process, the term criterion and its quantitative and qualitative properties are a very important factor. Quantitative properties include precise measurement and the possibility of expressing them in different measurement units. Unlike quantitative ones, qualitative properties cannot be expressed in units of measurement, but are expressed as properties that can be divided into two groups: those that can be precisely measured and with which it is possible to make their quantitative comparison, and others whose values cannot be quantified express.

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