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Application of MCDA/TOPSIS methodology in supplier selection With a case study

تطبيق منهجية تحليل القرار المتعدد المعايير (MCDA) TOPSIS في اختيار الموردين مع دراسة حالة

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Abstract:

This case study aims to apply the MCDA/TOPSIS methodology to the selection of suppliers for a major maintenance program in an electric power production company. The study's objectives are to evaluate suppliers' performance based on technical and financial criteria and to demonstrate the effectiveness of the MCDA/TOPSIS approach. The research methodology involves a step-by-step process, including problem definition, criteria identification, aggregation of preferences, and ranking of alternatives. The study utilizes data normalization and weighting techniques to calculate performance scores using the TOPSIS methodology. The findings indicate that the MCDA/TOPSIS approach provides a comprehensive evaluation of suppliers, considering both technical and financial aspects. The study highlights the importance of balancing qualitative and quantitative factors in the decision-making process. The results demonstrate that the MCDA/TOPSIS methodology effectively ranks the suppliers, allowing for the selection of the most suitable candidates. Overall, this case study showcases the application of the MCDA/TOPSIS methodology in supplier selection and highlights its effectiveness in considering multiple criteria. The study provides valuable insights into improving procurement practices and enhancing the overall performance of the supply chain.

Keywords: Multi-Criteria Decision Analysis (MCDA), Supplier Selection, TOPSIS Methodology, Technical and Financial Criteria.

JEL Classification Codes: C44, D21, D24, L24, M11.

ملخص:

تهدف هذه الدراسة إلى تطبيق منهجية MCDA/TOPSIS في اختيار الموردين لبرنامج صيانة رئيسي في شركة إنتاج الطاقة الكهربائية. تهدف الدراسة إلى تقييم أداء الموردين بناءً على المعايير التقنية والمالية وإظهار فعالية منهجية.MCDA/TOPSIS ، تتضمن منهجية البحث عملية تدرجية تشمل تحديد المشكلة، وتحديد المعايير، وتجميع التفضيلات، وتصنيف البدائل. تستخدم الدراسة تقنيات تطبيع البيانات وتوزينها لحساب نقاط الأداء باستخدام منهجية.TOPSIS ، تشير النتائج إلى أن منهجية MCDA/TOPSIS توفر تقييمًا شاملاً للموردين، مع النظر في الجوانب التقنية والمالية. تسلط الدراسة الضوء على أهمية توازن العوامل الكمية والنوعية في عملية اتخاذ القرار، حيث تظهر أن منهجية MCDA/TOPSIS تقوم بتصنيف الموردين بشكل فعال، مما يتيح اختيار المرشحين الأكثر ملاءمة، وبشكل عام، تُبرز هذه الدراسة تطبيق منهجية MCDA/TOPSIS في اختيار الموردين وتؤكد فعاليتها في النظر في المعايير المتعددة،كما تقدم الدراسة نظرة موضوعية في تحسين ممارسات التوريد وتعزيز الأداء العام لسلسلة التوريد.

كلمات مفتاحية: تحليل القرار المتعدد المعايير (MCDA) ، اختيار الموردين ، منهجية TOPSIS ، المعايير التقنية والمالية.

تصنيفات JEL : C44, D21, D24, L24, M11.

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1. Introduction :

1.1. Preface :

In the realm of electric power generation, the process of supplier and product selection transcends a mere administrative procedure and evolves into a complex multicriteria optimization challenge, specific to each product's requirements. Astute supplier selection holds the potential to minimize procurement costs, elevate supply quality and reliability, and ultimately enhance a company's profit margin by mitigating risks within the upstream supply chain. It ensures the procurement of impeccable components, safeguarding critical production facilities from potential disruptions.

The success and resilience of a company's supply chain hinge significantly upon the prudent and meticulous selection of suppliers. Hence, power plants are tasked with striking a delicate balance between tangible and intangible criteria in order to identify the most suitable supplier. Amidst a plethora of available methodologies, Multi-Criteria Decision Analysis (MCDA) emerges as a comprehensive approach, encompassing a range of techniques. Prominent among these techniques are the well-known TOPSIS method, the Analytic Hierarchy Process (AHP), and the Analytic Network Process (ANP). These methodologies are widely embraced due to their computational prowess, methodological simplicity, and inherent consistency.

1.2. Problematic :

The research problem of this paper is framed by the following question: How does the Purchasing Department apply MCDA for supplier selection?

To address this main research problem, the following sub-questions will assist in its resolution:

1) What are the requirements for implementing MCDA?
2) What are the steps involved in the MCDA process?
3) Is it possible for the results of this method to be incompatible with procurement regulations?

By addressing these sub-questions, the study aims to provide insights into the practical application of MCDA in the context of supplier selection and examine the alignment of its outcomes with procurement regulations.

1.3. Hypothesis :

The main hypothesis of this research paper is as follows:

The MCDA/TOPSIS method effectively contributes to supplier selection while adhering to the criteria adopted for the choice of the goods to be purchased.

1.4. Methodology :

The research methodology for this study involving the use of the TOPSIS method for supplier selection can be described as a mixed research approach, combining analytical and descriptive methods. The methodology includes a literature review to establish a conceptual framework, the collection of relevant data, data analysis using statistical techniques, the application of the TOPSIS method to the collected data, validation of the results, and interpretation of the findings. By employing this approach, the study aims to gain a comprehensive understanding of the TOPSIS method for supplier selection and provide meaningful and relevant results.

2. literature review:

2.1. Procedures :

To retrieve relevant research and studies closely related to the theme of this research paper, the PoP application (A. W. Harzing, 2007) was used with the keyword "MCDA" AND [("Supply" OR "Supplier") OR "Procurement"], and the selection was based on criteria including Google Scholar Rank, relevance of the title, citation per article and per year, database (Google Scholar), type (Studies and Patents), language (English), and a time period from 2015 to 2022.

2.2. Findings :

Based on the aforementioned criteria, a selection of five (05) studies has been finalized, which pertains to the most relevant research articles as follows:

1) Kizielewicz et al., (2021) : Study published under the title "*Study towards the time-based MCDA ranking analysis – a supplier selection case study*"

The objective of this study is to examine the variation in rankings obtained using three multi-criteria decision analysis (MCDA) methods, namely COMET, TOPSIS, and SPOTIS, while considering the selection of material suppliers.

The weights of the criteria were determined using the equal weights method, entropy method, and standard deviation method. The final preference values were compared using the WS similarity coefficient and the weighted Spearman correlation coefficient to verify the similarity of the received rankings.

The result of this study demonstrates that all methods provide highly correlated results, and the obtained positional rankings are not significantly different.

2) Ortiz-Barrios et al., (2020) : Study published under the title "*A case of food supply chain management with AHP, DEMATEL, and TOPSIS*"

The aim of this study is to evaluate supplier performance using a hybrid approach that integrates the Analytic Hierarchy Process (AHP), Decision-Making Trial and Evaluation Laboratory (DEMATEL), and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). AHP was employed to determine the weights of criteria and sub-criteria. Subsequently, DEMATEL was applied to assess the interdependence and feedback among decision elements. Finally, TOPSIS was implemented to distinguish high-performing and low-performing suppliers.

A case study in the supply chain is presented to validate the proposed approach. The findings of this study highlighted that the most significant criterion was "service level," and the most influential factor was the "financial profile." Furthermore, based on the supplier evaluation results, improvement plans and new negotiations were developed, and strategies were established for each supplier to mitigate the bullwhip effect throughout the supply chain.

3) Ijadi Maghsoodi et al. (2018) : Study published with the title "*CLUS-MCDA: A novel framework based on cluster analysis and multiple criteria decision theory in a supplier selection problem*".

The objective of this study is to propose a novel approach for enhancing Multi-Criteria Decision Analysis (MCDA) by considering the input of large-scale data structures, known as the CLUS-MCDA algorithm (Analysis for Improving Multi-Criteria Decision Analysis). The proposed method is based on the fusion of a data mining technique, namely clustering, and a Multiple Attribute Decision-Making (MADM) approach called MULTIMOORA.

The CLUS-MCDA method is a rapid and practical approach that has been developed in this research and applied to a supplier selection problem, taking into account structured input from large-scale data. A real case study in the multinational company MAMUT is presented to demonstrate the validity and practicality of the CLUS-MCDA approach. The calculations were conducted considering business domains and criteria based on expert opinions from the mentioned organizations and previous literature on supplier selection problems.

4) Rehman et al. (2018) : Study published with the title "*Supply chain performance measurement and improvement system: a MCDA-DMAIC methodology*"

The aim of this study is to adopt a Supply Chain Performance Measurement (SCPM) framework to model a new SCPM Index system (SCPMI) for measuring and enhancing supply chain performance (SCP).

The study results demonstrated an average SCP of 82% for the investigated company over a four-month period. The DMAIC methodology was employed to identify inherent issues and propose improvements. Post-improvement SCP measurement showed an average increase from 82% to 83.82% over the four-month period.

The proposed generic SCPMI framework, supported by AHP-DMAIC, was successfully implemented in the company, and managers and decision-makers observed improvements in their SCP.

5) Chorfi et al. (2015) : Study published and untitled "*Selection of Key Performance Indicators for Supply Chain monitoring using MCDA*"

In this study, an MCDA/AHP approach is used to facilitate the ranking of Key Performance Indicators (KPIs) based on SMART criteria (Simple, Measurable, Achievable, Realistic, and Time-bound). The proposed approach can assist in determining which KPIs are more relevant than others for organizational objectives. A case study was conducted in a public pharmaceutical supply chain in a developing country to illustrate how the suggested approach could be applied. When ranking the KPIs, the selection of the most appropriate ones is left to the managers, as there is no predetermined weighting threshold to be accepted.

The proposed measurement system has certain limitations. If the environment changes, the organization's strategic objectives may also change, which can influence the accuracy of the entire system. Therefore, it must be adapted to accommodate strategic shifts. The ranking and selection of the most relevant KPIs depend on decision-makers' preferences, which can impact the accuracy and relevance of the selected KPIs.

3. Theoritical Generalities on Multi-Critria Decision:

3.1. Definition of MCDA :

The MCDA (Multi-Criteria Decision Analysis) methodology is a problem-solving approach for complex and conflicting real-life situations, and it offers a simple and pragmatic way to address such challenges (Mukherjee, 2017). MCDA tools can be broadly categorized into Multi-Attribute Decision Making (MADM) and Multi-Objective Decision Making (MODM). MADM involves a finite set of alternatives, while MODM is suitable for scenarios with an infinite number of alternatives.

3.2. General Steps of MCDA:

The MCDA methodology can be viewed as a nonlinear recursive process consisting of four steps (Guitouni & Martel, 1998):

1) Define the problem;

2) Identify preferences or criteria;

3) Aggregate preferences;

4) Rank alternatives. Regarding this ranking step, Opricovic and Tzeng (Opricovic & Tzeng, 2004) have proposed the following elements that refine the analysis results:

- Evaluate each alternative with respect to each criterion.
- Utilize suitable multicriteria analysis tools or techniques.
- Accept appropriate alternatives to achieve the objectives.
- If the final solution is not feasible or acceptable, proceed to the next iteration until feasible solutions are attained.

3.3. Types of Scales Used in MCDA:

In multicriteria decision analysis, each preference is associated with an appropriate scale to evaluate or rank alternatives in order to achieve the objective. For instance, if A is twice as good as B, the linguistic term "twice as good as" requires a scale to measure the degree of preference.

Scales encompass a set of numbers, a set of objects, and the mapping of objects to numbers. Different types of scales exist (Saaty, 2004), such as:

1) Nominal Scale: A number is assigned to each object. For example, queueing at the train ticket reservation counter.

2) Ordinal Scale: Numbers are assigned to each object to represent their order, either ascending or descending.

3) Interval Scale: For example, $Y = B - 30$, where Y is a dependent variable and B is an independent variable.

4) Ratio Scale: For example, $K = BL$, where $B > 0$, and L is a proportional constant.

5) Absolute Scale: The number is used directly for pairwise comparisons. It is commonly employed in the Analytic Hierarchy Process (AHP).

There are also eight different scales identified by Ishizaka and Labib (2011) (Mukherjee, 2017): Saaty's linear scale (1977), Harker and Vargas' power scale (1987), Lootsma's geometric scale (1989), Ishizaka et al.'s logarithmic scale (2010), Harker and Vargas' square root scale (1987), Dodd and Donegan's asymptotic scale (1995), Ma and Zheng's inverse linear scale (1991), and Salo and Hamalainen's balanced scale (1997).

The author also suggests the use of the Likert scale, which can be highly useful for simplifying and refining results, particularly with scales such as x4, x5, or x7, allowing for a wide range of outcomes.

3.4. Multicriteria Decision-Making Methods:

Multicriteria decision-making (MCDM) methods have evolved to accommodate various application types, with several methods developed and minor changes made to existing methods, leading to the emergence of new branches of research (Velasquez & Hester, 2013). The following are the most common MCDM methods, although their advantages and disadvantages have been the subject of intensive studies that are beyond the scope of this paper:

1) Multi-Attribute Utility Theory (MAUT)
2) Analytic Hierarchy Process (AHP)
3) Fuzzy Set Theory
4) Case-Based Reasoning
5) Data Envelopment Analysis
6) Simple Multi-Attribute Rating Technique
7) Goal Programming
8) ELECTRE
9) PROMETHEE
10) Simple Additive Weighting
11) Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS)

These methods offer various approaches and techniques for handling multicriteria decision-making problems, allowing decision-makers to select the most appropriate method based on their specific requirements and preferences.

4. Practical Case Study: Selection of the Most Performant Supplier

4.1. Study Framework:

To achieve the objectives of this paper, a case study was conducted within a power generation plant affiliated with Sonelgaz-Production d'Electricité. The study focused on a national tender for the supply of spare parts to meet the needs of a major systematic maintenance program.

The tender was launched in 2020, with five (05) companies participating and submitting technically and commercially proposals.

In the case study, the author has chosen to utilize the TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) method as a tool within the broader framework of Multi-Criteria Decision Analysis (MCDA). MCDA provides a structured approach for evaluating and ranking alternatives based on multiple criteria, taking into account the preferences and priorities of decision-makers. By employing TOPSIS, the author aims to effectively assess and compare the performance of different bidders in the supplier selection process. TOPSIS, with its ability to consider both positive and negative aspects of alternatives, offers a systematic and comprehensive approach to decision-making, facilitating the identification of the most suitable supplier based on their proximity to the ideal solution. The selection of TOPSIS within the MCDA framework underscores its suitability for addressing complex decision problems, such as supplier selection, and highlights the author's emphasis on achieving an informed and well-justified decision-making process.

4.2. Selection Conditions:

The selection of the goods to be purchased and the bidder must be carried out in accordance with generally accepted procurement rules in the business world, which are applicable to Sonelgaz-PE and its subsidiaries. These conditions include:

1) Transparency of the selection procedure and criteria.
2) Promotion of competition.
3) Ensuring equal treatment of bids and suppliers.

By adhering to these conditions, the study aims to ensure a fair and objective evaluation of the bidders and their proposals, ensuring a selection process that is in line with industry best practices and regulatory guidelines.

4.3. Selection Criteria:

The specifications of the company under study include two groups of criteria:

1) Technical Criteria:

This group encompasses purely technical criteria that primarily focus on the quality aspects related to the supplier/provider and the deliverable product. The selection method is specified in the tender documents (Transparency Rule), and it pertains to the technical proposals (Supply to be delivered) with an evaluation grid comprising the following criteria.

Table N°4.1 – Bids Evaluation Criteria

N°	Criteria	Weights
01	The bidder has experience in the field of similar supply.	Exp ≤ 1 Year = 50 02 ≤ Exp < 5 = 100 05 ≤ Exp < 10 = 150 Exp < 10 = 200
02	The number of professional references for the delivery of similar supply.	Ref ≤ 1 = 75 02 ≤ Ref < 5 = 150 05 ≤ Ref < 8 = 225 Ref < 8 = 300
03	The bidder offers the entirety of the supply.	Yes = 250 No = 0
04	The bidder possesses certificates and tests for the proposed supply.	Yes = 250 No = 0

Source : By author.

2) Financial Criteria: The bidder's commercial proposal, whose technical offer is deemed acceptable and not eliminated, is evaluated. It outlines the modality of awarding the contract, which can be either based on the lowest commercial offer (lowest bidder) or the economically most advantageous offer.

4.4. Data Sorting:

The data collected from the tender documents regarding the participating bidders are synthesized in the following table:

Table N°4.2 - Data of offers by criteria/supplier.

Bids	Experience in the field (Years)	Professional references	Completeness of the supply	Certificates and tests	Commercial offer
Company 1	07	08	Yes	Yes	3.125.000,00
Company 2	08	07	Yes	No	2.850.000,00
Company 3	06	13	Yes	No	3.452.000,00
Company 4	04	02	No	Yes	5.752.000,00
Company 5	01	05	Yes	Yes	3.885.250,00

Source : the author.

4.5. Normalization Procedure:

Step 01: Constructing the Normalized Matrix:

The canonical matrix of the problem is presented as follows:

Weights	W_1	W_2	W_3	…	W_j
Product	Criteria 1	Criteria 2	Criteria 3	…	Criteria n
P_1	X_{11}	X_{12}	X_{13}	…	X_{1j}
P_2	X_{21}	X_{22}	X_{23}	…	X_{2j}
P_3	X_{31}	X_{32}	X_{33}	…	X_{3j}
…	…	…	…	…	…
P_i	X_{i1}	X_{i2}	X_{i3}	…	X_{ij}

First, it is necessary to standardize the collected data in the following table according to the Likert scale:

Table N°4.3 –Likert Scale.

Criteria	Criteria 01	Criteria 02	Criteria 03	Criteria 04	Criteria 05
Scale	50 → 01 100 → 02 150 → 03 200 → 04	75 → 01 150 → 02 225 → 03 300 → 04	0 → 0 250 → 01	0 → 0 250 → 01	Ranking of the offers

Source : The author

The standardized table is constructed as follows:

Table N°4.4 – Conversion of the data using the Likert scale.

Bids	Experience in the field (Years)	Professional references	Completeness of the supply	Certificate s and tests	Commercial offer
Company 1	3	4	1	1	2
Company 2	3	3	1	0	1
Company 3	3	4	1	0	3
Company 4	2	2	0	1	5
Company 5	1	3	1	1	4

Source : The author.

The standardized matrix will be calculated using the MCDA/TOPSIS method with the optimal solution.

$$\bar{X}_{ij} = \frac{X_{ij}}{\sqrt{\sum_{j=1}^{n} X_{ij}^2}} \quad (4.1)$$

Table N°4.5 – Standarize Matrix

Bids	Experience in the field (Years)	Professional references	Completeness of the supply	Certificates and tests	Commercial offer
Company 1	0.53	0.54	0.49	0.53	0.27
Company 2	0.53	0.41	0.49	0.27	0.13
Company 3	0.53	0.54	0.49	0.27	0.40
Company 4	0.35	0.27	0.24	0.53	0.67
Company 5	0.18	0.41	0.49	0.53	0.54

Source : The Author

Step 02: Constructing the Weighted Normalized Matrix:

It is calculated using the formula:

$$V_{ij} = \bar{X}_{ij} \times W_j \quad (4.2)$$

Weighting:

The weighting factor is determined based on the maximum rating assigned to each criterion in the evaluation grid, and it is defined as follows:

Table N°4.6 – Weighting Coefficients of Criteria

	Criteria 01	Criteria 02	Criteria 03	Criteria 04	Criteria 05
Notation	200	300	250	250	1 000
Weighting	10.00%	15.00%	12.50%	12.50%	50.00%

Source : The Author.

Assuming a rating of 1000 was assigned to the commercial offer criterion, as the evaluation process in the company is divided into two phases: technical and commercial. After applying the weighting to the standardized matrix, the resulting matrix is as follows:

Table N°4.7 - Weighted Standardized Matrix

Bids	Experience in the field (Years)	Professional references	Completeness of the supply	Certificate s and tests	Commercial offer
Company 1	0.05	0.08	0.06	0.07	0.13
Company 2	0.05	0.06	0.06	0.03	0.07
Company 3	0.05	0.08	0.06	0.03	0.20
Company 4	0.04	0.04	0.03	0.07	0.34
Company 5	0.02	0.06	0.06	0.07	0.27

Source : The Author.

Step 03: Calculation of Ideal Values

It is important in this step to understand the ranking of preferences for each criterion. In our case, the preference for the price criterion will be a minimum value, while for the other criteria, a maximum value is chosen.

The Best Ideal Value: It is calculated for the price criterion as the minimum value among all supplier offers. For the technical criteria, it is calculated as the maximum value since the company's preference is to purchase a high-quality product at a low price.

The Worst Ideal Value: It is calculated for the price criterion as the maximum value among all supplier offers. For the technical criteria, it is calculated as the minimum value.

Table N°4.8 – Ideal Value

Bids	Experience in the field (Years)	Professional references	Completeness of the supply	Certificates and tests	Commercial offer
Best Ideal Value	0.05	0.08	0.06	0.07	0.07
Worst Ideal Value	0.02	0.04	0.03	0.03	0.34

Source : Etabli par l'auteur.

Step 04: Calculation of Euclidean Distance from the Ideal Value

In Step 04, the Euclidean distance from the ideal value is calculated for each alternative. This distance represents the deviation or proximity of each alternative to the ideal solution. Two types of deviations are considered: the deviation from the Best Ideal Value and the deviation from the Worst Ideal Value.

The deviation from the Best Ideal Value measures how close an alternative is to the ideal solution in terms of maximizing the desired criteria. It is calculated by taking the square root of the sum of the squared differences between the alternative's performance and the Best Ideal Value for each criterion.

On the other hand, the deviation from the Worst Ideal Value measures the extent to which an alternative deviates from the worst possible performance for each criterion. It is calculated in a similar manner to the deviation from the Best Ideal Value.

By calculating these deviations for each alternative, the relative distances from the ideal and worst values can be determined. These distances provide valuable insights into the performance of each alternative, enabling the ranking and selection of the most favorable alternative based on their proximity to the ideal solution.

Two deviations are distinguished, one deviation from the Best Ideal Value, which is calculated using the formula:

$$S_i^+ = \sqrt{\left[\sum_{j=1}^{m} \left(V_{ij} - V_j^+\right)^2\right]} \qquad (4.3)$$

And a deviation from the Worst Ideal Value, which is calculated using the formula:

$$S_i^- = \sqrt{\left[\sum_{j=1}^{m} \left(V_{ij} - V_j^-\right)^2\right]} \qquad (4.4)$$

Table N°4.9 - Euclidean Distance from the Ideal Value (Best and Worst)

Bids	S_i^+	S_i^-
Company 1	0.005	0.053
Company 2	0.006	0.078
Company 3	0.023	0.025
Company 4	0.079	0.006
Company 5	0.043	0.014

Source : The Author.

Step 05: Calculation of Performance

In Step 05, the performance of each alternative is calculated based on the Euclidean distance from the ideal value. This performance score provides a quantitative measure of how well each alternative aligns with the ideal solution.

The calculation involves transforming the Euclidean distance into a performance score. A common approach is to use a formula that assigns higher scores to alternatives that are closer to the ideal value and lower scores to alternatives that are further away. This transformation allows for a standardized representation of performance across different criteria.

By calculating the performance score for each alternative, decision-makers can easily compare and rank the alternatives based on their overall performance. This step helps in identifying the most suitable alternative that best meets the defined criteria and objectives of the decision-making process.

This performance is represented by a score calculated using the formula:

$$P_i = \frac{S_i^-}{S_i^+ + S_i^-} \quad (4.5)$$

Table N°4.10 – Performance Score

Bids	S_i^+	S_i^-	P_i	**Rank**
Company 1	0.005	0.053	0.92	2
Company 2	0.006	0.078	0.93	1
Company 3	0.023	0.025	0.52	3
Company 4	0.079	0.006	0.07	5
Company 5	0.043	0.014	0.25	4

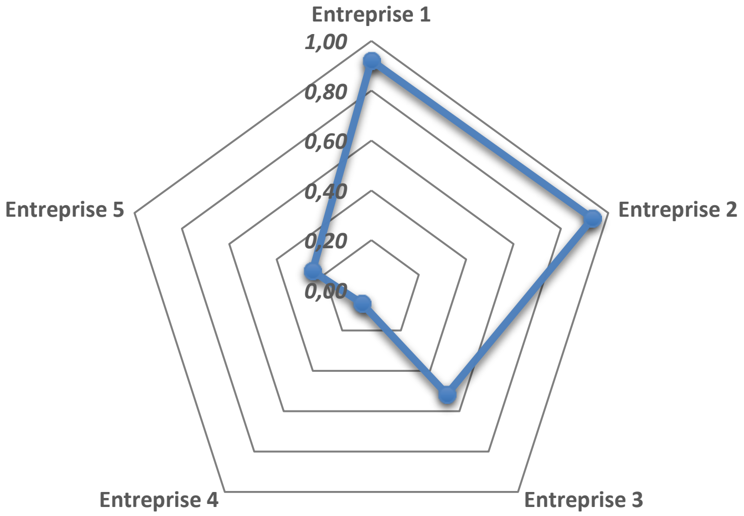
Source : The Author.

At the end of this method, it is evident that the performances of the two companies, 01 and 02, are almost identical, with scores of 0.92 and 0.93, respectively, despite the second company having a slightly lower commercial offer by approximately -10%.

The MCDA method effectively contributes to supplier selection by enabling a detailed ranking that considers multiple criteria simultaneously. It allows for a comprehensive evaluation of suppliers, taking into account various factors and criteria that are essential for decision-making.

In this case, the MCDA approach has facilitated a thorough assessment, considering both technical and financial aspects, resulting in a close performance comparison between the two companies. This demonstrates the efficacy of MCDA in supporting decision-making processes related to supplier selection, enabling a comprehensive evaluation that goes beyond a single criterion, such as commercial offer, and takes into account a broader range of criteria for a more informed decision.

Figure N°4.1 - Performance Trend by Bidder



Source : The Author.

5. Conclusion and recommendations :

5.1. Conclusion :

In conclusion, the application of the MCDA/TOPSIS methodology in the supplier selection process has yielded valuable insights and facilitated a comprehensive evaluation. Through the step-by-step process, including the definition of the problem, identification of criteria, aggregation of preferences, and ordering of alternatives, the methodology has provided a systematic approach for decision-making.

The use of MCDA/TOPSIS has allowed for the consideration of both technical and financial criteria, ensuring a balanced evaluation of suppliers. The normalization and weighting of data have enabled a fair and consistent comparison among the alternatives. The calculation of Euclidean distances and performance scores has provided a quantitative measure of each alternative's proximity to the ideal solution.

The results indicate that the performances of the evaluated suppliers, particularly Companies 01 and 02, are nearly identical, demonstrating the effectiveness of the MCDA/TOPSIS methodology in capturing nuanced differences in performance across multiple criteria.

Overall, the MCDA/TOPSIS approach has proven to be a valuable tool for supplier selection, enabling a comprehensive and objective assessment that goes beyond a single criterion. The methodology supports decision-makers in making informed choices and enhances the overall effectiveness and efficiency of the supply chain management process.

By incorporating the MCDA/TOPSIS methodology into the supplier selection process, organizations can optimize their decision-making, minimize risks, and select suppliers that align with their objectives and requirements. This methodology offers a robust framework for evaluating alternatives and paves the way for improved performance and competitiveness in the procurement and supply chain domains.

5.2. Recommendations:

Based on the findings and limitations identified in the study, the following recommendations are proposed:

1) Invest in Information Technology: Considering the potential complexities of the MCDA process, organizations should consider investing in information technology solutions that can support the calculation and analysis of performance scores. Implementing appropriate software tools or platforms can facilitate the efficient and accurate evaluation of suppliers, particularly when dealing with a large number of criteria or participants.

2) Enhance Technical Expertise: To effectively apply MCDA and ensure the proper identification and definition of technical criteria, organizations should strive to enhance their technical expertise. This may involve training staff members or engaging external experts who possess the necessary knowledge and experience in the relevant domain. Building a competent team capable of accurately defining and assessing technical criteria is essential for the success of the MCDA process.

3) Evaluate the Feasibility of E-Procurement: Organizations should consider exploring the feasibility of implementing an e-procurement system. Such a system can offer numerous benefits, including improved control over purchases, customizable selection criteria, and adherence to established procurement principles. Conducting a thorough feasibility study will help determine the viability and potential advantages of adopting an e-procurement solution.

4) Continuously Monitor and Update Criteria: Given the evolving nature of technology and changing market dynamics, it is crucial to continuously monitor and update the selection criteria. Regularly reviewing and refining the criteria will ensure their relevance and alignment with organizational goals. This proactive approach will help maintain the effectiveness of the MCDA process over time.

5) Seek Feedback from Stakeholders: It is important to involve relevant stakeholders, such as end-users and decision-makers, in the supplier selection process. Seeking their input and feedback can provide valuable insights into the criteria and priorities that are most important to the organization. This collaborative approach fosters transparency and helps ensure that the selected suppliers align with the overall objectives of the organization.

By implementing these recommendations, organizations can enhance their supplier selection process, leverage the benefits of MCDA, and make more informed decisions. These steps contribute to effective procurement practices, ultimately improving the overall performance and success of the supply chain.

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