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Multicriteria Decision-Making in the Evaluation of Public Services: Application of MCDM Methods in a Real Case Study

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Abstract: Managing the public sector increasingly requires the application of modern analytical methods that enable decision-making based on multiple criteria. This paper presents a real-world case study in which multicriteria decision-making (MCDM) method sare applied to evaluate the marketing activities and performance of a public institution. The research includes an analysis of the services offered, user satisfaction, and a comparison with alternative institutions in the same field. The obtained results highlight the relevance of MCDM methods for the objective assessment of public services and for strategic planning within the public sector. The paper contributes to a better understanding of the potential for applying MCDM tools in the context of public administration, with particular emphasis on marketing as a mechanism for improving transparency and effectiveness.

Keywords: Engineering management; Public sector; MCDM methods; Marketing; Real case study

1 Introduction

In today's dynamic social and economic environment, the public sector is increasingly faced with the need to improve its operations in order to meet the rising expectations of citizens and maintain their trust. In this context, approaches traditionally associated with the private sector such as marketing and strategic analysis are gaining importance in the domain of public administration and public services. Although marketing is typically linked to market driven businesses and profit generation, its concepts and tools can be effectively applied in the public sector as well. Instead of focusing on customers and profit, marketing in public institutions targets service users, the fulfillment of the organization's mission, improvement of service quality, and enhancement of transparency and accountability. The modern public sector strives to be more than a passive administrator it aims to actively recognize and respond to the needs of its citizens.

One of the key challenges in this process is making objective, evidence-based decisions particularly when multiple criteria, limited resources, and various stakeholder interests must be considered. In this regard, Multi-Criteria Decision-Making (MCDM) methods play a crucial role. These methods provide a structured approach for evaluating complex decisions, reducing reliance on intuition. This paper aims to examine the role and significance of marketing in the public sector, as well as the applicability of MCDM methods in evaluating marketing activities and overall institutional performance. Through a real-world case study involving multiple public institutions in the field of healthcare and rehabilitation, the research evaluates criteria such as service offerings, user satisfaction, pricing, infrastructure, organizational structure, and promotional strategies. By combining qualitative and quantitative techniques, the study provides insight into the potential of multicriteria analysis to support the development and improvement of public sector management. The research is based on the following assumptions:

• Applying marketing principles in public institutions contributes to more efficient and transparent achievement of their mission.

• MCDM methods enable the objective ranking and evaluation of public institutions based on multiple criteria relevant to both users and society.

• Social marketing is a key element of modern strategic management within the public sector.

• Institutions that systematically apply marketing approaches achieve higher levels of user satisfaction and are better positioned compared to similar organizations.

This study employs the methods of induction and deduction, analysis and synthesis, as well as verification, description, comparison, and generalization, in order to derive valid scientific insights based on real-world data. This research contributes to a deeper understanding of how marketing principles, when integrated with decision-making models, can enhance the effectiveness of public sector management. Additionally, it highlights the practical applications of MCDM methods in evaluating public services and offers a novel perspective on their use for improving organizational performance and user satisfaction in public institutions.

The paper is structured as follows: In the first chapter, the introduction and background of the research are provided, discussing the significance of marketing in the public sector and the role of MCDM methods. The second chapter presents a comprehensive literature review, covering previous research on marketing strategies in the public sector and the application of MCDM methods. The third chapter outlines the methodology used in the research and analysis techniques. The fourth chapter presents the results of the case study analysis, followed by a discussion of the findings in the context of improving public sector operations. Finally, the fifth chapter concludes the paper, summarizing the key findings and suggesting areas for future research.

2 Literature Review

The application of MCDM methods has grown increasingly important in the evaluation and decision-making processes across various sectors, particularly in the public sector, where complex decisions often involve multiple conflicting criteria. These methods offer systematic ways to evaluate alternatives when decisions must account for various factors, such as cost, efficiency, social impact, and user satisfaction, making them ideal for assessing public services, policy choices, and strategic planning.

MCDM methods are widely used to evaluate and prioritize a range of criteria that might not be easily comparable. These criteria can be both quantitative, such as costs or performance measures, and qualitative, such as user satisfaction or social outcomes. Among the most prominent MCDM methods are the Analytic Hierarchy Process (AHP), the Analytic Network Process (ANP), Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), Elimination and Choice Expressing Reality (ELECTRE), Preference Ranking Organization Method for Enrichment Evaluations (PROMETHEE) and VICTOR each offering different advantages depending on the complexity of the decision context and the relationships among the criteria [1–6]. The graphical representation is shown in Figure 1 [7].

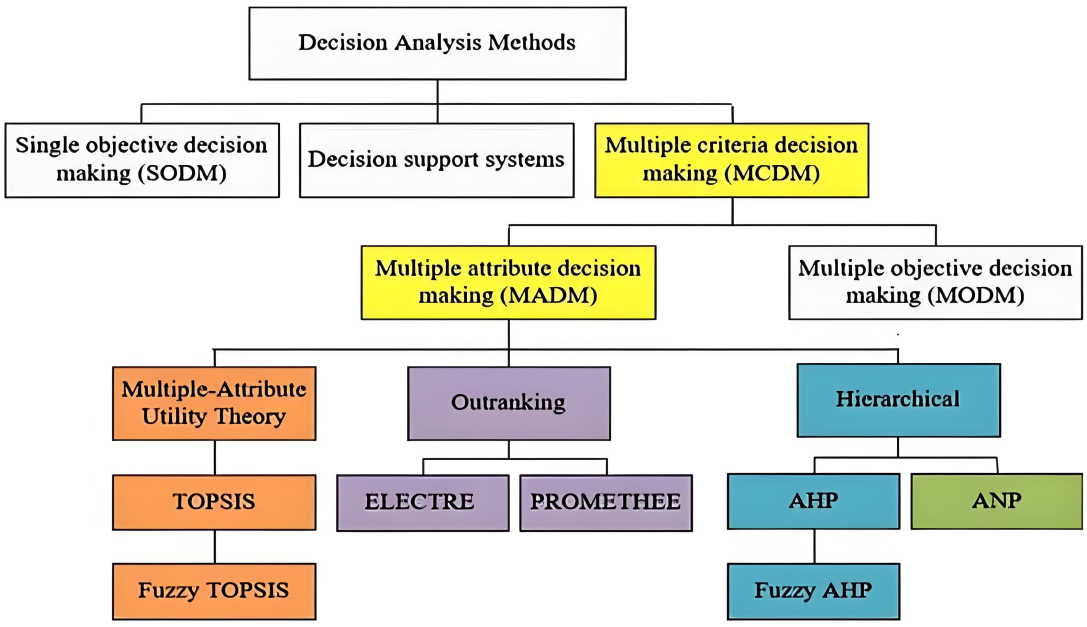

Figure 1. Selection using multi-criteria decision making: a comprehensive overview

While AHP remains one of the most widely recognized methods, a growing body of research has focused on expanding the repertoire of MCDM approaches. The ANP, for example, extends AHP by incorporating interdependencies among criteria, making it a more flexible tool for complex decision-making in situations where elements are interrelated [7]. On the other hand, methods like TOPSIS and VIKOR are used to rank alternatives based on their closeness to an ideal solution, making them well-suited for decision contexts where ranking alternatives is a

primary concern [8, 9].

The application of MCDM methods is highly relevant today, particularly in evaluating public sector services. As public institutions increasingly face pressures to optimize resource allocation, improve service quality, and meet diverse stakeholder needs, MCDM methods provide an objective and structured framework for assessing multiple competing criteria. For instance, studies have applied MCDM methods in evaluating healthcare services, where the goal is to balance factors such as patient satisfaction, treatment outcomes, and cost-effectiveness [10]. Similarly, in environmental decision-making, MCDM methods have been used to prioritize sustainability initiatives that consider economic, ecological, and social impacts [11]. In recent years, hybrid MCDM approaches have gained attention, where two or more methods are combined to take advantage of the strengths of each. For example, combining TOPSIS with fuzzy logic allows for dealing with uncertainties in decision-making, especially when the criteria and alternatives involve imprecision [6]. Such hybrid models have become increasingly popular in the public sector, as they provide a more robust decision-making framework that accounts for various uncertainties and interdependencies [12–16].

A growing area of research is the integration of MCDM methods with other management tools, such as marketing strategies, to improve public sector performance. For example, combining MCDM with social marketing principles enables public institutions to evaluate marketing campaigns more effectively, by taking into account both social outcomes and public engagement [17]. This combination of methods can help public organizations enhance transparency, accountability, and the overall impact of their initiatives.

Moreover, MCDM methods have been successfully applied in a variety of public sector domains, such as education, urban planning, and public transport. Studies by Ho et al. [18] and Tzeng and Huang [10] demonstrated how MCDM methods were used to evaluate public transportation systems, allowing policymakers to optimize service delivery based on a wide range of criteria, including cost, accessibility, and user satisfaction.

This underscores the versatility of MCDM methods in making informed, data-driven decisions that can lead to improvements in public service delivery. Although MCDM methods have been widely applied in the public sector, there remain gaps in the literature, particularly regarding the integration of MCDM techniques with other approaches such as marketing. While individual MCDM methods are well researched, fewer studies have explored how combining these methods with other strategies can improve overall decision-making and service outcomes in public organizations. This gap presents an opportunity for further exploration, particularly in areas such as healthcare, public utilities, and education, where the integration of marketing and MCDM methods could lead to more effective service delivery and better resource allocation.

The literature widely explores the application of MCDM methods in various industrial and managerial problems, such as supplier selection, transportation policy optimization, laser cutting parameter assessment, flexible job shop scheduling optimization, and transportation system performance analysis. Petrovic et al. [19] used fuzzy MCDM methods such as SWARA, TOPSIS, WASPAS, and ARAS for supplier selection in the supply chain context, while Chatterjee et al. [20] integrated MCDM methods with Taguchi's robust design principles for selecting transportation policies, developing an adaptive expert system. Petrović et al. [21] investigated the application of MCDM methods in optimizing laser cutting parameters, combining different MCDM techniques with Taguchi's principles, while Madić et al. [22] applied fuzzy AHP, FFUCOM, and WASPAS for flexible job shop scheduling optimization using the NSGA-II metaheuristic algorithm. Stanković and Petrović [23] utilized integrated fuzzy AHP and FTOPSIS methods for supplier selection in the supply chain, while Kumar and Pamucar [24] applied MCDM and the Entropy method for analyzing road transport performance in Serbia, using the TOPSIS method to rank transportation system performance. These papers demonstrated the effectiveness of MCDM methods in solving complex problems with multiple conflicting criteria and provided insights into different ways of applying these methods in industry and management evaluation [25–28].

3 Methodology

Given the main objective of the study to analyze and compare the quality of services provided by public institutions through the application of modern MCDM methods this chapter outlines the research approach, techniques, and methods used for data collection, processing, and analysis [29–31]. The methodology is based on a combination of quantitative and qualitative techniques to enable an objective and comprehensive evaluation [32–34]. The research is grounded in a real-world case study involving the analysis of marketing activities and performance of several public institutions operating in the same service domain. The sample includes public health and rehabilitation institutions that offer accommodation, treatment, and rehabilitation services within the territory of the Republic of Serbia.

The selection of institutions was based on data availability, similarity in service structures, and the number of users. The use of MCDM methods enabled the evaluation of services from multiple perspectives, including service quality, user satisfaction, service variety, promotional activities, and level of equipment. Based on a literature review and consultations with domain experts, the following evaluation sub-criteria were selected:

- Service cost,
- Diversity of service offerings,

• Service quality,
• Staff professionalism,
• User satisfaction,
• Visibility of marketing activities,
• Modernity of equipment and facilities.

Two MCDM methods were applied in the decision-making process:

(a) AHP—to determine the weights of the selected criteria based on expert evaluations and rank the public institutions according to their performance on all selected criteria,

(b) TOPSIS—to rank the public institutions according to their performance on all selected criteria.

The data used for analysis included:

• Survey questionnaires conducted among service users,
• Semi-structured interviews with staff and management,
• Publicly available reports and official documentation,
• Direct observation of marketing activities and operational conditions.

Expert assessments for the AHP method were collected from a panel of six professionals with experience in healthcare management, public sector marketing, and administration. For the TOPSIS method, all criterion values were normalized, after which the institutions were ranked based on their proximity to the ideal and anti-ideal solution.

4 Case Study Description: Comparative Evaluation of Public Rehabilitation Institutions

The comparative evaluation in this case study focuses on two leading Serbian rehabilitation institutions that have established reputations in the field of specialized medical services.

A_1: Spa Institute for Treatment and Rehabilitation in Niš is a renowned healthcare facility specializing in cardiovascular disease treatment, physical medicine, and orthopedic rehabilitation. The institute combines modern therapeutic approaches with natural healing resources specific to the Niš Spa region, providing a comprehensive range of inpatient and outpatient services. Its strategic mission emphasizes patient-centered care, high-quality diagnostics and treatment procedures, and the continuous improvement of service standards in line with national healthcare reforms.

A_2: Selters Rehabilitation Institute in Mladenovac offers a broad spectrum of rehabilitation programs for cardiovascular, pulmonary, neurological, and orthopedic conditions. With facilities located in both Belgrade and the Selters Spa in Mladenovac, this institution has developed extensive capacities, including advanced diagnostic departments, specialized therapeutic units, and wellness amenities. Selters is recognized for integrating traditional spa treatments with state-of-the-art rehabilitation practices, aiming to deliver effective recovery programs tailored to patient needs. The goal of this case study is to determine the optimal solution in selecting a rehabilitation institution based on given criteria: K_1: Economic Efficiency, K_2: Location, K_3: Effectiveness, K_4: Infrastructure. Figure 2 presented decision model for selecting rehabilitation center.

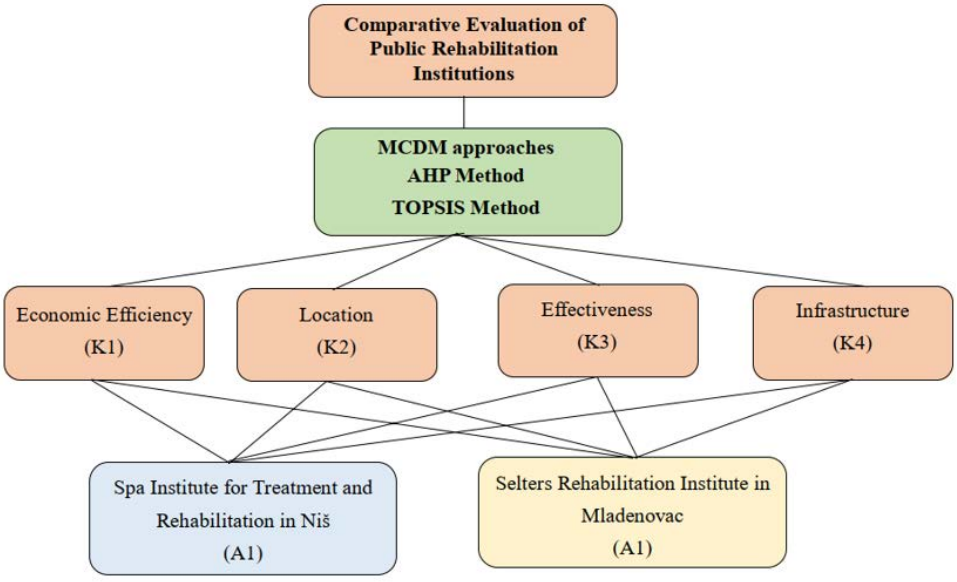

Figure 2. Decision model for selecting rehabilitation center

4.1 AHP Method

The Analytic Hierarchy Process is a MCDM method developed by Saaty [7]. It enables decision-makers to model a complex problem in a hierarchical structure, breaking it down into a goal, criteria, sub-criteria (if needed), and alternatives. By using pairwise comparisons and a fundamental 1–9 scale to express the relative importance of criteria and performance of alternatives, AHP quantifies subjective judgments. The method then calculates priority vectors (weights) through matrix normalization and consistency checks, allowing for a systematic and mathematically supported ranking of alternatives. AHP is widely used in public policy, healthcare, industry, and many other fields due to its transparency, simplicity, and robustness in handling both qualitative and quantitative criteria. AHP is a structured technique used for analyzing complex decisions by organizing them into a hierarchical framework. It relies on pairwise comparisons and uses Saaty's fundamental scale to determine the relative importance of criteria and alternatives shown in Table 1 [7].

Table 1. Saaty's fundamental scale of absolute numbers

Intensity of Importance	Definition	Explanation
1	Equal importance	Two criteria contribute equally to the objective
2	Weak or slight	Slight preference of one over another
3	Moderate importance	Experience and judgment slightly favor one over another
4	Moderate plus	Moderate plus preference
5	Strong importance	Experience and judgment strongly favor one over another
6	Strong plus	Strong plus preference
7	Very strong or demonstrated importance	A criterion is strongly favored and its dominance is demonstrated in practice
8	Very, very strong	Very strong plus preference
9	Extreme importance	Evidence favors one over another with the highest possible order of affirmation

In the next step, the characteristics of each alternative institution are evaluated based on four key criteria: economic efficiency, location, effectiveness, and infrastructure. The qualitative evaluations (Excellent, Very Good, Good) were converted into numerical values using Saaty's scale to enable a quantitative analysis. The following tables present the decision-making process based on these criteria shown in Table 2.

Table 2. Characteristics of the alternatives

Criteria	A_1	A_2
K_1: Economic Efficiency	Excellent	Good
K_2: Location	Excellent	Excellent
K_3: Effectiveness	Very Good	Excellent
K_4: Infrastructure	Excellent	Excellent

To proceed with the AHP analysis, these qualitative assessments are transformed into numerical values based on Saaty's scale. The decision-making matrix is shown in Table 3.

Table 3. The decision-making matrix

Criteria	K_1	K_2	K_3	K_4
A_1	9	9	7	9
A_2	5	9	9	9

The next step involves determining the relative importance of the criteria through pairwise comparisons. The criteria evaluation matrix is shown in Table 4.

The sums of each column are used to normalize the matrix, and the final priority weights for each criterion f_i are calculated. The normalized matrix is shown in Table 5. Figure 3 presented criteria weights and priorities.

Table 4. Pairwise comparison matrix of criteria

	K_1	K_2	K_3	K_4
K_1	1	7	3	8
K_2	0.142	1	2	4
K_3	0.333	0.5	1	9
K_4	0.125	0.25	0.111	1

Table 5. Normalized criteria evaluation matrix

	K_1	K_2	K_3	K_4	k_i	f_i
K_1	0.480	0.545	0.621	0.222	1.868	0.467
K_2	0.120	0.136	0.1035	0.333	0.692	0.173
K_3	0.158	0.27	0.207	0.333	0.968	0.242
K_4	0.2403	0.045	0.068	0.111	0.4643	0.116

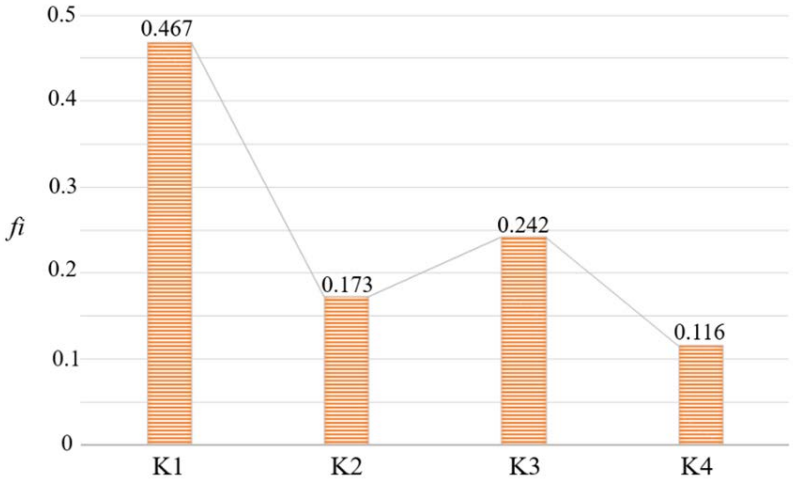

Figure 3. Criteria weights and priorities

With the criteria weights now defined, each alternative is evaluated against each criterion in the form of a normalized matrix.

The weighted scores are then calculated to determine the best alternative. Tables show the pairwise comparisons, normalized values, and the calculated contributions of each criterion to the total utility of each alternative. Based on the aggregated weighted scores, the final values are show in Table 6.

Table 6. Rank alternative AHP method

Alternative	Total Utility Score	Rank
A_1	0.596	I
A_2	0.4032	II

As the table indicates, Alternative A_1—Spa Institute for Treatment and Rehabilitation in Niš ranked as the optimal choice according to the AHP method. This decision is based on higher values in economic and operational criteria when compared with the A_2—Selters Rehabilitation Institute in Mladenovac.

4.2 TOPSIS Method

The Technique for Order Preference by Similarity to Ideal Solution is a MCDM method introduced by Sivalingam and Subramaniam [4]. The core principle of TOPSIS is that the optimal alternative should have the shortest distance from the ideal solution (the best possible values across all criteria) and the farthest distance from the negative-ideal solution (the worst values).

The method involves normalizing the decision matrix, applying weights to criteria, and calculating Euclidean distances from the ideal and negative-ideal points. The final ranking is based on a similarity index, which quantifies how close each alternative is to the ideal solution.

TOPSIS is valued for its simplicity, logical foundation, and ability to handle both benefit and cost criteria in practical decision-making scenarios. In this study, we apply the TOPSIS method using the same decision matrix and criteria as in the AHP analysis. The criteria weights obtained from the AHP method (Table 5) are used to construct the weighted normalized decision matrix.

Step 1: Normalize the decision matrix: Each element in the decision matrix is divided by the square root of the sum of squares of its column to create the normalized decision matrix, as shown in the Table 7.

Table 7. Normalize the decision matrix

Criteria	A_1	A_2
K_1	0.480	0.120
K_2	0.545	0.136
K_3	0.621	0.1035
K_4	0.222	0.333

Step 2: The weighted normalized decision matrix, as shown in Table 8: Multiply the normalized matrix values by the respective criteria weights from AHP (f_i values in Table 5).

Table 8. The weighted normalized decision matrix

Criteria	Weight (f_i)	A_1	A_2
K_1	0.467	0.408	0.227
K_2	0.173	0.122	0.122
K_3	0.242	0.147	0.189
K_4	0.116	0.082	0.082

Step 3: Identify ideal and negative ideal solutions, as shown in Table 9:
• Ideal solution (best values): max values in each column,
• Negative-Ideal solution (worst values): min values in each column.

Table 9. Ideal and negative ideal solutions

Criteria	Ideal	Negative Ideal
K_1	0.408	0.227
K_2	0.122	0.122
K_3	0.189	0.147
K_4	0.082	0.082

Step 4: Calculate the distance to ideal and negative ideal solutions: using Euclidean Distance formula:

$$D_i^+ = \sqrt{\sum \left(x_{ij} - x_j^+\right)^2} \tag{1}$$

$$D_i^- = \sqrt{\sum \left(x_{ij} - x_j^-\right)^2} \tag{2}$$

where, D_i^+—distance of alternative i from the positive ideal solution, D_i^-—distance of alternative i from the negative ideal solution, x_{ij}—the normalized and weighted value of alternative i with respect to criterion j, x_j^+—the ideal value for criterion j (maximum for benefit criteria, minimum for cost criteria), x_j^-—the anti-ideal value for criterion j (minimum for benefit criteria, maximum for cost criteria), i index of the alternative $(i = 1, 2, ..., m)$, j—index of the criterion $(j = 1, 2, ..., n)$. Distances to ideal and negative ideal are shown in Table 10.

Table 10. Distances to ideal and negative ideal

Alternative	Distance to Ideal D_i^+	Distance to Negative Ideal D_i^-
A_1	0.053	0.203
A_2	0.182	0.073

Step 5: Calculate closeness coefficient (similarity index):

$$C_i = \frac{D_i^-}{D_i^+ + D_i^-} \tag{3}$$

where, C_i—closeness coefficient of alternative i, representing its relative closeness to the ideal solution. Interpretation: $C_i \in [0, 1]$. The higher the C_i, the closer the alternative is to the ideal solution. Alternatives are ranked in descending order of C_i values. Similarity index and rank alternatives are shown in Table 11.

Table 11. Similarity index

Alternative	Similarity Index C_i	Rank
A_1	0.793	I
A_2	0.286	II

According to the TOPSIS method, A_1: Spa Institute for Treatment and Rehabilitation in Niš is the optimal choice based on its higher similarity to the ideal solution.

Both methods, AHP and TOPSIS, indicate that A_1: Spa Institute for Treatment and Rehabilitation in Niš is the optimal choice based on the criteria of Economic Efficiency K_1, Location K_2, Effectiveness K_3 and Infrastructure K_4. A graphical representation of the obtained results and a comparative analysis is presented in Figure 4.

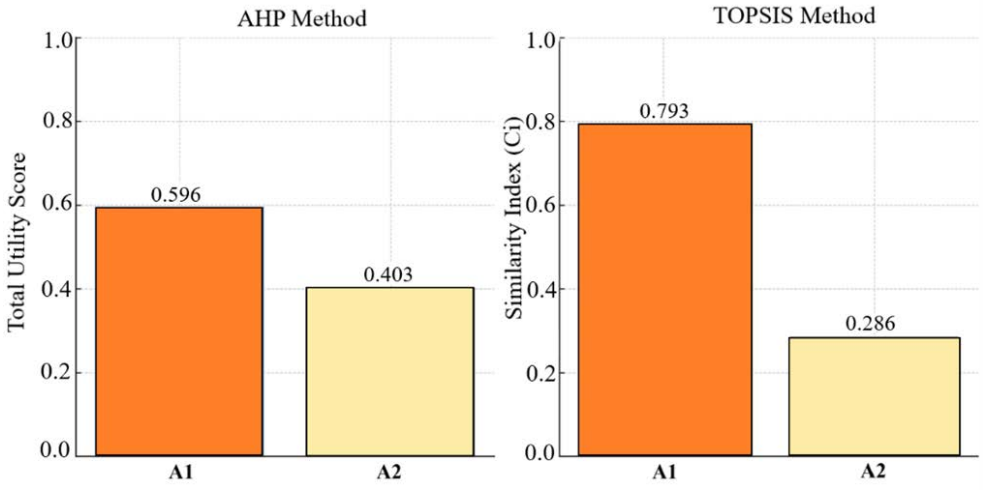

Figure 4. A comparative chart showing AHP and TOPSIS scores for both alternatives

This case study highlights the effectiveness of MCDM methods in evaluating and selecting the most suitable rehabilitation institution based on a set of predefined criteria. The results obtained through the AHP method indicated that A_1 was the more favorable option, with a total utility score of 0.596, compared to A_2 score of 0.4032. Similarly, the TOPSIS method, which is based on measuring the distance from an ideal and a negative-ideal solution, assigned a higher similarity index to A_1 (0.793) than to A_2 (0.286).

5 Conclusions

This study conducted a comparative evaluation of public rehabilitation institutions in the Republic of Serbia, with the aim of identifying the optimal choice based on multiple criteria: economic efficiency, location, effectiveness, and infrastructure. The analyzed alternatives were A_1 and A_2, evaluated using two well-established MCDM methods (AHP and TOPSIS). Both methods consistently rank the Niš institute as the more suitable option, particularly due to its strong performance in cost-effectiveness, a critical factor in the socio-economic context. However, the analysis also highlighted areas for improvement, including infrastructure modernization, facility renovation, and the expansion of services. The key scientific contribution of this research lies in the dual application of AHP and TOPSIS within the public healthcare sector, offering a transparent and replicable framework for institutional decision-making. Practically, the methodology can support healthcare managers and policymakers in strategic planning, investment prioritization, and service development aimed at enhancing user satisfaction and operational efficiency.

Future research should broaden the scope by including more rehabilitation centers and expanding the set of evaluation criteria to capture patient satisfaction, equipment quality, digitalization, and international collaboration.

The integration of hybrid MCDM methods and machine learning techniques may further improve the objectivity, adaptability, and accuracy of institutional evaluations. Conducting sensitivity analyses is also recommended to assess the stability of outcomes under varying decision-making scenarios.

Author Contributions

Conceptualization, M.S. and A.S.; methodology, M.S., M.I.Đ. and A.S,; formal analysis, M.S. and A.S.; resources, S.S.; data curation, M.S. and A.S.; writing—original draft, M.S. and A.S.; writing—review & editing, M.I.Đ. and S.S.; supervision, M.I.Đ.; project administration, A.S. and S.S. All authors have read and agreed to the published version of the manuscript.

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Data Availability

The data used to support the research findings are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflict of interest.

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