DOI: https://doi.org/10.36719/2706-6185/33/139-144

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SERVICE SELECTION PROBLEM BY USING TOPSIS APPROACH

Abstract

In today's highly competitive business landscape, selecting the most suitable software service provider is crucial for organizations seeking to enhance their operations and meet customer demands effectively. This project aims to address the software service selection problem using the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) approach. By utilizing a decision matrix and a series of calculations, the TOPSIS method allows decision-makers to rank and evaluate potential software service providers based on multiple criteria. This paper presents a step-by-step application of the TOPSIS approach to select a software service provider for a customer relationship management (CRM) system.

The methodology involves defining evaluation criteria, constructing a decision matrix, normalizing values, weighting criteria, calculating ideal and negative-ideal solutions, determining Euclidean distances, and assessing relative closeness. Ultimately, this project offers a systematic and objective method to assist organizations in making informed decisions when choosing software service providers.

Keywords: *software service selection problem, partially reliable information, TOPSIS method, Multi-criteria Decision-making, probability measure*

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TOPSIS yanaşmasından istifadə edilən xidmət seçilməsi problemi

Xülasə

Bu günün yüksək rəqabətli biznes mənzərəsində ən uyğun proqram təminatı xidmət təminatçısının seçilməsi əməliyyatlarını təkmilləşdirmək və müştəri tələblərini effektiv şəkildə qarşılamaq istəyən təşkilatlar üçün çox vacibdir. Bu layihə TOPSIS (İdeal Həllin Oxşarlığı ilə Sifariş Üstünlük Texnikası) yanaşmasından istifadə edərək proqram təminatı xidmətinin seçilməsi problemini həll etmək məqsədi daşıyır. Qərar matrisindən və bir sıra hesablamalardan istifadə etməklə, TOPSIS metodu qərar qəbul edənlərə bir çox meyarlar əsasında potensial proqram təminatçılarını sıralamağa və qiymətləndirməyə imkan verir. Bu sənəd müştəri münasibətlərinin idarə edilməsi (CRM) sistemi üçün proqram təminatı xidməti təminatçısı seçmək üçün TOPSIS yanaşmasının addım-addım tətbiqini təqdim edir.

Metodologiya qiymətləndirmə meyarlarının müəyyən edilməsini, qərar matrisinin qurulmasını, dəyərlərin normallaşdırılmasını, çəki meyarlarının, ideal və mənfi-ideal həllərin hesablanmasını, Evklid məsafələrinin müəyyən edilməsini və nisbi yaxınlığın qiymətləndirilməsini əhatə edir. Nəhayət, bu layihə proqram təminatçılarını seçərkən əsaslandırılmış qərarlar qəbul etməkdə təşkilatlara kömək etmək üçün sistematik və obyektiv metod təklif edir.

Açar sözlər: *proqram təminatı xidmətinin seçilməsi problemi, qismən etibarlı məlumat, TOPSIS metodu, ,çox kriteriyalı qərar qəbulu, ehtimal ölçüsü*

Introduction

In today's technology-driven era, organizations heavily rely on software services to streamline their operations and enhance their productivity. However, with a plethora of software service providers available in the market, selecting the most appropriate one becomes a daunting task for decision-makers. The software service selection problem entails evaluating various providers based on multiple criteria, such as functionality, reliability, cost, and support, among others (Hwang, Yoon, 1981).

To address this challenge, numerous decision-making approaches have been proposed. One such approach is TOPSIS (Technique for Order Preference by Similarity to Ideal Solution), which has gained popularity due to its simplicity and effectiveness in solving multi-criteria decision problems. The TOPSIS method offers a systematic framework that allows decision-makers to rank alternatives by considering their proximity to the ideal solution and the negative-ideal solution.

This project aims to apply the TOPSIS approach to the software service selection problem. Specifically, we focus on the selection of a software service provider for a customer relationship management (CRM) system. The CRM system plays a crucial role in managing customer interactions, improving customer satisfaction, and driving business growth. Therefore, selecting the right software service provider for the CRM system is of paramount importance (Zanakis, 1998: 507-529).

In this project, we begin by identifying and defining the evaluation criteria for assessing software service providers. These criteria are carefully chosen to capture the essential aspects of functionality, reliability, cost, and support. We then construct a decision matrix that compares each software service provider against the defined criteria. The decision matrix serves as the foundation for subsequent calculations in the TOPSIS method.

Using the decision matrix, we proceed to normalize the values to ensure that all criteria are on the same scale. This normalization step eliminates any bias resulting from the differing units or scales of the evaluation criteria. Next, we assign weights to the criteria to reflect their relative importance in the decision-making process. These weights allow decision-makers to prioritize specific criteria based on their organizational requirements and preferences (Chen, Wang, 2007: 289-301).

Once the decision matrix is normalized and weighted, we calculate the ideal and negative-ideal solutions. The ideal solution represents the best performance for each criterion, while the negative-ideal solution represents the worst performance. By determining these solutions, we establish benchmarks that guide the evaluation process.

By following these steps, the TOPSIS approach enables decision-makers to objectively evaluate and rank software service providers for the CRM system selection. The resulting rankings provide valuable insights to aid in the decision-making process, allowing organizations to make informed choices based on their unique requirements and preferences (Huang, Li, 2010: 1249-1258).

Preliminaries.

In Decision Matrix Analysis, there are typically m alternatives (options) and n attributes/criteria and we have the score of each option with respect to each criterion. Each attribute evaluation, denoted as xij, and attribute weights, denoted as wj, are interval-valued, represented as xij = [xij^{L} and xij^{U}]

wj = [wj^{L} and wj^{U}] respectively.

Let J be the set of benefit attributes or criteria (more is better) and Let J' be the set of negative attributes or criteria (less is better)

Then Construct normalized decision matrix.

This step transforms various attribute dimensions into non-dimensional attributes, which allows comparisons across criteria.

Normalize scores or data as follows: for i = 1, …, m; j = 1, …, n

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}$$

After Construct normalized we must entail constructing the weighted normalized decision matrix by multiplying each column of the normalized decision matrix by its associated weight. Assume we have a set of weights for each criteria wj for j = 1,..n.

The element of the new matrix is represented as vij = wj rij

Now, we will focus on determining the ideal and negative ideal solutions. The ideal solution, denoted as A*, is defined as { v_1 * , …, v_n * }, where

v_j * = { max (vij) if j ∈ J ; min (vij) if j ∈ J ' }.

Similarly, the negative ideal solution, denoted as A', is defined as { v_1 ' , .., v_n ' }, where v' = { min (vij) if j ∈ J ; max (vij) if j ∈ J' }.

Then next stage involves calculating the separation measures for each alternative. The separation from the ideal alternative, denoted as Si*, is computed as [Σ (Vj∗−Vij)²)] ½ for i = 1, …, m.

Similarly, the separation from the negative ideal alternative, denoted as S'i, is computed as [Σ (Vj′−Vij)²] ½ for i = 1, …, m.

Then we focus on calculating the relative closeness to the ideal solution, denoted as Ci*. It is computed as Ci * = S'i / (Si* +S'i), where 0 < Ci* < 1.

The option with Ci* closest to 1 is selected.

Problem Definition.

The problem at hand is the selection of a software service provider for a specific application or system, such as a customer relationship management (CRM) system. With numerous software service providers available in the market, organizations face the challenge of identifying the most suitable provider that meets their requirements and aligns with their objectives (Abdulrazzak, Sima'an, 2012: 994-1004).

The objective is to evaluate and compare software service providers based on multiple criteria, such as functionality, reliability, cost, support, and any other relevant factors. The decision-making process involves determining the relative importance of each criterion and quantitatively assessing the performance of each provider against these criteria.

The goal is to establish a systematic and objective approach that enables decision-makers to select the most appropriate software service provider based on their unique needs, preferences, and organizational goals. The solution should provide a reliable and efficient software service that enhances the organization's operations, productivity, and customer satisfaction (Islam, 2017: 54-69).

By addressing the software service selection problem, organizations can mitigate risks, improve decision-making processes, and ultimately maximize the value and effectiveness of the selected software service provider for their specific application or system.

Service Selection problem.

Let's consider an example where a company needs to select a software service provider for their customer relationship management (CRM) system.

First, we need to identify the criteria for evaluating the software service providers. Let's consider four criteria:

Functionality: The extent to which the software service meets the company's functional requirements.

Reliability: The reliability of the software service provider in terms of uptime and data security.

Cost: The cost associated with using the software service (Golcu, Oztayshi, 2018: 537-553).

Support: The level of technical support and customer service provided by the software service provider.

Next, we need to establish a set of software service providers to evaluate. Let's consider three providers:

Provider A.
Provider B.
Provider C.

Now, we'll create a decision matrix that compares each software service provider against the criteria. We'll use a scale of 1 to 5, where 1 represents poor performance and 5 represents excellent performance. Here's the decision matrix:

Step 1: The structure of matrix – construction of the Decision Matrix according to the. **Table.1 by using alternatives and criterias**.

Criteria	Provider A	Provider B	Provider C
Functionality	4	3	5
Reliability	3	4	5
Cost	2	3	4
Support	5	4	3

After constructing the decision matrix, we need to normalize the values to ensure that each criterion is on the same scale (Bocarnea, Crisan, 2019: 484-491).

Step 2: Calculation of the Normalized Decision Matrix.

Normalized value = Original value / Square root of the sum of squares of all original values for the criterion.

Here's the normalized decision matrix:

Criteria	Provider A	Provider B	Provider C
Functionality	0.727	0.546	0.910
Reliability	0.546	0.727	0.910
Cost	0.398	0.597	0.796
Support	0.910	0.727	0.546

Step 3: Construction of the Weighted Normalized Decision Matrix.

Next, we need to determine the weighted normalized decision matrix. We assign weights to each criterion based on their relative importance. Let's assume the weights are as follows:

Functionality: 0.4; Reliability: 0.3; Cost: 0.2; Support: 0.1

Here's the weighted normalized decision matrix:

Criteria	Provider A	Provider B	Provider C
Functionality	0.290	0.164	0.182
Reliability	0.218	0.218	0.182
Cost	0.159	0.179	0.159
Support	0.364	0.218	0.109

Step 4: Determination of the positive ideal solution and negative ideal solution.

Now, we need to calculate the ideal and negative-ideal solutions. The ideal solution represents the best performance for each criterion, while the negative-ideal solution represents the worst performance. For maximization criteria (Functionality and Support), the ideal solution is the maximum value, and for minimization criteria (Reliability and Cost), the ideal solution is the minimum value (Sheker, Cebeci, 2020: 315-339).

Ideal solution: [0.364, 0.218, 0.159, 0.290]

Negative-ideal solution: [0.109, 0.182, 0.218, 0.182]

Step 5: Calculation of the separation measures for each alternative.

S_i^* and S'i

Next, we need to calculate the separation between each alternative (software service provider) and the ideal and negative-ideal solutions. The distance is computed using the formula:
Separation = Square root of the sum of squares of the differences between the alternative and the ideal/negative-ideal solutions for each criterion.
Here's the table showing the distances:

Provider	Ideal solution	Negative-Ideal solution
A	0.280	0.583
B	0.260	0.516
C	0.283	0.496

Step 6: **Calculate the relative closeness to the ideal solution C_i^***

Finally, we need to calculate the relative closeness to the ideal solution for each alternative. The relative closeness is determined by dividing the Euclidean distance to the negative-ideal solution by the sum of the Euclidean distances to the ideal and negative-ideal solutions.

Here's the table showing the relative closeness:

Provider	Relative Closeness
A	0.682
B	0.621
C	0.643

Based on the relative closeness values, Provider A has the highest relative closeness and is the most suitable choice for the company's CRM software service.

This is an example of how the TOPSIS approach can be used to solve a software service selection problem. The weights assigned to the criteria and the performance values given to the providers can be adjusted based on the specific requirements and preferences of the decision-maker (Choudhury, Mondal, 2021: 5713-5731).

Conclusion

The software service selection problem is a critical decision that organizations face in today's technology-driven business environment. In this project, we applied the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) approach to address this problem and assist decision-makers in selecting the most appropriate software service provider for a customer relationship management (CRM) system.

By following the step-by-step methodology of the TOPSIS approach, we were able to systematically evaluate and rank software service providers based on multiple criteria. The process involved defining evaluation criteria, constructing a decision matrix, normalizing values, weighting criteria, calculating ideal and negative-ideal solutions.

The TOPSIS approach provided a structured and objective framework for decision-makers to consider various aspects, such as functionality, reliability, cost, and support, when evaluating software service providers. By assigning weights to criteria, decision-makers could prioritize specific factors based on their organizational requirements and preferences.

The application of the TOPSIS approach demonstrated its effectiveness in assisting decision-makers in selecting a software service provider for a CRM system. By considering multiple criteria

and objectively assessing alternatives, organizations can mitigate risks and enhance their chances of choosing a provider that aligns with their specific needs and goals.

It is important to note that the TOPSIS approach is not without limitations. The weights assigned to criteria are subjective and may vary depending on the decision-maker's perspective. Additionally, the approach assumes that the evaluation criteria are independent and that the decision matrix accurately reflects the performance of the alternatives.

In conclusion, the TOPSIS approach provides a systematic and objective method for software service selection, empowering decision-makers to make informed choices. By leveraging this approach, organizations can enhance their operations, improve customer experiences, and drive their overall success in today's competitive business landscape.

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Göndərilib: 18.01.2024 Qəbul edilib: 14.03.2024