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Determination of the Most Suitable Credit Provider in Banking Services with Multi Criteria Decision Making Methods

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Abstract: *In our age, banking became inevitable for businesses especially in economic life. Even, banks are the first institutions as saviors that come to mind in economic crises that businesses face. The most obvious reason for this is the availability of credit opportunities. In particular, banks can solve financial bottlenecks of large corporations rather than individuals. However, when offering these solutions to businesses, banks can drag the other side to a burden of debt. For this reason, it has been considered necessary to use multi criteria decision making (MCDM) methods in order to meet the lesser costs of the buyers in the loans required from the banks. In this study, a company operating in Turkey to purchase a new machine has been determined that it needs to financial support. In line with this requirement, it was deemed appropriate to use SMART and EDAS methods in determining the most suitable bank for the need loan to be taken from the selected banks. As a result, the results of the two methods of analysis overlap to a great extent. A4 (Ziraat Bankası) was ranked first as the result of the analysis carried out by two different methods. The result of the analysis is shared with the authorities of the relevant business.*

Keywords:*Multi Criteria Decision Making Methods, SMART and EDAS Methods, Banking Services*

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I. Introduction

In the universe, all sorts of organisms that are willing to try different methods to achieve different purposes. The simplest way to select the most appropriate of these alternative methods is to say "decision". However, there is a deep link between the fact that decision making requires a process and the factors that influence this process. If this bond is well understood, then multi-criteria decision making (MCDM) problems can be understood. The most important elements of the MCDM problems are; goals, criteria, alternatives and decision makers.

In the current life, individuals are often influenced by their feelings of judgment problems they meet. However, nowadays, it is imperative for enterprises to use scientific decision making methods because it means finishing their own assets if they decide with their feelings in the current competitive conditions.

Considering the criteria existing in the structure of the decision problems, it is essential to act in a logical manner in the process of selecting the most suitable among the alternatives. For this reason, this relationship between logic principles and decision problems has long attracted the attention of researchers.

In classical logic there is no possibility for any decision situation other than true or false possibilities. But among these two possibilities, the existence of countless decisions is obvious. In addition, there are countless constraints and alternatives to be taken into consideration, depending on the decision problem.

In order to solve decision problems known as MCDM problems in literature, researchers have developed many methods based on classical or intuitive basis. While it is essential to express and solve the decision problem with mathematical formulas and concepts at the basis of classical approaches, heuristic approaches aim at finding the nearest solution to the exact solution of multivariable decision problems in a short time.

The decision problem in the application section of this study was analyzed by considering the current classification of MCDM methods. Recently, new or hybrid methods seem to be used extensively when examining the studies related to the MCDM methods.

In the study, it is aimed to determine the most suitable loan provider with the judgment that an enterprise should obtain a loan. It is also aimed to demonstrate the applicability of the MCDM methods in this decision problem.

The implementation of the MCDM methods in banking services cannot be ignored in terms of social benefits. This study has been particularly focused on these benefits and aims to raise awareness on this issue. In accordance with this purpose, an application has been made in order to show that the new MCDM methods can be easily used in the banking services problems.

For example; (Çalışkan and Eren, 2016) selected public, private and foreign capital deposit banks and compared the performances of these banks using AHP and PROMETHEE methods with the help of ten financial ratios.

In the application part of the study, which operates in Turkey and is essential for a business that buy new machines in the regeneration process. The most appropriate credit provider institutions should be listed for obtaining the machines that are needed.

In accordance with this Purpose, it is clear that the most appropriate credit provider should be used and that scientific methods such as the MCDM methods should be used. Criteria and alternatives for this decision problem were identified by searching the managers of the decision maker and related literature. Based on the obtained data, a model for determining the most appropriate credit provider was established and this model was analyzed separately by SMART and DEAS methods of the MCDM methods.

In the second part of the study, the literature on banking sector applications of the MCDM problems was searched. In the third part, there is an application for the use of MCDM methods in determining the most appropriate loan provider, which is a common problem of the enterprises. In the fourth and final section, the results of the analysis were expressed, interpreted and recommendations for future studies were made, focusing on the benefits for the business.

II. LiteratüreRevıew

A number of institutions can work in coordination, contributing to the development of the economy and the financial system. Among these, one of the important institutions is the banks (Taşkın, 2011). Banks are classified as commercial, development and investment banks according to their expertise in the literature and classified as public, private and foreign capital according to capital structures.

(Rod et al., 2009) utilized five dimensions of the Servqual scale in their work to determine customer satisfaction and service quality in internet banking. They found that important relationships among online information system, product quality and customer satisfaction with the structural equation model.

(Han and Baek, 2004) have used the dimensions of service quality from their physical characteristics, reliability, trust and empathy in their work using the structural equation model. In online banking, they determined that there is a positive relationship between service quality and customer satisfaction.

(Al-Tamimi and Al-Amiri, 2003) have benefited from five dimensions of service quality in their bank oriented work. It has been determined that the gender and nationality of the customer do not affect the level of service quality by the ANOVA test.

(Cerit, 2006) tried to measure the quality of offered internet service. Servqual scale was made by adapting to e-services. The resulting dimensions of the factor analysis; the nature of information, enthusiasm, physical appearance, electronic help, empathy and feedback.

(Joseph et al., 1999) investigated the effects of banking services on the Internet. In their study, the quality of electronic banking service has six dimensions, these are convenience, accuracy, feedback, complaint management, efficiency and queue management.

(Miranda et al., 2006) have made an objective assessment of private and savings banks in Spain. When the quality of the homepage of the internet sites was determined, they used the web evaluation index and worked on four dimensions including accessibility, speed, intra-site routing and content.

(Kılıç, 2006), it has identified ten ratios that distinguish banks, which primarily suffer from financial failure. Later, these ratios were used as criteria in the ELECTRE-TRI model and the banks were classified according to this model. The results of the study were influential in the creation and implementation of the early warning system and provided social benefit.

(Kosmidou and Zopounidis, 2008) evaluated the performance of commercial and cooperative banks operating in Greece between 2003 and 2004 with PROMETHEE method. They shared their findings with the authorities and made suggestions.

(Ertuğrul and Karakaşoğlu, 2009) applied the VIKOR method to evaluate the performance of commercial banks, which have a significant share in the service sector, and shared their results with related parties.

(Doumpos and Zopounidis, 2010) was ranked performances of banks by PROMETHEE II method. They used 31 criteria in their analysis. They also emphasized the evaluation parameters.

(Bağcı and Rençber, 2014) examined the comparison of profitability performances between public and private banks. The work was done by PROMETHEE method. Three public banks and ten open publicity private banks were used for their analyzes.

(Taşabat et al., 2015) evaluated the financial performance of the deposit banks operating in the Turkish Banking Sector in 2013 separately with the methods of ELECTRE, TOPSIS, VIKOR, PROMETHEE, ORESTE and MAPPAC. As a result of the analyzes, the grading among the analyzed banks was made and the criterion weighting method has been used in their analyzes.

(Ulutaş, 2017) used the EDAS method for the decision problem regarding the purchase of sewing machines in a textile operation, graded the most suitable machines and shared them with the business authorities.

2.1. SMART Method

The SMART (Simple Multi Attribute Rating Technique) method developed by Edwards in 1971 is a simple method that helps to implement multi criteria decisions. Edwards believes that decisions are based on subjective ideas of probability. In fact, as questions directed at decision makers become more complex, the chances of information errors will increase. SMART does not need preference or divergence ideas on alternatives as it is in other MCDM methods. Edwards has argued that personal ideas cannot be trusted or true.

In the SMART method, alternatives are evaluated for each criterion. Then the alternatives are multiplied by the weight of the criterion and the score they get from each criterion, resulting in a general ranking of the alternatives. Edwards proposed a ten step chain for this method.

Step 1: Identify the objective function
Step 2: Determine the benefits and cost elements that will bring to purpose
Step 3: Determine alternatives
Step 4: Determine the criteria and consider that these criteria are cost or benefit
Step 5: Sort criteria by their importance.
Step 6: Evaluate the criteria according to the order of importance.
Step 7: Sum the criteria weights and divide each to sum.
Step 8: Determine the location of each alternative in the criteria.
Step 9: Calculate the result values for alternatives
Step 10: Decide

2.2. EDAS Method

The EDAS (Evaluation Based on Distance from Average Solution) method of Ghorabaee et al. developed in 2015 can be summarized in six steps (Ghorabaee et al., 2015);

Step 1: Create the decision matrix (Y). The matrix shown by the following equation (1) is the decision matrix consisting of the basic data.

$$Y = [Y_{ij}]_{n\times m} = \begin{bmatrix} Y_{11} & Y_{12} & \cdots & Y_{1m} \\ Y_{21} & Y_{22} & \cdots & Y_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ Y_{n1} & Y_{n2} & \cdots & Y_{nm} \end{bmatrix} \quad (1)$$

Step 2: The averages of the values of all the criteria are taken. These operations are evaluated as shown in equations (2) and (3).

$$AV = [AV_j]_{1\times m} \quad (2)$$

$$AV_j = \frac{\sum_{i=1}^{n} Y_{ij}}{n} \quad (3)$$

Step 3: Positive Distance Matrix (PDA) and Negative Distance Matrix (NDA) are calculated for each criterion. These distances can be calculated with the help of equations (4) and (5).

$$PDA = [PDA_{ij}]_{n\times m} \quad (4)$$

$$NDA = [NDA_{ij}]_{n\times m} \quad (5)$$

If the criterion is in benfit position , the positive and negative distances are calculated by the following equations (6) and (7).

$$PDA_{ij} = \frac{\max(0,(Y_{ij} - AV_j))}{AV_j} \quad (6)$$

$$NDA_{ij} = \frac{\max(0,(AV_j - Y_{ij}))}{AV_j} \quad (7)$$

If the criterion is in the cost position, equations (8) and (9) below can be applied.

$$PDA_{ij} = \frac{\max(0,(AV_j - Y_{ij}))}{AV_j} \quad (8)$$

$$NDA_{ij} = \frac{\max(0,(Y_{ij} - AV_j))}{AV_j} \quad (9)$$

Step 4: SPi and SNi values are calculated for all alternatives. These values can be made using equations (10) and (11).

$$SP_i = \sum_{j=1}^{m} w_j \times PDA_{ij} \quad (10)$$

$$SN_i = \sum_{j=1}^{m} w_j \times NDA_{ij} \quad (11)$$

Step 5: SPi and SNi values for all alternatives are normalized by the following equations (12) and (13).

$$NSP_i = \frac{SP_i}{max_i(SP_i)} \quad (12)$$

$$NSN_i = 1 - \frac{SN_i}{max_i(SN_i)} \quad (13)$$

Step 6: Finally, the evaluation performances for each alternative ASi are calculated by the following equation (14).

$$AS_i = \frac{1}{2} \times (NSP_i + NSN_i) \quad (14)$$

The alternative with the greatest evaluation performance is identified as the best alternative.

III. Methodology

3.1. Purpose Of The Study

From an economic point of view, banks play an important role as they quickly resolve financial difficulties. Banks have been influenced by recent economic developments and have added many innovations to their services. The widespread of banking services and competition with other banks is beneficial to society and businesses.

In this study, a company operating in Turkey wants to buy new machines, but have to provide cash or loan from banks in the process of innovatıon. In this phase of decision business has to use scientific methods for solving this problem of decision. Because the business wants to borrow less. For this reason, it is aimed to determine the most suitable credit supplier by using SMART and DEAS methods. In this determination analysis, the authorities of the relevant business are accepted as decision makers. Four alternatives have been assessed by considering the six criteria that decision makers use to determine their objective scores.

3.2. Scope Of The Study

In the scope of the study, the opinions of the decision makers and related literature studies were taken into consideration while determining the alternative banks to be provided with the most appropriate loans. The research focuses on SMART and DEAS methods in the analysis of the most appropriate credit supplier identification model. Because ranking the alternatives and rating them are easy to use.

3.3. Model Of The Study

SMART and DEAS methods are used in analyzing the model of determining the most appropriate credit supplier based on the verbal evaluations made by the decision makers selected for the problem structure in the study. Bilateral conversations were held with decision makers, mutual comparisons of criteria and alternatives were sought, and the decision matrix, which was the first stage of DEAS, was established taking these benchmark values into consideration. This decision matrix is also the first data table of the analysis carried out by the DEAS method. With these two methods, alternatives are determined according to priority order as a result of analyzes made separately.

3.4. Determination Of Criteria And Alternatives

The number of criteria at the beginning was reduced to six by examining the decision makers and the related literature. The alternative for all public operating in Turkey are public, private and participation banks. Four alternative banks were identified within this scope. In this scope, they have determined the following criteria and alternatives;

Criteria;
C1: Amount of insurance
C2: Total Amount to be Paid
C3: Credit File Cost
C4: Voucher Status
C5: Credit Allocation Fee
C6: Insurance Transaction Tax
Alternatives;
A1: Garanti Bank
A2: İş Bank
A3: Ak Bank
A4: Ziraat Bank

3.5. Determination of Weights of Criteria

In the decision problem of determining the most appropriate credit supplier for the relevant business, the weight of the criteria was determined using the SMART method and each individual criterion of the decision makers.

IV. Implementation

4.1. Determine the Best Credit Supplier with SMART Method

Step 1: The basic data matrix is the expressed.

Table. 1: Basic Data Set Matrix for Alternatives and Criteria

	Amount of Insurance (TL) C1	Total Amount to be Paid (TL) C2	Credit File Cost (TL) C3	Voucher Status (Score) C4	Credit Allocation Fee (TL) C5	Insurance Transaction Tax (TL) C6
A1 (Garanti Bank)	1650	69156	250	0,7	2363	787
A2 (İş Bank)	1280	67173	525	0,5	2313	771
A3 (Ak Bank)	1566	67041	263	0,5	2566	855
A4 (Ziraat Bank)	831	66645	260	0,7	2064	688

Step 2: The alternatives are scored by the decision makers according to the criteria. This scoring consists of values between 0 and 1.

Table. 2: Alternative Scores According to Criteria

	Amount of Insurance (TL) C1	Total Amount to be Paid (TL) C2	Credit File Cost (TL) C3	Voucher Status (Score) C4	Credit Allocation Fee (TL) C5	Insurance Transaction Tax (TL) C6
A1 (Garanti Bank)	0,3	0,4	0,8	0,6	0,6	0,5
A2 (İş Bank)	0,7	0,6	0,4	0,8	0,7	0,6
A3 (Ak Bank)	0,5	0,6	0,7	0,8	0,4	0,3
A4 (Ziraat Bank)	0,9	0,8	0,7	0,6	0,9	0,7

Step 3: Criteria are scored by decision makers and normalized.

Table. 3: Ranking of Criteria by Decision Makers and Normalization

	1. Decision Making	2. Decision Making	Normalization Scores of the First Decision Maker	Normalization Scores of the Second Decision Maker	Criteria Weights
C1	80	75	0,200	0,188	0,194
C2	70	65	0,175	0,163	0,168
C3	60	70	0,150	0,175	0,162
C4	50	60	0,125	0,150	0,138
C5	75	70	0,188	0,175	0,181
C6	65	60	0,163	0,150	0,157

Step 4: Final scores of alternatives are determined.

Table. 4: Alternative Final Points

	Final Total Points	Final Rankings
A1 (Garanti Bank)	0,5250	4.
A2 (İş Bank)	0,6327	2.
A3 (Ak Bank)	0,5411	3.
A4 (Ziraat Bank)	0,7780	1.

A4 (Ziraat Bankası) alternative came first in the order of using SMART method analysis steps.

4.2. Determination of the Most Suitable Credit Supplier by DEAS Method

Step 1: The basic data matrix and the average performance of the criteria according to each alternative are expressed.

Table. 5: Initial Data Matrix and Average Performances

	Amount of Insurance (TL) C1	Total Amount (TL) C2	Credit File Cost (TL) C3	Voucher Status (Score) C4	Credit Allocation Fee (TL) C5	Insurance Transaction Tax (TL) C6
A1 (Garanti Bank)	1650	69156	250	0,7	2363	787
A2 (İş Bank)	1280	67173	525	0,5	2313	771
A3 (Ak Bank)	1566	67041	263	0,5	2566	855
A4 (Ziraat Bank)	831	66645	260	0,7	2064	688
Total	5327	270015	1298	2,4	9306	3101
Average	1332	67504	325	0,6	2327	775

Step 2: Positive and negative distances of the criterion are determined and expressed as a matrix.

Table. 6: Positive Distances Matrix

	Amount of Insurance (TL) C1	*Total Amount (TL) C2*	*Credit File Cost (TL) C3*	*Voucher Status (Score) C4*	*Credit Allocation Fee (TL) C5*	*Insurance Transaction Tax (TL) C6*
A1 (Garanti Bank)	0,000	0,000	0,230	0,167	0,000	0,000
A2 (İş Bank)	0,039	0,005	0,000	0,000	0,006	0,005
A3 (Ak Bank)	0,000	0,007	0,190	0,000	0,000	0,000
A4 (Ziraat Bank)	0,376	0,013	0,200	0,167	0,113	0,112

Table. 7: Matrix of Negative Distances

	Amount of Insurance (TL) C1	**Total Amount (TL) C2**	**Credit File Cost (TL) C3**	**Voucher Status (Score) C4**	**Credit Allocation Fee (TL) C5**	**Insurance Transaction Tax (TL) C6**
A1 (Garanti Bank)	0,239	0,024	0,000	0,167	0,015	0,015
A2 (İş Bank)	0,000	0,000	0,615	0,000	0,000	0,000
A3 (Ak Bank)	0,176	0,000	0,000	0,000	0,103	0,103
A4 (Ziraat Bank)	0,000	0,000	0,000	0,167	0,000	0,000

Step 3: The results of the alternatives are calculated taking into account the positive and negative distance values of the criterion.

Table. 8: Result Values for Alternatives

	SPi	**SNi**	**NSPi**	**NSNi**	**ASi**	**Final Sort**
A1 (Garanti Bank)	0,0603	0,0785	0,3568	0,2118	0,2843	2.
A2 (İş Bank)	0,0102	0,0996	0,0603	0,000	0,0302	4.
A3 (Ak Bank)	0,0319	0,0689	0,1888	0,3082	0,2485	3.
A4 (Ziraat Bank)	0,1690	0,0230	1,000	0,7690	0,8845	1.

A4 (Ziraat Bankası) alternative came in first rank in analyzes made using DEAS method.

V. Results And Recommendations

In this study, the problem of determining the most suitable credit provider, which has a very important place especially in the banking services planning, has been tried to find a solution by using SMART and DEAS methods. As it is understood from the related literature, it has not been found to use the ÇKKV methods in determining the bank which provides the most suitable loan base in banking services. In terms of eliminating this gap in the literature, the study can be considered as a new approach. The results of the study were shared with the managers of the related business and the results of the analysis were interpreted together.

SMART and DEAS methods that do not require very detailed calculations and complex programs can be easily implemented by business managers in banking services.

In the future studies more sophisticated banking services problems can be made more profitable by using fuzzy logic and artificial intelligence optimization methods.

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