ANALYSING THE SECTORS IN TERMS OF QUALITY MANAGEMENT: AHP, TOPSIS AND EDAS APPROACH

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Abstract

Total Quality Management (TQM) has become a critical managerial approach for businesses seeking to gain a competitive advantage in increasingly dynamic and globalized markets. In environments characterized by intense competition, enhancing job performance and employee satisfaction is essential for organizational sustainability. As such, TQM serves as a strategic framework aimed at embedding quality into every aspect of organizational operations. This study aims to identify and compare the quality management performance of six major economic sectors in Türkiye for the year 2022, based on data published in 2023 by the Turkish Statistical Institute (TurkStat). The evaluation is conducted using an integrated Multi-Criteria Decision-Making (MCDM) approach that employs the Analytic Hierarchy Process (AHP) to weight the criteria and utilizes the TOPSIS and EDAS methods for sectoral performance ranking. By doing so, the study seeks to provide data-driven insights into sectoral strengths and weaknesses in quality management and to offer strategic guidance for improvement efforts.

The criteria selected for the analysis include production value, number of employees, productivity (calculated as production value per employee), turnover, and number of enterprises. According to the AHP results, production value (0.5208) and number of employees (0.2495) emerged as the most influential criteria in determining quality performance. The consistency of the AHP decision matrix was validated with a consistency ratio (CR) of 0.0993, ensuring the methodological reliability of the weighting process. The sectoral rankings obtained from both TOPSIS and EDAS methods showed strong alignment. In both evaluations, the industrial sector demonstrated the highest quality management performance, indicating its strong capacity in terms of output, workforce size, and structured quality practices. Conversely, the construction sector consistently ranked lowest, revealing significant deficiencies in quality implementation and highlighting the need for targeted improvement strategies and comprehensive project management reforms.

Keywords: Sectoral Evaluation, Total Quality Management, Multi-Criteria Decision Making, AHP, TOPSIS, EDAS

JEL Codes: C44, C61, D81, L15, M31

SEKTÖRLERİN KALİTE YÖNETİMİ AÇISINDAN İNCELENMESİ: AHP, TOPSIS VE EDAS YAKLAŞIMI

Özet

Toplam Kalite Yönetimi (TKY), giderek daha dinamik ve küreselleşen piyasalarda rekabet avantajı elde etmeyi hedefleyen işletmeler için kritik bir yönetim yaklaşımı haline gelmiştir. Yoğun rekabetin hâkim olduğu ortamlarda iş performansının ve çalışan memnuniyetinin artırılması, örgütsel sürdürülebilirlik açısından büyük önem taşımaktadır. Bu doğrultuda TKY, kalite anlayışını örgütsel faaliyetlerin her aşamasına entegre etmeyi amaçlayan stratejik bir çerçeve sunmaktadır. Bu çalışma, Türkiye'deki altı temel ekonomik sektörün 2022 yılına ait kalite yönetimi performanslarını, Türkiye İstatistik Kurumu (TÜİK) tarafından 2023 yılında yayımlanan veriler temelinde belirlemeyi ve karşılaştırmayı amaçlamaktadır. Değerlendirme süreci, kriterlerin ağırlıklandırılmasında Analitik Hiyerarşi Süreci (AHS) ve sektörlerin performans sıralamasında TOPSIS ile EDAS yöntemlerini içeren bütünleşik bir Çok Kriterli Karar Verme (ÇKKV) yaklaşımıyla gerçekleştirilmiştir. Bu sayede çalışma, sektörlerin kalite yönetimi açısından güçlü ve zayıf yönlerine ilişkin veri temelli içgörüler sunmayı ve iyileştirme çalışmalarına stratejik yönlendirme sağlamayı hedeflemektedir.

Analizde kullanılan kriterler; üretim değeri, çalışan sayısı, verimlilik (üretim değeri/çalışan sayısı), ciro ve girişim sayısıdır. AHP yöntemiyle yapılan ağırlıklandırma sonuçlarına göre, kalite performansını belirlemede en etkili iki kriterin üretim değeri (0.5208) ve çalışan sayısı (0.2495) olduğu belirlenmiştir. Karar matrisinin tutarlılığı, 0.0993'lük tutarlılık oranı (CR) ile doğrulanmış ve yöntemin metodolojik güvenilirliği sağlanmıştır. TOPSIS ve EDAS yöntemleriyle elde edilen sektör sıralamaları büyük ölçüde örtüşmektedir. Her iki analizde de sanayi sektörü, en yüksek kalite yönetimi performansını sergileyerek; üretim hacmi, iş gücü büyüklüğü ve sistematik kalite uygulamaları açısından güçlü bir yapıya sahip olduğunu göstermiştir. Buna karşılık, her iki yöntemde de inşaat sektörü en düşük sırada yer almış ve bu durum, sektörde kalite yönetimi uygulamalarının yetersizliğini ve kapsamlı iyileştirme stratejilerine olan ihtiyacı ortaya koymuştur.

Anahtar Kelimeler: Sektörel Değerlendirme, Toplam Kalite Yönetimi, Çok Kriterli Karar Verme, AHP, TOPSIS, EDAS

JEL Kodları: C44, C61, D81, L15, M31

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INTRODUCTION

Total Quality Management (TQM) is a comprehensive and structured approach to organizational management that seeks to improve the quality of products and services through ongoing refinement in response to continuous feedback. It involves the participation of all members of an organization in improving processes, products, services, and organizational culture. Total Quality Management (TQM) provides significant advantages in areas such as business development and performance management. In this context, TQM practices increase productivity, offer advantages such as the ability to identify problems, and engage in activities to reduce costs. It is effectively applied across a wide range of sectors, including manufacturing, healthcare, education, public administration, and service industries, contributing to enhanced efficiency, customer satisfaction, and organizational excellence. The interest in TQM has a global spread and many countries, organizations and businesses pay special attention to quality management practices. Internationally, countries such as Japan, the United States, and European Union members have integrated TQM into national quality strategies and industrial policies. In Turkey, TQM has been implemented in various sectors through initiatives led by both the public and private sectors, such as quality awards, ISO certification programs, and institutional reforms aimed at fostering quality culture. In addition, TQM stands out as one of the basic elements of contemporary business understanding, and its economic contributions to all sectors, especially the industrial and service sectors, have made it necessary to adopt quality-oriented approaches in these sectors. For example, while the industrial sector sustains economic growth by ensuring the continuity of production, the service sector contributes to increasing social welfare. The differences and dynamics between all sectors require quality management to be evaluated on a sectoral basis. As the locomotive of the Turkish economy, these sectors are critical for increasing the country's competitiveness and ensuring sustainable growth. However, there are limited scientific studies on the criteria by which these sectors should be evaluated in terms of quality management and how these criteria should be ranked.

Quality management approaches shape not only financial performance but also cultural and environmental impacts. The aim of this study is to prioritize the sectors in Turkey in line with the criteria affecting quality, encourage continuous improvement processes and increase competitiveness. Açan (2016) states that employee participation is a critical factor in the success of TQM and that management should support this process.

There are a limited number of studies that reveal the differences in quality management between sectors in Turkey. In this study, the criteria affecting quality are weighted using the AHP method and the sectors are ranked using TOPSIS and EDAS methods. The TurkStat data for 2023 used in the study provides a reliable data set for the evaluation of sectoral differences for the year 2022.

This study is important in terms of providing a data-based and comparative evaluation framework for understanding the strengths and weaknesses of sectors in quality management. By using production value, number of employees, productivity, turnover, and number of enterprises as evaluation criteria, the study presents a comprehensive picture of sectoral performance. The application of the Analytic Hierarchy Process (AHP) enables the determination of the relative importance of each criterion through expert judgment, while the use of TOPSIS and EDAS methods allows for the ranking of sectors based on different performance logics—namely, proximity to an ideal solution and distance from an average benchmark.

The study also contributes to filling a critical gap in national literature by systematically evaluating the quality management performance of sectors using a multi-method decision model. As a result of the research, the findings are expected to guide policymakers, business managers, and sectoral stakeholders in developing targeted strategies for quality improvement. The recommendations derived from the results aim to support the effective shaping of quality management practices in alignment with the unique characteristics and needs of each sector.

1. LITERATURE REVIEW

In recent years, the EDAS method has been widely used in different sectors in combination with other CRM methods such as AHP and TOPSIS. These methods, which are preferred in the evaluation and ranking of alternatives in various fields such as finance, logistics, energy and e-commerce, allow decision processes to be carried out more objectively and effectively. In this section of the study, studies that are similar to the purpose and methods of this article are included.

Quality management is a discipline that aims to optimize the processes of items and maintain products and services continuously. This field includes methods such as quality control, quality assurance systems and total quality management (TQM). TQM is an approach to improve quality with all warehouses, reserves and resources (Juran & Godfrey, 1999). This management approach is based on the principles of continuous regime and customer orientation.

TOPSIS is frequently preferred by researchers in the evaluation of business performance due to its advantages (Demireli, 2010: 104; Yıldırım & Önder, 2014: 134).

Some of the studies in which AHP is used independently are as follows: Lombardi et al. (2016) used this method to identify combinations of isolated power systems; Kumru and Kumru (2014) developed a method for selecting the most appropriate transportation mode. Koç and Burhan (2014), Verma and Pateriya (2013), Asamoah et al. (2012), Chan and Chan (2010) and Levary (2008) used the AHP method in supplier selection processes. In addition, Yavuz (2013) identified flexibility, cost, delivery and quality as the main criteria in his study conducted in a food business operating in the retail sector.

Different methods are used to improve quality in industrial and service sectors. In the industrial sector, ongoing adaptation and efficiency in the production process gain importance; while in the service sector, customer interaction and service customization are at the forefront. Therefore, different quality management strategies are required for each sector. In the literature, quality management systems are shaped by international standards such as ISO 9001, which provide a framework for organizational structure and broad scope (Oakland, 2014).

The study by Zavadskas et al. (2014) provides a comprehensive overview of QMS methods. The study includes examples of AHP and TOPSIS methods and examines different application areas of these methods in detail.

In the energy sector, the EDAS method developed by Ghorabaee et al. (2015) is used to evaluate energy investments and rank the financial performance of companies. Studies show that EDAS is a powerful method to be used together with TOPSIS in financial performance analysis.

Gümüş et al. (2017) analyzed the financial performance of 15 companies traded in the BIST cement sector by using financial ratios and cash flow ratios calculated from 2016 financial statements of the companies using TOPSIS method. Sureeyatanapas et al. (2018) presented an extension of the traditional TOPSIS method for the case of uncertain or unavailable criteria weights.

Various packages reveal that AHP and TOPSIS methods are very useful for the effective deployment of quality management practices and that these methods are very useful, especially for the acquisition of complex parts. While AHP allows for a better weighting of the criteria used in sectoral evaluations, TOPSIS offers an objective ranking recommendations to select the most appropriate sector based on these expenditures (Taylan & Çelik, 2019).

In a study by Ersoy (2021), Entropy-based TOPSIS, EDAS and CODAS methods were used to determine the most suitable computer hardware for a company in the e-commerce sector. In the study, Entropy method was used to calculate the uncertain criteria weights and then the alternatives were ranked by TOPSIS, EDAS and CODAS methods.

2. MATERIALS AND METHODS

In this study, a multi-criteria decision-making (MCDM) approach is adopted to evaluate sectoral quality management performance using AHP (Analytic Hierarchy Process), TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution), and EDAS (Evaluation based on Distance from Average Solution) methods. These methods were selected due to their complementary strengths in handling subjective judgments, proximity-based ranking, and distance-from-average evaluations. The integration of these methods provides a robust analytical framework for comparing performance indicators across different sectors in a systematic, transparent, and data-driven manner. The analysis is based on 2022 sectoral data provided by the Turkish Statistical Institute (TurkStat), and the methodology is structured into clearly defined steps for each MCDM technique to ensure consistency and validity in the evaluation process.

2.1. AHP, TOPSIS and EDAS Methods

The use of CRM methods is becoming more and more important to evaluate quality management in industry and service sectors in an effective and unbiased manner. Methods such as AHP, TOPSIS and EDAS allow for more accurate and comprehensive performance analysis by taking into account sector-specific differences. By using these methods, it becomes possible to develop more effective quality management policies by making comparisons between sectors. In this respect, the main purpose of this study is to analyze the contributions of the mentioned QQM methods to quality management at sectoral level and to provide applicable solution suggestions for enterprises.

2.1.1. AHP Method

AHP is a method that is used to solve CRM problems and takes into account the subjective preferences of the decision maker. This technique simplifies complex decision problems, reducing them to smaller and manageable sub-criteria. It then performs a weighting process based on the relative importance of these sub-criteria. AHP is a particularly useful tool for decision makers who want to balance between different losses or gains and determine criteria weights (Saaty, 1980). This method aims to determine the relative priorities of alternatives in the decision-making process and to measure the consistency of the decision maker's evaluations. The main strength of the AHP is that it considers the intuitive judgments of the decision maker and organizes these judgments in a systematic way. The fact that the decision maker makes decisions based on knowledge and experience makes it easier for the method to adapt to decision processes. The effectiveness of the AHP method is enhanced by the fact that it considers concrete and abstract elements together and provides a partially simple solution (Al-Subhi Al-Harbi, 2001: 20). The application stages of the AHP method are given below in order.

Step 1. Establishing the Model and Defining the Problem

All factors affecting the decision process are identified through expert opinions or surveys. Based on the data obtained, the objective, criteria, sub-criteria and alternatives are defined, and a hierarchical structure is created to show the relationships between these elements (Yang & Lee, 1997: 246).

Step 2. Data Collection and Preparation of Pairwise Comparison Matrices

Once the hierarchical structure is determined, data are collected using the pairwise comparison scale (Saaty, 1986: 843). At this stage, a pairwise comparison matrix of "mXn" dimensions is created (Cheng et al., 2002: 34).

$$A = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ 1/a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ 1/a_{m1} & a_{m2} & \dots & 1 \end{bmatrix} \quad (1)$$

Step 3. Calculation of the Relative Weights (Eigenvectors) of Hierarchical Elements

Following the creation of the pairwise comparisons matrix, normalization is performed on the matrix to calculate the relative weight of each element. This is done by taking the sum of the column values and dividing each value by the column sums. Then, by averaging the values in the rows and obtaining the eigenvectors, the importance level of each criterion is determined (Cheng & Li, 2001: 33).

Step 4. Calculating the Consistency Ratio and Assessing Validity

The Consistency Ratio (CR) is calculated to test the validity of the pairwise comparisons obtained in the decision process. For consistency to be at an acceptable level, the CR value should be below 0.1 (Chan et al., 2006: 641). The following steps are followed to calculate the consistency ratio:

Consistency index; CI = (λmax – n)/(n – 1) is calculated with the formula.

The consistency ratio (CR = CI/RI) can be calculated by using Table 3 (RI = random consistency index, λmax= largest eigenvector value of the pairwise comparisons matrix and n = number of columns). Appropriate CR values were generated for different matrix sizes. For 3*3 matrices the CR value = 0.05; for 4*4 matrices the CR value = 0.08; for larger matrices the value is 0.1 (Shyjith et al., 2008: 380-381).

Step 5. Using Relative Weights in the Decision Process

After the relative weights of the elements at each level of the hierarchy are calculated, a choice is made between the alternatives at the last level. At this stage, the alternative with the highest score is evaluated as the most appropriate option and the alternatives are compared using these weights in the decision process (Cheng et al., 2002: 35).

2.1.2. TOPSIS Method

The TOPSIS method was developed by Hwang and Yoon (1981) and is a common method used in the problem of MCDM. This approach is based on the proximity of alternatives to the positive ideal solution and the distance from the negative ideal solution. This feature enables decision makers to make an accurate and rational choice among a large number of criteria and alternatives. In addition, TOPSIS has a simple and understandable mathematical structure and provides an objective analysis in the decision-making process (Hung & Chen, 2009). The application stages of the TOPSIS method are given below in order.

Step 1. Creating the Decision Matrix (A)

The decision matrix created in Equation (2) according to the alternatives and criteria is denoted by A. Each element a_{ij} of this matrix represents the actual value of alternative *i* in matrix A according to criterion *j* (Rao, 2008: 444).

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix} \tag{2}$$

Step 2. Creating the Normalized Decision Matrix

After the decision matrix A is created, the normalized decision matrix is obtained using the formula in Equation (3) (Mahmoodzadeh et al., 2007:138).

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{k=1}^{m} a_{kj}^2}} \tag{3}$$

(r_{ij}; i: 1,2, …. N; number of criteria j: 1,2,....K; number of alternatives)

Step 3. Creating the Weighted Normalized Decision Matrix (V)

A weighted decision matrix is created by multiplying the weights (ω_{ij}) determined for each criterion by the elements of the normalized matrix: V_{ij}= ($\omega_{ij} x\ R_{ij}$)

This matrix provides data containing the relative importance of the criteria (Rao, 2008: 444).

Step 4. Determination of Ideal (A^{*}) and Negative Ideal (A^{-}) Solutions

The positive ideal solution (A^{*}) contains the best performance values and the negative ideal solution (A^{-}) contains the worst performance values. Ideal solutions are calculated as follows (Yurdakul & İç, 2005: 4613):

$$A^{*} = \{(max_i^{v_{ij}} | j \in J), (min_i^{v_{ij}} | j \in J')\} \tag{4}$$

$$A^{-} = \{(min_i^{v_{ij}} | j \in J), (max_i^{v_{ij}} | j \in J')\} \tag{5}$$

The values obtained from Equation (4) are shown as $A^{*} = \{v_1^{*}, v_2^{*}, \dots, v_n^{*}\}$ and the values obtained from Equation (5) are shown as $A^{-} = \{v_1^{-}, v_2^{-}, \dots, v_n^{-}\}$

Step 5. Calculation of Segregation Measures

At this step, the separation measures for each alternative are computed by determining their distances from the positive ideal and negative ideal solutions. These distances represent how far each alternative deviates from the optimal and the least desirable performance levels, respectively. The closer an alternative is to the ideal solution, and the farther it is from the negative ideal, the more favorable its overall evaluation. The calculations are performed using the following formulas.

"For alternative j, the distance from the ideal solution (S_i^{*}), is defined as the ideal separation, while the distance from the negative ideal solution (S_i^{-}) is defined as the negative ideal separation and is calculated using the equation in Equation (6) and Equation (7) (Mahmoodzadeh et al., 2007: 139)

$$S_i^{*} = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^{*})^2} \tag{6}$$

$$S_i^{-} = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^{-})^2} \tag{7}$$

Step 6. Calculating Relative Proximity to the Ideal Solution

Using the equation in Equation (8), the relative proximity to the ideal solution (C_i^{*}) is calculated and higher values indicate better performance (Olson, 2004:2).

$$C_i^{*} = \frac{S_i^{-}}{S_i^{-} + S_i^{*}} \qquad 0 \le C_i^{*} \le 1 \tag{8}$$

Step 7. Ranking of Alternatives

The alternatives are ranked according to the value of C_i^{*} and the alternative closest to the positive ideal solution is determined as the most appropriate choice.

2.1.3. EDAS Method

The EDAS method is a CRM technique developed by Keshavarz Ghorabaee et al. (2015). EDAS uses the distances to the average solution to rank alternatives according to specified criteria. This method has the advantages that it can work with uncertain data, the computational process is simple and offers flexibility to decision makers. The basic principle of the EDAS method is based on calculating the positive and negative distances of each alternative to the average solution. The performance of the alternatives is determined by comparing them to the average solution. This feature offers a complementary approach to AHP and TOPSIS methods (Stević et al., 2018). The application stages of the EDAS method are listed below in order.

Step 1. Creating the Decision Matrix

The EDAS method begins with the construction of a decision matrix that outlines all alternatives and the criteria by which they are evaluated. This matrix serves as the foundational structure for the analysis, where each element reflects the performance value of a specific alternative with respect to a given criterion. In Equation (6), *n* represents the total number of criteria, while *m* denotes the number of alternatives considered in the decision-making process.

$$X = \left[x_{ij}\right]_{mxn} = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \tag{9}$$

Step 2. Creating the Mean Values Matrix

In the second step, the mean values matrix is obtained for each of the criteria. This process is created by averaging the j. criterion values in the decision matrix as shown in Equation (10).

$$AV_j = \frac{\sum_{i=1}^{n} x_{ij}}{n} \tag{10}$$

Step 3. Calculation of Positive and Negative Distance from Average Matrices

After the initial decision matrix is created, positive distance from average (PDA) and negative distance from average (NDA) matrices are created by using Equation (11) and Equation (12).

$$PDA = [PDA_{ij}]_{nxm} \tag{11}$$

$$NDA = [NDA_{ij}]_{nxm} \tag{12}$$

Where PDA is the positive distance of alternative i from the average solution according to criterion j and NDA is the negative distance of alternative i from the average solution according to criterion j. In other words, the average values of each value in the decision matrix calculated by Equation (10) are determined and the positive and negative distances of each alternative from the average according to various criteria are obtained as PDA_{ij} and NDA_{ij} by processing the maximum value in the relevant column. Furthermore, in the construction of the distance matrices, it is taken into account whether the criteria have benefit or cost characteristics, and the formulas in Equation (13-16) are used to ensure this situation.

The benefit criterion refers to the criteria that are desired to be maximum.

$$PDA_{ij} = \frac{\max\left(0,\left(X_{ij} - AV_j\right)\right)}{AV_j}, j. \in benefit\ criterion \tag{13}$$

$$NDA_{ij} = \frac{\max\left(0,\left(AV_j - X_{ij}\right)\right)}{AV_j}, j. \in benefit\ criterion \tag{14}$$

The cost criterion refers to the criteria that are desired to be minimum.

$$PDA_{ij} = \frac{\max\left(0,\left(AV_j - X_{ij}\right)\right)}{AV_j}, j. \in cost\ criterion \tag{15}$$

$$NDA_{ij} = \frac{\max\left(0,\left(X_{ij} - AV_j\right)\right)}{AV_i}, j. \in cost\ criterion \tag{16}$$

Step 4. Calculation of Weighted Total Positive and Negative Distances

In step 4 of the EDAS method, total positive (SP_i) and negative distances (SN_i) are calculated through positive-negative distance matrices. This is done by using the formulas in Equation (17) and Equation (18) and multiplying the distance matrices by the weight values (w_j) that express the importance levels.

$$SP_i = \sum_{j=1}^{m} w_j PDA_{ij} \quad (17)$$

$$SN_i = \sum_{j=1}^{m} w_j NDA_{ij} \quad (18)$$

An increase in the value of SP_i and a decrease in the value of SN_i indicates that the alternatives are at the desired level, that is, the alternatives have reached the optimal level at the end of the application.

Step 5. Normalization of Weighted Total Distances

At this stage of the method, the values of SP_i and SP_i are normalized with the formulas in Equation (17) and Equation (18) to obtain the normalized weighted total positive and negative values of alternative i.

$$NSP_i = \frac{SP_i}{max_i(SP_i)} \quad (19)$$

$$NSN_i = 1 - \frac{SN_i}{max_i(SN_i)} \quad (20)$$

Step 6. Calculating the Evaluation Scores of Each Alternative

In the final step of the EDAS method, the performance score of each alternative (AS_i) is computed using Equation (21). These scores reflect the overall evaluation of the alternatives based on their positive and negative distances from the average solution. Once calculated, the alternatives are ranked in descending order according to their AS_i values, and the one with the highest score is identified as the most favorable or optimal option within the decision-making context.

$$AS_i = \frac{1}{2}(NSP_i + NSN_i) \quad (21)$$

2.2. Data Source

This study is based on statistical data on sectors published by TurkStat in 2023. The data set used includes critical performance indicators such as sectoral production value, number of employees, productivity (calculated within the scope of the study), turnover and number of enterprises for 2022. These data provide the basic information needed to assess the quality management performance of the sectors.

For the assessment of sectors in terms of quality management, the following elements were taken into account:

- Value of Production: Reflects the total production volume of the sectors.
- Number of Employees: Refers to the size of the workforce in the sector and the sectoral employment structure.
- Productivity: It represents the amount of output produced by the sectors per labor force and is calculated as “Value of Production/Number of Employees”.
- Turnover: Indicates the financial performance and market share of the sectors.
- Number of Enterprises: Refers to the diversity and density of enterprises in the sector.

These elements are the basic parameters that enable the sectors to be compared and analyzed in the context of quality management practices. The data were analyzed with AHP, TOPSIS and EDAS methods and the performance rankings of the sectors were made.

Sectoral scope:

Annual industry and services statistics published by TUIK are prepared by years using different activity classifications. NACE Rev.1.1 classification was used between 2002-2008 and NACE Rev.2 classification has been used since 2009. This classification is applied as the Statistical Classification of Economic Activities in the European Community. The scope of the study includes the following sectors in accordance with the NACE Rev.2 classification:

- *Industry sector:*
  - Mining and quarrying
  - Manufacturing
  - Electricity, gas, steam and air conditioning production and distribution
  - Water supply; sewerage, waste management and remediation activities
- *Construction sector:*
  - Construction
- *Trade sector:*
  - Wholesale and retail trade
  - Repair of motor vehicles and motorcycles
- *Transportation and communication sector:*
  - Transportation and storage
  - Information and communication
- *Self-employment and other services sectors:*
  - Accommodation and food service activities
  - Professional, scientific and technical activities
  - Administrative and support service activities
  - Education
  - Human health and social work activities
  - Culture, arts, entertainment, recreation and sports
  - Other service activities
- *Rental sector:*
  - Real estate activities
- *Sectors not covered:*
  - Agriculture, forestry and fisheries
  - Finance and insurance activities
  - Public administration and defense; compulsory social security
  - Activities of households as employers
  - Activities of international organizations and their representative offices

Confidentiality principles:

TUIK acts in accordance with confidentiality principles as per the Turkish Statistical Law No. 5429. Sector data is not published in sectors with fewer than three enterprises or in cases where one or two enterprises are dominant. These data are included in sector totals or country-wide statistics (TUIK, 2022), as shown in Table 1.

Table 1. Analysis Based on Data from TUIK

Sectors	Production Value (C1)	Number of Employees (C2)	Productivity (C3)	Ciro (C4)	Number of Initiatives (C5)
Industry (P1)	12.786.510.218.712	5.348.832	2.390.524	13.320.792.865.870	481.999
Construction (P2)	1.735.668.763.043	1.716.831	1.010.972	1.817.338.489.953	283.435
Trade (P3)	2.366.441.173.090	4.430.779	534.091	15.941.134.292.437	1.363.585
Transportation and Communication (P4)	2.375.965.359.171	2.000.574	1.187.642	2.990.737.699.555	628.836
Self-employment and Other Service Enterprises (P5)	1.933.239.685.879	4.981.834	388.058	2.037.237.390.596	966.985
Rental (P6)	274.627.698.295	167.312	1.641.411	281.612.870.852	59.624

The variables presented in Table 1—Production Value (C1), Number of Employees (C2), Productivity (C3), Turnover (C4), and Number of Enterprises (C5)—were selected as the evaluation criteria for this study. These indicators were chosen due to their direct relevance to sectoral performance and their alignment with the principles of quality management. As such, they constitute the core criteria set utilized in the multi-criteria decision-making framework and were weighted using the Analytic Hierarchy Process (AHP) to reflect their relative importance in assessing quality management across sectors.

Furthermore, the sectoral alternatives listed in Table 1 were evaluated using TOPSIS and EDAS, two widely applied Multi-Criteria Decision-Making (MCDM) methods that allow for a comprehensive ranking of alternatives based on the selected criteria. These techniques were employed to generate performance scores for each sector, thereby enabling a comparative analysis of their quality management capabilities. The integrated use of AHP for determining criteria weights and TOPSIS/EDAS for ranking ensures that the assessment is both methodologically robust and analytically consistent. The sectors evaluated in this study include Industry (P1), Construction (P2), Trade (P3), Transportation and Communication (P4), Self-employment and Other Service Enterprises (P5), and Rental (P6). These alternatives represent key components of Türkiye's economic structure and differ significantly in terms of operational characteristics, scale, and complexity. By applying the same evaluation framework to these diverse sectors, the study enables a systematic and objective comparison of their respective quality management performances, thus providing actionable insights for policymakers, regulators, and sector leaders.

3. APPLICATION

In this section, the findings obtained through the application of AHP, TOPSIS, and EDAS methods are presented in detail. The analysis was conducted to evaluate the sectoral quality management performance based on five main criteria: production value, number of employees, productivity, turnover, and number of enterprises. These criteria were weighted using the Analytic Hierarchy Process (AHP) through expert judgment, and the consistency of the decision matrices was verified. Subsequently, the sectoral performances were analyzed using the TOPSIS and EDAS methods, which rely on ideal solution proximity and distance from average, respectively. The results obtained from each method were interpreted comparatively to determine the relative performance of the sectors in terms of quality management. The analyses provide insight into the strengths and weaknesses of each sector, offering a data-driven foundation for strategic improvement and policy development.

The primary objective of this study is to develop a comprehensive and systematic framework for evaluating the quality management performance of key economic sectors in Türkiye using a multi-criteria decision-making (MCDM) approach. By integrating AHP for criteria weighting and TOPSIS and EDAS for performance evaluation, the study aims to deliver an analytically sound methodology that reflects both expert judgment and quantitative sectoral data. The focus on five fundamental indicators—production value, number of employees, productivity, turnover, and number of enterprises—ensures that the evaluation is grounded in widely recognized metrics of organizational performance.

The significance of this study lies in its potential to inform sector-specific improvement strategies by highlighting the relative strengths and weaknesses of each sector. Through the application of AHP, sectoral priorities are clarified based on expert consensus, while the use of TOPSIS and EDAS enables a nuanced comparison of sectoral performance under varying methodological perspectives. The consistency between these methods reinforces the reliability of the results and enhances their applicability for decision-makers. Ultimately, the study provides a data-driven basis for directing quality management reforms, resource allocation, and policy interventions, supporting the broader goals of sustainable development and competitive growth within Türkiye's economy.

3.1. AHP Analysis Findings

In the study, CR values were calculated for criteria and alternatives within the scope of the AHP method used in the decision-making process. As a result of these calculations using Microsoft Excel program, it was determined that all consistency ratios obtained for criteria and alternatives were less than 0.10. This result indicates that the decision matrices are consistent, and the evaluations are reliable. Furthermore, this supports that subjective errors are minimized in the decision-making process and AHP analysis is valid.

Criteria Weighting: Analytic Hierarchy Process (AHP) and Expert Opinions

In the study, the criteria weights to evaluate the sectors in terms of quality management were determined as a result of one-to-one interviews with 4 authorized experts (Appendix 1). The experts compared the five criteria with each other using the pairwise comparison method and determined the relative importance of the criteria. Table 2 presents the pairwise comparison matrix obtained from expert opinions.

Table 2. Pairwise Comparison Matrix Obtained from Expert Opinions

Criteria	C1	C2	C3	C4	C5
C1	1	3 1/4	7	7	8 1/4
C2	1/3	1	3 3/4	4	6 1/4
C3	1/7	2/7	1	1 1/4	4 1/2
C4	1/7	1/4	7/8	1	5
C5	1/8	1/6	1/4	1/4	1

The normalized weights and the priority vector results of the criteria determined through AHP are presented in Table 3. This table shows how each criterion was weighted based on expert evaluations and reflects their relative importance in assessing sectoral quality management performance. The results demonstrate that the criteria were consistently evaluated and that the derived weights can be reliably used in further analysis.

Table 3. AHP Weighting of Criteria with Priority Vector

Criteria	C1	C2	C3	C4	C5
C1	0.5801	0.6565	0.5430	0.5181	0.3300
C2	0.1813	0.2020	0.2909	0.2961	0.2500
C3	0.0837	0.0564	0.0776	0.0925	0.1800
C4	0.0837	0.0522	0.0679	0.0740	0.2000
C5	0.0711	0.0329	0.0207	0.0193	0.0400

The ranking of the criteria based on their average weight values is provided in Table 4. This ranking highlights the most influential criteria in the decision-making process, with production value emerging as the most significant, followed by productivity. The lower ranks of other criteria such as number of employees indicate their relatively limited impact on quality management performance according to expert judgment.

Table 4. AHP Criteria Weighting Ranking

Criteria	Average	Rank
C1	0.5208	1
C2	0.2495	2
C3	0.0949	4
C4	0.0976	3
C5	0.0372	5

Relative Importance of Criteria (AHP Findings):

In the analysis using AHP, the relative importance of the criteria affecting the performance of the sectors in terms of quality management was calculated, and production value and productivity stood out among the most critical criteria determining quality management performance.

Production Value (C1 – 0.5208): This remains the most important criterion in evaluating quality management performance. Its high weight indicates that economic contribution and output volume are central to how quality is perceived at the sectoral level. Sectors with higher production volumes are seen as more successful in managing quality.

Number of Employees (C2 – 0.2495): Contrary to the previous assessment, this criterion now has the second highest importance. This shows a significant shift in emphasis, suggesting that employment scale and workforce presence are increasingly considered important indicators of operational quality and institutional capacity within sectors.

Turnover (C4 – 0.0976): Turnover is now the third most influential factor. Although not as critical as production value or workforce size, it still reflects the financial performance and market strength of the sector. Its moderate weight implies that financial turnover supports quality, but is not the primary determinant.

Productivity (C3 – 0.0949): Productivity, previously the second most important factor, now ranks fourth. This shows a reduced emphasis on efficiency, suggesting that in the updated model, raw output and labor capacity are seen as more influential than efficiency metrics in quality management evaluations.

Number of Initiatives (C5 – 0.0372): This remains the least important criterion. The relatively low weight indicates that entrepreneurial density or number of active firms has a minimal impact on perceived quality. It may suggest that just having many businesses does not necessarily contribute to effective or structured quality practices.

To assess the reliability of the pairwise comparisons made in the AHP process, a consistency analysis was conducted. The consistency indicators were calculated as follows: maximum eigenvalue (λmax) = 5.4449, consistency index (CI) = 0.1112, and consistency ratio (CR) = 0.0993. Since the CR value is slightly below the generally accepted threshold of 0.10, the decision matrix is deemed sufficiently consistent. This indicates that the judgments used in the pairwise comparisons are logically coherent and stable, supporting the validity of the resulting priority vector. Overall, the revised AHP model provides a robust and reliable framework for assessing quality management performance across sectors, with a focus on economic capacity and workforce as the leading determinants.

These results provided a strong basis for evaluating cross-industry quality management performance and contributed to the subsequent TOPSIS and EDAS analysis.

3.2. TOPSIS Analysis Results

The calculated criteria weights will be used to evaluate the performance of the alternatives (sectors) using the TOPSIS method. In the TOPSIS method, the ranking will be created by calculating the distance of each alternative from the ideal and negative ideal solutions. The distance from the ideal solution (S_i^*), is defined as the ideal separation, while the distance from the negative ideal solution (S_i^-) is defined as the negative ideal separation and is calculated using the equation in Equation (6) and Equation (7). Table 5 shows the performance indicators obtained for the alternatives.

Table 5. TOPSIS Decision Stage

Alternatives	S_i^+	S_i^-	C_i^*
P1	0.0254	0.5355	0.9547
P2	0.4640	0.0820	0.1502
P3	0.4186	0.1883	0.3102
P4	0.4356	0.1095	0.2010
P5	0.4402	0.1819	0.2924
P6	0.5350	0.0381	0.0665

The evaluation scores (C_i^*) i.e. performance values, of each alternative sector were calculated by using the formula in Equation (18). Table 6 shows the ranking of the performance values of the alternatives.

Table 6. TOPSIS Performance Rankings of Alternatives

	P1	P2	P3	P4	P5	P6
C_i^*	0.9547	0.1502	0.3102	0.2010	0.2924	0.0665
Arrangement	1	5	2	4	3	6

3.3. EDAS Analysis Findings

The calculated criteria weights will be used to evaluate the performance of alternatives (sectors) using the EDAS method. In the EDAS method, the positive and negative distance of each alternative to the average solution will be calculated and the ranking will be created. The weighted total positive distance (SP_i) calculated with the formula Equality (14) and the weighted total positive distance (SN_i) calculated with the formula Equality (15) for the regions in Table 6 were obtained. Then, the SP_i and SP_i values were normalized with the formulas in Equality (16) and Equality (17) to obtain the normalized weighted total positive and negative values of the i. alternative. The performance indicators obtained for the alternatives are given in Table 7.

Table 7. EDAS Alternatives Performance Indicators

Alternatives	SP_i	SN_i	NSP_i	NSN_i	AS_i
P1	1.7321	0.0088	1.0000	0.9896	0.9948
P2	0.0000	0.4832	0.0000	0.4273	0.2137
P3	0.3085	0.2288	0.1781	0.7288	0.4535
P4	0.0000	0.3139	0.0000	0.6280	0.3140
P5	0.1703	0.3683	0.0983	0.5635	0.3309
P6	0.0357	0.8437	0.0206	0.0000	0.0103

The evaluation scores (AS_i) for each alternative sector, namely the performance values, were calculated using the formula in Equation (18). Table 8 shows the ranking of the performance values of the alternatives.

Table 8. EDAS Alternative Performance Rankings

	P1	P2	P3	P4	P5	P6
AS_i	0.9948	0.2137	0.4535	0.3140	0.3309	0.0103
Arrangement	1	5	2	4	3	6

The evaluation results derived from both the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) and EDAS (Evaluation Based on Distance from Average Solution) methods revealed that the alternative rankings across sectors were identical. This alignment confirms the robustness and consistency of the applied multi-criteria decision-making framework. Despite the methodological differences between the two techniques—where TOPSIS is based on the proximity to ideal and anti-ideal solutions, and EDAS evaluates alternatives based on their deviation from the average—the fact that both yielded the same ranking order enhances the credibility of the findings. It demonstrates that the relative quality management performance levels of the sectors are stable and method-independent under the given criteria and weight structure. Such consistency provides strong validation for the decision model and supports the reliability of sectoral quality assessments made within this study.

According to the evaluation results obtained through both the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) and EDAS (Evaluation Based on Distance from Average Solution) methods, the Industrial Sector (P1) consistently ranked first among all alternatives, demonstrating superior performance in terms of quality management. This convergence across methodologies highlights the industrial sector's robust integration of structured quality processes, particularly in relation to its dominant position in production value, workforce size, and turnover. The sector's commitment to technological advancement and operational discipline reinforces its leading status in both analyses. The Trade Sector (P3) secured second place in both methods, suggesting that its strong financial activity and market presence are critical contributors to its performance. While not as prominent as the industrial sector, the trade sector's competitiveness can be further enhanced through more systematic customer-focused quality strategies and continuous improvement initiatives.

The Service Sector (P5) ranked third in both models, reflecting a moderate level of performance. Although entrepreneurial activity and service diversity are strengths, the sector lacks a fully developed and formalized quality management infrastructure. Perceived service quality and responsiveness remain areas requiring attention to improve overall outcomes. Closely following, the Transportation and Communication Sector (P4) ranked fourth in both approaches, reinforcing its position as a sector with strategic importance but operational limitations. Its relatively low scores underscore the need for stronger process standardization and customer orientation to boost performance levels.

The Construction Sector (P2) and Rental Sector (P6) occupied the fifth and sixth positions, respectively, across both methods. The construction sector faces ongoing challenges related to project delivery, cost efficiency, and production consistency, which significantly hinder its quality performance. Similarly, the rental sector's extremely low scores indicate substantial deficiencies in service standardization, client engagement, and quality monitoring mechanisms. The alignment of these rankings in both TOPSIS and EDAS confirms the severity of quality management gaps in these domains and supports the need for targeted interventions.

The consistency in sectoral rankings across both methods demonstrates the robustness and validity of the evaluation framework employed in this study. It also indicates that the observed differences in quality management performance are not method-dependent but reflect fundamental structural realities in each sector. These findings offer a reliable basis for policymakers, managers, and stakeholders to prioritize sector-specific quality improvement strategies, allocate resources effectively, and design long-term plans aimed at enhancing national-level performance in quality management practices.

4. DISCUSSION

The findings of this study are largely consistent with similar studies in existing literature. For example, Ersoy (2021) emphasized that logistics processes play a critical role in quality management in the e-commerce sector, and this supports the findings of the current study regarding the logistics and communication sector.

On the other hand, some of the results obtained may be inconsistent with other studies in literature. For example, it was observed that the quality management performance of the service sector was relatively lower, indicating that customer satisfaction-oriented quality management models should be developed. Oakland (2014) stated that Total Quality Management (TQM) applications in the service sector strengthen competitive advantage by increasing customer satisfaction. From this perspective, the findings obtained in this study are both consistent with the literature and remarkable.

Moreover, the high performance of the industrial sector is in line with numerous studies emphasizing the role of standardized processes, technological investments, and institutional quality frameworks in industrial settings. According to Taylan and Çelik (2019), sectors that implement MCDM-supported TQM practices tend to demonstrate superior performance due to structured process control and continuous improvement mechanisms. This finding validates the superior ranking of the industrial sector in this study.

Similarly, the relatively strong performance of the trade sector aligns with findings by Demireli (2010), who highlighted the importance of financial indicators and customer-facing processes in determining quality performance in commercial enterprises. However, this also suggests that further integration of digital quality tools and customer feedback systems could enhance its performance.

The rental sector's poor performance, as shown in this study, is also echoed by findings in the literature that point to the lack of formal quality management structures in fragmented service areas (Oakland, 2014). This highlights the necessity for the development of sector-specific quality models and regulatory oversight mechanisms in less-institutionalized service sectors.

Furthermore, while productivity was expected to play a greater role in quality performance, its relatively lower weight in this study suggests that raw output and workforce size are currently perceived as more decisive indicators by experts. This finding opens a new discussion in the literature about the evolving perceptions of what constitutes "quality" in different sectors.

In this study, the combined use of MCDM methods such as AHP, TOPSIS and EDAS provides decision makers with an objective and systematic evaluation framework in comparing sectoral quality management performances. However, one of the main limitations of the study is that the analyses are based only on statistical data provided by TÜİK and are not supported by field studies. This situation may partially limit the validity of the findings obtained. In future studies, the inclusion of field studies and expert opinions in the analysis process may contribute to obtaining more robust and comprehensive results. In addition, this study is limited to certain quality criteria, and the integration of additional criteria such as environmental sustainability in future studies may provide a more in-depth assessment.

Another limitation is the static nature of the dataset used. Since the evaluation is based on 2022 data, it may not fully capture dynamic changes such as post-pandemic adjustments, inflationary pressures, or digital transformation trends that can significantly affect sectoral quality management performance. Therefore, longitudinal studies that track quality performance over time could enrich the analysis.

It is also worth noting that although the study employed a robust MCDM framework, the subjective nature of expert judgments in AHP might introduce bias. Future research can benefit from hybrid approaches combining objective weighting (e.g., entropy, CRITIC) with expert-based methods to minimize this effect.

Finally, it is recommended that future studies conduct a comprehensive analysis that includes more sectors and benefits from wider data sets.

5. CONCLUSION AND RECOMMENDATIONS

In this study, a comprehensive evaluation of quality management performance across six key economic sectors in Türkiye was conducted using an integrated multi-criteria decision-making (MCDM) framework. The methods employed included the Analytic Hierarchy Process (AHP) for determining the relative importance of evaluation criteria, and the TOPSIS and EDAS techniques for ranking sectoral alternatives. The primary goal was to assess quality management practices through objective, measurable indicators and to derive data-driven improvement strategies tailored to each sector's context.

The criteria used in the evaluation—production value, number of employees, productivity, turnover, and number of enterprises—were selected based on their relevance to both operational efficiency and organizational structure. Their weights were determined through expert judgments using AHP, and the resulting consistency ratio confirmed the methodological soundness of the weighting process.

The criteria employed in this study—production value, number of employees, productivity, turnover, and number of enterprises—were carefully selected due to their dual relevance to both operational efficiency and the structural characteristics of sectors. These indicators are widely recognized as essential components of performance evaluation in the context of quality management and provide a robust basis for cross-sectoral comparison. To ensure that the assessment reflects expert-informed priorities, the Analytic Hierarchy Process (AHP) was used to derive the relative importance (weights) of each criterion based on judgments collected from decision-makers with domain expertise. The consistency ratio (CR = 0.0993) obtained from the pairwise comparison matrix confirmed the internal coherence and reliability of the weighting process, remaining just below the generally accepted threshold of 0.10.

According to the AHP results, production value emerged as the most influential criterion, with a weight of 0.5208, underscoring the dominant role of economic output in the evaluation of sectoral quality performance. This finding aligns with the observation that sectors contributing higher levels of output are often better positioned in terms of resource allocation, infrastructure, and systematic quality control. The number of employees, weighted at 0.2495, was identified as the second most important criterion, reflecting the growing recognition of workforce size and labor capacity as vital elements of quality implementation, particularly in labor-intensive industries. Turnover, with a weight of 0.0976, and productivity, at 0.0949, were both assigned moderate importance. While these criteria reflect financial and efficiency-based performance, their comparatively lower weights suggest that, although relevant, they are not the sole determinants of quality perception. Finally, the number of enterprises, receiving the lowest weight of 0.0372, indicates that entrepreneurial density alone has limited influence on sectoral quality performance, particularly when not accompanied by strong institutional frameworks or standardized practices.

The justification for using the AHP method lies in its ability to transform expert judgments into numerical weights, allowing for a consistent and transparent prioritization of quality-related criteria. Its use ensures that subjective insights are incorporated systematically and that the criteria selection is not solely data-driven but also experience-informed. The subsequent use of TOPSIS and EDAS methods, both of which are robust tools in MCDM literature, provided complementary approaches to ranking: while TOPSIS measures the proximity of alternatives to an ideal solution, EDAS evaluates alternatives based on their distance from the average. The convergence of rankings across these two methods validated the reliability and robustness of the evaluation framework.

The results of both TOPSIS and EDAS methods revealed a high degree of consistency in the ranking of alternatives, which enhances the validity and robustness of the findings. In both methods, the Industrial Sector (P1) was ranked highest, demonstrating clear superiority in quality management performance. This result reflects the sector's strong position in production output, workforce size, and financial turnover, as well as its effective integration of structured quality processes and commitment to operational excellence. The consistent ranking of the industrial sector as the top performer across both methods confirms its leading role in Türkiye's economic landscape and its alignment with modern quality standards and innovation-driven practices.

The Trade Sector (P3) also ranked second in both evaluations, indicating that strong market presence and financial activity contribute positively to overall quality performance. However, despite this relatively favorable position, both methods signal that there remains room for improvement, particularly in customer-focused practices and standardization. Enhancing customer satisfaction mechanisms, digital service interfaces, and SME-oriented quality programs could elevate the sector's performance further.

Similarly, both the Service Sector (P5) and the Transportation and Communication Sector (P4) were ranked third and fourth, respectively, in both methods. These sectors exhibit moderate quality management performance. The service sector, while dynamic and diverse, suffers from a lack of formal quality frameworks and measurable standards. The transportation sector, though strategically important, is hindered by low financial turnover and inconsistent implementation of quality processes. Their positions in both methods suggest that mid-tier sectors require targeted improvements in process standardization, monitoring systems, and customer feedback integration.

The Construction Sector (P2) and the Rental Sector (P6) were identified as the lowest-performing alternatives, ranking fifth and sixth, respectively, in both TOPSIS and EDAS results. The construction sector's deficiencies in areas such as cost control, timely project completion, and adherence to quality standards were clearly reflected in its low scores. The rental sector's bottom-ranking position signals the absence of institutionalized quality management mechanisms and highlights the need for regulatory frameworks and training programs tailored to this fragmented service area.

The near-identical rankings produced by TOPSIS and EDAS methods confirm the reliability and internal consistency of the evaluation framework. Despite the methodological differences—where TOPSIS focuses on the ideal solution and EDAS considers deviation from the average—the convergence of results underlines the structural stability of sectoral quality performance in Türkiye. This agreement across techniques strengthens the basis for interpreting the findings as a trustworthy representation of the current quality landscape.

In summary, the methodological rigor and complementary structure of AHP, TOPSIS, and EDAS enabled the study to produce consistent, valid, and interpretable findings on sectoral quality management. This integrated MCDM framework offers a replicable and flexible model for evaluating organizational quality across sectors and contexts.

Based on the outcomes of this study, several sector-specific recommendations can be offered. For the industrial sector, investments in digitalization and automation should be further incentivized, and wider adoption of national and international quality standards should be promoted through policy support. The trade sector would benefit from strengthened supply chain quality monitoring and SME-specific quality incentives to enhance service reliability and responsiveness. For service and rental sectors, expanding employee training initiatives, implementing CRM systems, and aligning service delivery with customer feedback mechanisms will be crucial in establishing performance consistency. Lastly, the construction sector requires an overhaul in quality assurance practices, including enforcement of occupational safety, project management discipline, and the promotion of sustainable construction methods. These strategic directions, grounded in the empirical findings of this study, are essential for enhancing sectoral quality management capacity and achieving long-term economic resilience.

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APPENDIX 1. Decision Makers

Decision Maker	Gender	Age	Profession	Income (₺)
DM1	Male	45	Quality Manager	120.000,00 ₺
DM2	Female	38	Industrial Engineer	70.000,00 ₺
DM3	Male	50	Operations Director	180.000,00 ₺
DM4	Female	42	Academician	95.000,00 ₺

STATEMENT OF ETHICAL AND SCIENTIFIC PRINCIPLES RESPONSIBILITY

The author declares that all stages of the preparation of this study were conducted in accordance with ethical rules and scientific citation principles. This study does not fall within a category that requires approval from an ethics committee.

AUTHOR CONTRIBUTION STATEMENT

1st author contribution: 40%
2nd author contribution: 30%
3rd author contribution: 30%

ETİK VE BİLİMSEL İLKELER SORUMLULUK BEYANI

Bu çalışmanın tüm hazırlanma süreçlerinde etik kurallara ve bilimsel atıf gösterme ilkelerine riayet edildiğini yazar beyan eder. Bu çalışma etik kurul izni gerektiren çalışma grubunda yer almamaktadır.

ARAŞTIRMACILARIN MAKALEYE KATKI ORANI BEYANI

1. **Yazar katkı oranı:** %40
2. **Yazar katkı oranı:** %30
3. **Yazar katkı oranı:** %30