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Analysis of Critical Success Factors in Total Quality Management Practices Using the Fuzzy DEMATEL Method: An Application for SMEs

Aysel ÇETİNDERE FİLİZ [1]

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Abstract

The aim of this study is to rank the importance levels of critical success factors (CSFs) that are effective in Total Quality Management (TQM) practices in Small and Medium-Sized Enterprises (SMEs), and to determine the cause-effect relationships among these factors. For this purpose, CSFs related to TQM practices were first identified through an extensive literature review and then finalized based on the opinions of quality management executives from 20 different SMEs operating in Turkey. These finalized factors were analyzed using the Fuzzy Decision-Making Trial and Evaluation Laboratory (Fuzzy DEMATEL) method. According to the results of the empirical case analysis, "Leadership and Support of Top Management" emerged as the factor with the highest level of interrelation with other criteria, while "Quality Management Activities of Suppliers" had the lowest level of interrelation. In terms of impact level “Quality management systems (ISO 9001)” was found to be the most influential factor. The findings provide valuable insights for both managers and academics in identifying and managing the critical success factors that influence the implementation of TQM in SMEs.

Key words: Critical Success Factors, Total Quality Management, Fuzzy DEMATEL, SMEs

JEL Code: C02, C44, M11

1. Introduction

As of 2023, there are approximately 3.71 million Small and Medium-Sized Enterprises (SMEs) operating in Turkey's industrial and service sectors. These enterprises account for 99.7% of the total number of businesses, 70.5% of employment, 47.9% of personnel costs, 47.4% of turnover, 41.6% of production value, and 40.1% of value added at factor cost. These figures clearly demonstrate that SMEs are a vital driving force behind the Turkish economy. Especially in developing countries like Turkey, SMEs play a crucial role in economic

[1] Assoc. Prof., PhD, Ondokuz Mayıs University, Turkey, aysel.cetindere@omu.edu.tr, https://orcid.org/0000-0003-1810-5559

development, particularly in terms of employment opportunities. Moreover, given that SMEs often serve as suppliers to large-scale enterprises and influence a wide range of sectors, the need for quality-focused product and service delivery in SMEs becomes increasingly important.

In recent years, Total Quality Management (TQM) has been implemented in businesses as a holistic continuous improvement approach aimed at enhancing performance in terms of quality and innovation. TQM is considered not only a tool for gaining competitive advantage but also a decision-making mechanism for increasing customer satisfaction and service quality (Samal et al., 2014). SMEs hold a significant advantage due to their ability to respond to rapidly changing customer demands with low costs and speed (Naktiyok and Küçük, 2003). Since SMEs often serve as suppliers to large enterprises, they are directly influenced by the quality programs of those larger organizations. Therefore, poor product quality in SMEs can negatively affect the competitiveness of the larger companies they supply. For this reason, TQM is regarded not only as a means to improve product and service quality in SMEs but also as a strategy for business survival (Quazi and Padibjo, 1998) In this context, identifying the factors that contribute to the success of TQM practices and determining the most influential ones has become a significant decision-making issue. When examining the multi-criteria decision-making (MCDM) methods used to determine the critical success factors (CSFs) that affect TQM implementations across enterprises of various sizes and sectors, methods such as AHP (Chin et al., 2002), DEMATEL (Jamali et al., 2010), TOPSIS (Khanna et al., 2011; Mehralian et al., 2016), Fuzzy AHP (Rezazadeh et al., 2012; Halim et al., 2019), Fuzzy DEMATEL (Gupta et al., 2017), and Fuzzy FUCOM (Savaş and Yacan, 2022) are commonly found in the literature. In this study, the Fuzzy DEMATEL method was utilized. The DEMATEL method was first implemented in 1973 by the Battelle Memorial Institute through the Geneva Research Centre. This method was developed to analyze causal relationships among complex criteria (Chang et al., 2011). Matrices and diagrams are used to visualize the structure of these complex causal relationships (Lin and Wu, 2008). One of the most important advantages of the DEMATEL method is its ability to categorize factors as cause and effect. Accordingly, factors with a higher influence and priority over others are identified as causes, while those that are more affected and less prioritized are classified as effects (Ömürgönülşen et al., 2020). One of the main challenges of this method is quantifying the interactions between criteria, as decision-makers may find it difficult to express their preferences with absolute clarity. To address this uncertainty, Zadeh's (1965) fuzzy set theory was introduced, allowing decision-makers to use linguistic variables to express imprecise judgments. The integration of fuzzy set theory with the DEMATEL method led to the development of the Fuzzy DEMATEL approach, which aims to reduce ambiguity in the decision-making process (Polat and Merdivenci, 2022; Ekşili et al., 2017). A review of the literature reveals that the Fuzzy DEMATEL method has been widely used in solving a variety of problems: supplier selection in the electronics industry (Chang et al., 2011), port selection in foreign trade firms (Polat and Merdivenci, 2022), green supplier evaluation in the food sector (Dalay and Sarı, 2022), domain selection by graduate

students in logistics (Dinçer et al., 2022), sustainable supply chain management (Jalali et al., 2022), agile manufacturing (Potdar et al., 2017), lean Six Sigma in healthcare (Singh et al., 2023), barriers to textile waste recycling (Ponnambalam et al., 2023), analysis of occupational risks in maritime transportation (Kuzu, 2023) and construction sites (Seker and Zavadskas, 2017), green lean supply chain management (Hossain et al., 2023), lean Six Sigma implementation (Raval, 2021), post-earthquake reconstruction projects (Zhong et al., 2023), success in knowledge management practices (Wu, 2012), environmental sustainability (Goyal et al., 2019), facility layout planning (Altuntaş et al., 2014), sustainable manufacturing (Jiang et al., 2020), emergency management (Zhou et al., 2011), performance in health tourism (Merdivenci and Karakaş, 2020), development of managerial competencies (Wu and Lee, 2007), hospital accreditation standards (Ghadami et al., 2021), organic food purchasing decisions (Yeo et al., 2022), service innovation (Feng and Ma, 2020), sustainable lean Six Sigma (Parmar and Desai, 2020), cloud computing (Thavi et al., 2022), and quality control practices (Çelik and Arslankaya, 2023).

Despite the broad use of the Fuzzy DEMATEL method across sectors and functions, the literature review indicates a lack of research focusing specifically on SMEs operating in Turkey. Therefore, this study employs the Fuzzy DEMATEL method to identify the critical success factors that contribute to the performance of quality management practices in Turkish SMEs and aims to provide a strategic guide for managers in this context.

Accordingly, the study seeks to answer the following two research questions:

1. What are the critical success factors that influence the implementation of TQM practices in SMEs operating in a specific region of Turkey?
2. What are the cause-effect relationships among these factors, and how can their levels of importance be ranked?

To answer the research questions posed in this study, critical success factors (CSFs) were identified through an extensive literature review (see Table 1). These factors were finalized with input from quality managers at 20 different SMEs operating in various manufacturing sectors. The relationships among the identified factors were analyzed using the Fuzzy DEMATEL method, based on pairwise comparison matrices filled out by quality managers, and the results of this analysis were evaluated, and recommendations were proposed for future research.

2. Literature Review

The factors influencing the success of TQM practices in this study were derived from a broad literature review, considering the diversity of sectors. Table 1 summarizes the CSFs commonly cited in the literature.

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Table 1. Summary of the Literature Review on Factors Affecting TQM Practice

Author (Year)	The Subject of the Study	Critical Success Factors
Saraph et al. (1989)	Developing a scale to define and measure the CSFs of TQM	1.Top management leadership 2. Role of the quality department 3. Training 4. Product design 5. Supplier quality management 6. Process management 7. Quality data and reporting 8. Employee relations
Porter and Parker (1993)	Examining the fundamental elements of TQM and the CSFs influencing its implementation	1.Attitudes and behaviors of management 2. Having a strategy for TQM practices 3.TQM organization 4. Communication 5. Education and training 6. Employee participation 7. Process management and systems 8. Technologies to be used in solving problems
Black and Porter (1996)	Defining the CSFs of TQM	1.Management of employees and customers 2. Supplier relations 3. Improvement activities 4. Customer satisfaction 5. External management 6. Strategic quality management 7. Teamwork 8. Operational quality planning 9. Use of measurement systems in quality improvement 10. Quality culture
Yusof and Aspinwall (2000)	Evaluating survey results to identify the CSFs for implementing TQM in SMEs	1.Management leadership 2. Continuous improvement system 3. Measurement and feedback systems 4. Use of improvement tools and techniques 5. Supplier quality assurance 6. Human resource management 7. Systems and processes 8. Resources 9. Education and training 10. Business Environment and culture
Joseph et al. (1999)	Developing an instrument to identify the CSFs of TQM in manufacturing-based business units in India	1.Organizational commitment 2. Human resources management 3. Cooperation with suppliers 4. Quality policy 5. Product design 6. Role of the quality department 7. Quality information system 8. Use of technology 9. Operation processes 10. Training and training
Chin et al. (2002)	Investigating the critical success factors and implementation of TQM in China's manufacturing sector	1.Organizing 2. Systems and techniques 3. Measurement and feedback 4. Culture and people
Wali et al. (2003)	Identifying the CSFs based on an exploratory analysis of Indian organizations in manufacturing and services	1.Leadership, creativity and quality strategy 2. Employee-manager interactions 3. Rewarding 4. Work culture 5. Information and data management 6. Customer Orientation 7. Values and ethics 8. Communication 9. Teamwork 10. Interpersonal relations 11. Delegation and authorization 12. Process improvement
Dilber et al. (2005)	Identifying the CSFs of TQM in the healthcare sector and measuring their impact on business performance in SME hospitals in Turkey	1.Role of senior management and quality policy 2. Process management 3. Quality data and reporting of this data 4. Relations with employees
Salaheldin (2009)	Determining the effective CSFs in TQM applications among SMEs in the Qatari industrial sector	1.Strategic factors 2. Tactical factors 3. Operational factors
Jamali et al. (2010)	Identifying the CSFs in TQM applications among Iranian SMEs and	1.Commitment of top management 2. Training 3. Customer Orientation 4. Employee participation 5. Supplier management 6. Strategic planning 7. Product

	investigating the causal relationships between them	and service design 8.Process management 9.Quality culture
Singh (2011)	Identifying structural relationships between success-related factors in TQM implementation within SMEs	1.Top management commitment 2.Employee training 3.Employee empowerment and participation 4.Interdepartmental coordination 5.Supplier relations 6.Customer feedback 7.Quality data and reporting 8.Process management 9.Product design 10.Customer satisfaction 11.Product quality
Khanna et al. (2011)	Evaluating effective CSFs in TQM practices within manufacturing enterprises operating in India	1.Leadership of top management 2.Role of the quality department 3.Training 4.Quality information systems and use of information technologies 5.Human resources management 6.Product design 7.Suppliers' quality management system 8.Process management 9.Customer orientation 10.Quality citizenship
Rezazadeh et al. (2012)	Identifying and prioritizing effective CSFs in TQM implementation in Iranian organizations	1.Organization 2.Product 3.Measurement 4.Customer 5.Quality 6.Employees 7.Management
Irfan and Kee (2013)	Evaluating the impact of CSFs in TQM practices on service quality improvement in Pakistan's service sector	1.Top management commitment and visionary leadership 2.Human resources management 3.Customer orientation 4.Analyzing information 5.Service culture 6.Social responsibility
Kaur and Sharma (2014)	Assessing the impact of CSFs on business performance in TQM practices in manufacturing SMEs	1.Leadership 2.Supplier relations 3.Employee orientation 4.Customer orientation 5.Process management 6.Quality management
Hietschold et al. (2014)	Conducting a systematic literature review on the measurement of CSFs in TQM practices	1.Human resources management/reward/teamwork 2.Senior management commitment and leadership 3.Process management 4.Customer focus and satisfaction 5.Supplier relations 6.Training 7.Information/analysis/data 8.Strategic quality planning 9.Culture and communication 10.Benchmarking 11.Social and environmental responsibility
Manhas et al. (2015)	Investigating the CSFs influencing the implementation of TQM in SMEs in Punjab, India	1.Commitment of top management 2.Customer orientation 3.Continuous improvement 4.Quality management system of suppliers 5.Employee participation 6.Training 7.Process management 8.Teamwork
Mehralian et al. (2016)	Identifying the CSFs affecting successful TQM implementation in the pharmaceutical industry	1.Information and analysis 2.Management commitment 3.Relations with suppliers 4.Customer orientation 5.Human resources management 6.Benchmarking 7.Quality assurance 8.Process management 9.Quality management systems
Yadav et al. (2016)	Identifying effective CSFs in TQM implementation in Indian manufacturing SMEs and evaluating their impact on operational and organizational performance	1.Operational factors (process management, quality assurance, employee involvement, continuous improvement) 2.Organizational factors (top management commitment, human resource management, benchmarking, social responsibility, employee satisfaction) 3.Strategic factors (information and analysis, training, supplier management, strategic planning, employee empowerment) 4.Tactical factors (customer focus, teamwork, product design, process control)

Aquilani et al. (2017)	Exploring effective CSFs in TQM practices through a systematic literature review	1.Leadership 2.Customer orientation 3.Training 4.Measurement Systems 5.Cooperation with suppliers 6.Quality management in processes 7.Continuous improvement 8.Role of Quality Department 9.Quality culture 10.Employee commitment and participation
Gupta et al. (2017)	Identifying and prioritizing effective factors influencing TQM practices in SMEs operating in India	1.Relationships between employees 2.Education and training programs for employees 3.Knowledge management 4.Organizational culture and internal environment 5.Process management 6.Commitment of top management 7.Quality management practices of suppliers 8.Links for inter-organizational cooperation
Halim et al. (2019)	Identifying the CSFs for successful TQM implementation in the Malaysian aviation industry (manufacturing industry)	1.Organization (management commitment, education and training) 2.Systems and techniques (continuous improvement, supplier partnership, product design, quality policies) 3.Measurement and feedback (quality data and reporting, communication to improve quality, customer satisfaction) 4.Culture and employees (role of the quality department, employee involvement)
Sin and Sin (2019)	Evaluating the importance of effective CSFs in TQM implementation in hotel companies in Malaysia	1.Technological factors (quality control and reporting, benchmarking, ISO 9001, just-in-time production, process management) 2.Organizational factors (organizational trust, continuous improvement, strategic planning, teamwork, organizational culture) 3.Human factors (customer orientation, employee empowerment, satisfaction and involvement, leadership)
Trang and Do (2020)	Assessing the CSFs involved in TQM implementation in Vietnam's supporting industries	1.Commitment of top management 2.Role of the quality department 3.Training 4.Continuous improvement 5.Quality policies 6.Quality data and reporting 7.Communication to improve quality 8.Customer satisfaction
Savaş and Yacan (2022)	Determining the CSFs in TQM for private hospitals and evaluating their levels of importance	1.Factors related to customer and service processes (customer orientation, continuous improvement and development, preventive approaches) 2.Factors related to employees (top management leadership, employee involvement, training) 3.Factors related to systems and techniques (quality system and standardization, measurement, analysis and reporting, benchmarking)
Wassan et al. (2023)	Identifying effective CSFs in TQM implementation in the manufacturing sector in Pakistan	1.Customer satisfaction 2.Employee participation 3.Education and training 4.Continuous improvement 5.Encouraging employees 6.Service quality

As seen in Table 1, in order to determine the most suitable factors for SMEs based on the commonly used critical success factors in the literature, a focus group discussion was conducted with quality managers from 20 different enterprises. As a result of the interviews conducted with experts, a total of 15 success criteria were identified, the explanations of which are provided below.

- ***Establishment of quality targets and policies (C1) -*** quality policies, which provide a framework for the creation and review of quality objectives, include the organization's vision, mission, and core values, and serve as a guide for everyone in the organization regarding the delivery of products to customers (Efil, 2016; Trang and Do, 2020). The quality objectives created in line with the quality policies should be consistent with the policies.

Furthermore, quality objectives should be measurable, monitored, and updated when necessary (Efil, 2016).

- ***Education and training activities (C2) -*** delivering high-quality products requires equipping employees with the necessary knowledge and skills and ensuring that they are aware of their roles and responsibilities within the quality management system. Planning training and educational activities as a continuous process, enhancing employee motivation, and implementing a quality-based performance evaluation system are crucial for performance improvement (Jamali et al., 2010; Aquilani et al., 2017). Since quality is everyone's responsibility in a TQM approach, training programs should involve all organizational members (Wassan et al., 2023).
- ***Leadership and support of top management (C3) -*** as a management philosophy, TQM starts with leadership. Therefore, top management must establish a foundation based on values and policies and allocate the necessary resources. This enables the creation of an environment that is conducive to quality management and demonstrates the importance of TQM to employees (Hietschold et al., 2014). Top management should adopt a long-term strategic view of quality, rather than focusing solely on production goals. A disconnect between the intentions of top management regarding TQM and the practices at lower organizational levels may result in failure (Khanna et al., 2011). Leadership in the TQM context refers to involving employees in implementation processes to enhance customer satisfaction efforts (Manhas et al., 2015). Although fundamental leadership qualities-such as professional competence, preparedness, awareness, the ability to motivate, consistency, responsibility, and fairness-are essential regardless of company size, the in-depth interviews revealed notable distinctions. SME leaders, who are often also business owners, tend to exhibit greater risk tolerance and, due to working with smaller teams, demonstrate higher levels of empathy and understanding. (Arany and Popovics, 2022).
- ***Effectiveness of the quality department (C4) -*** the main role of the quality department is to increase profit margins by reducing inefficiencies, quality costs, operational errors, and product defects. It is also responsible for improving operations and enhancing quality through the introduction of new tools, techniques, or skills. A well-structured quality management system and effective collaboration with other departments can significantly improve product quality and increase customer satisfaction (Khanna et al., 2011; Rahman, 2018; Trang and Do, 2020).
- ***Teamwork (C5) -*** employees support quality improvement by demonstrating collaborative behavior and positive attitudes while working as part of a team (Wali et al., 2003). Teamwork involves direct, face-to-face interaction, enabling innovative solutions to emerge-solutions that may not be possible through individual effort alone (Rahman, 2018).
- ***Strategic planning and management of quality (C6) -*** the development of quality strategies and plans outlines the requirements for implementing TQM. These plans should be practical and help solve existing problems.

Quality plans must clearly articulate how they will be implemented and managed (Rahman, 2018).

- ***Use of measurement systems in quality improvement (C7) -*** to facilitate the effective execution of quality management activities, it is essential to use data collection tools, information systems, reporting mechanisms, and statistical methods (Savaş and Yacan, 2022).
- ***Empowerment of employees (C8) -*** empowerment refers to the delegation of authority and responsibility from higher levels to lower-level employees in the organizational hierarchy, especially in terms of decision-making. Empowering employees is a long-term process involving strengthening, training, providing all necessary tools, and motivating employees to perform at an optimal level. When an employee is trusted with the authority to solve problems, they can resolve issues more quickly than someone who does not possess such authority (Mohapatra and Sundaray, 2018). Through empowerment, the level of management is reduced, and responsibility is transferred to employees at every level. Thus, instead of escalating issues to upper management, employees try to resolve problems as they arise. For example, when there is a problem with components purchased from a supplier, operators may have the authority to return the parts to the supplier (Ghobadian and Gallear, 1996).
- ***Establishment of a continuous improvement system (C9) -*** continuous improvement refers to the ongoing enhancement of processes carried out to deliver value to customers, leading to a continual increase in performance (Manhas et al., 2015). The long-term success of a business depends on its approach to quality improvement as a never-ending pursuit. Continuous improvement activities aim to enhance both current results and the capabilities needed to achieve better results in the future (Trang and Do, 2020).
- ***Quality management systems (ISO 9001) (C10) -*** firms that wish to obtain quality management certifications must design processes that demonstrate measurable quality, alignment with customer expectations, and the implementation of corrective actions when necessary (Iyer et al., 2013). ISO 9001 is an international standard that specifies requirements for a quality management system. One of its primary advantages is that it clarifies expectations for employees.
- ***Quality management activities of suppliers (C11) -*** in TQM practices, it is essential for businesses to establish long-term relationships and close collaborations with suppliers, who are often regarded as an integral part of the organization. The quality of the final product is directly related to the quality of raw materials and equipment supplied. Therefore, keeping records to identify and improve supplier-related issues is of great importance (Manhas et al., 2015. Researchers argue that small firms lack influence over suppliers, do not have sufficient financial resources, specialized skills, or the necessary information channels to keep up with quality developments, and have limited impact on the market. Moreover, it appears that SMEs tend

to focus primarily on short-term goals, which suggests that they may lack long-term quality improvement plans. (Mendes, 2002).

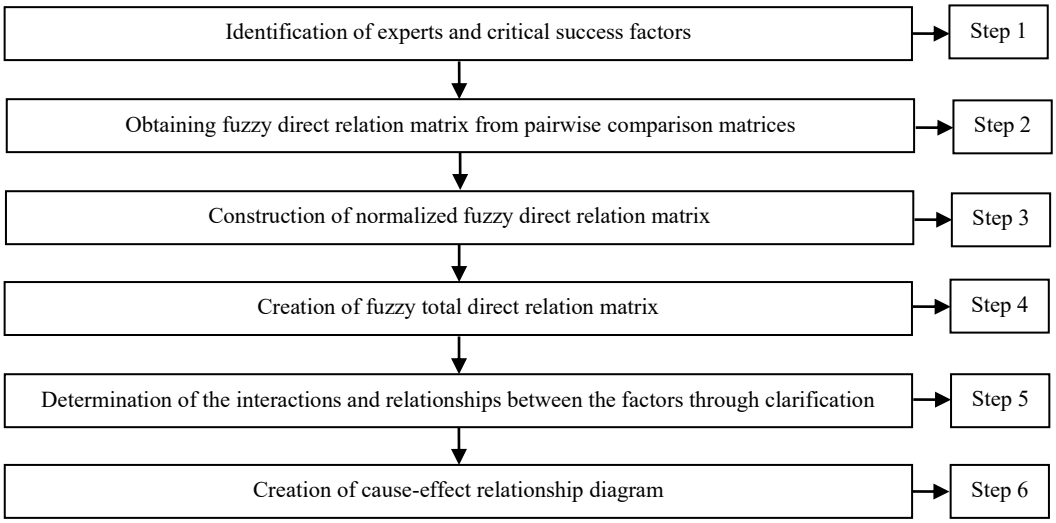
- ***Customer focus and satisfaction (C12) -*** customer orientation is defined as the extent to which a company consistently meets customer needs. A business that understands and fulfills what customers want can gain a competitive advantage (Wassan, 2023). Understanding, satisfying, and exceeding customer needs and expectations should be the primary goal of every organization (Jamali et al., 2010). Customer orientation is a fundamental principle of TQM. Customer feedback must be integrated into every stage of the product development process, as it directly contributes to product quality. In a customer-oriented approach, the interests of not only end customers but also other stakeholders-such as business owners, managers, and employees-must be considered to achieve long-term profitability (Manhas et al., 2015; Trang and Do, 2020).
- ***Employee participation (C13) -*** often associated with fostering positive workplace attitudes and behaviors, employee involvement refers to the participation of employees in decision-making and problem-solving processes at all levels of the organization (Manhas et al., 2015). For TQM initiatives to be effective, everyone in the organization must use their skills and competencies to take responsibility for quality. Employees who feel that they are part of the organization should be encouraged to control, manage, and improve the processes within their areas of responsibility (Jamali et al., 2010; Aquilani et al., 2016).
- ***Reward programs for employee incentive (C14) -*** employee motivation is closely related to their level of engagement, sense of responsibility, and creativity. Motivation is one of the core components of TQM practices. To help employees feel valued within the organization, their efforts, contributions, and achievements should be rewarded through both financial and non-financial incentives (Wassan, 2023). Reward systems are among the key elements that enhance employee potential and engagement, thus contributing significantly to the organization's quality journey (Rahman, 2018).
- ***Organizational culture (C15) -*** organizational culture refers to the shared mindset, beliefs, and values among organizational members that shape institutional practices. It is therefore a key element that differentiates one organization from another (Prajogo and McDermott, 2005). In an organizational culture that embraces TQM, the principle is to do things right the first time and to eliminate defects and waste (Mohammad Mosadegh Rad, 2006). Establishing a culture that encourages employees to participate in decision-making processes significantly enhances the success of TQM implementation (Gupta et al., 2017).

3. Methodology

Ethical approval for this study was obtained from the Social and Humanities Research Ethics Committee of the Rectorate of Ondokuz Mayıs University. (Date: 28.04.2023 and No: 2023-426). This research was conducted in two stages. First,

critical success factors (CSFs) affecting the success of TQM implementations were identified based on a comprehensive literature review and expert opinions. Then, the importance levels of these factors and the cause-effect relationships among them were analyzed using the Fuzzy DEMATEL method. The research design is illustrated in Figure 1.

Figure 1. Research Methodology



- **Step 1 -** the first step involves selecting the experts whose knowledge will be consulted within the scope of the research topic. After that, through a literature review, the criteria that are suitable for the scope of the study are identified by the experts. At this stage, the criteria to be evaluated in the study must be finalized with the consensus of the experts.

- **Step 2 -** based on the criteria identified in Step 1, pairwise comparison matrices have been created and each cell in these matrices has been evaluated by the experts. To resolve the uncertainty in the decision-makers' evaluations, the scale shown in Table 2 has been used. Based on this scale, fuzzy direct relation matrices, expressed as $\tilde{Z}$, have been created by taking the positive triangular numbers corresponding to the linguistic expressions defined in the pairwise comparison matrices. A fuzzy event is expressed by a triangular fuzzy number set (l, m, u), where "l" represents the minimum possible value, "m" represents the most likely value, and "u" represents the maximum possible value.

Table 2. Fuzzy Evaluation Scale Based on Impact Scores

Linguistic terms	Impact score	Triangular fuzzy numbers
Very high influence	5	(0.75; 1; 1)
High influence	4	(0,5; 0,75; 1)
Low influence	3	(0,25; 0,5; 0,75)
Very low influence	2	(0; 0,25; 0,5)
No influence	1	(0; 0; 0,25)

After the relationships between the criteria C={C_i|i = 1, 2,....,n} are evaluated by "p" decision makers, an nxn dimensional matrix is obtained and "p" number of $\tilde{z}^1$, $\tilde{z}^2$, $\tilde{z}^3$,…. ,$\tilde{z}^p$ fuzzy direct relationship matrices are created. The elements of the fuzzy direct relationship matrix, which consist of triangular fuzzy numbers and show the degree to which the i. criterion affects the j. criterion for each "k" expert; $\tilde{z}^k_{ij}=(l^k_{ij}, m^k_{ij}, u^k_{ij})$ are obtained. By taking the average of the matrices belonging to the obtained "k" experts, a single fuzzy direct relationship matrix ($\tilde{Z}$) expressing the joint decisions of the experts is created.

- **Step 3 -** the sum of the values corresponding to each "u" column in the rows of the average fuzzy direct relation matrix obtained in Step 2 is calculated, and the largest value is expressed as "r". Then, all the values in the fuzzy direct relation matrix are divided by the "r" value as shown in Equation (1), and a normalized fuzzy direct relationship matrix ($\tilde{X}$) is obtained.

  As $r = max_{1 \le i \le n} \left(\sum_{j=1}^{n} u_{ij}\right)$

  $$\tilde{X}_{ij} = \frac{\tilde{z}_{ij}}{r} = \frac{l_{ij}}{r}, \frac{m_{ij}}{r}, \frac{u_{ij}}{r} \quad (1)$$

- **Step 4 -** since it is difficult to apply Equation (2) to the entire matrix, three triangular fuzzy numbers for the first, second, and third matrices (l, m, u) are created from the normalized fuzzy direct relationship matrix ($\tilde{X}$) obtained in Step 3. After subtracting the unit matrix "I" from each of these three matrices (l, m, and u), their inverses are calculated and multiplied by the original matrix. The results are combined to form the fuzzy total relationship matrix, denoted by $\tilde{T}$.

  $$\tilde{T} = \tilde{X}.(I - \tilde{X})^{-1} \quad (2)$$

- **Step 5 -** the sums of the rows ($\tilde{D}_i$) and columns ($\tilde{R}_i$) of the fuzzy total relationship matrix ($\tilde{T}$) are calculated. Then, for each "i" criterion, ($\tilde{D}_i + \tilde{R}_i$) and ($\tilde{D}_i - \tilde{R}_i$) are computed. Based on these values, interactions and relationships between the criteria are identified. ($\tilde{D}_i - \tilde{R}_i$) indicates the interaction between criteria. Criteria with a positive ($\tilde{D}_i - \tilde{R}_i$) value have a higher impact on other criteria and are categorized as influencing criteria, while those with a negative ($\tilde{D}_i - \tilde{R}_i$) value have a lower impact and are categorized as influenced criteria. The ($\tilde{D}_i + \tilde{R}_i$) values indicate the degree of relationship between the criteria. Criteria with a higher ($\tilde{D}_i + \tilde{R}_i$) value are more related to other criteria, while criteria with a lower ($\tilde{D}_i + \tilde{R}_i$) value are less related (Albayrak and Erkayman, 2018).

($\tilde{D}_i + \tilde{R}_i$) and ($\tilde{D}_i - \tilde{R}_i$) values are obtained from triangular fuzzy numbers (l, m, u), and to reduce these numbers to a single value, a defuzzification process is carried out using Equations (3 and 4). The abbreviation "def" stands for defuzzifying.

$$D_i^{def} + R_i^{def} = 1/4(l + 2m + u) \quad (3)$$

$$D_i^{def} - \tilde{R}_i^{def} = 1/4(l + 2m + u) \quad (4)$$

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- **Step 6 -** the values obtained in Step 5 are used to construct a cause-and-effect diagram. The horizontal axis of the diagram represents the importance level, shown by $D_i^{def} + R_i^{def}$, while the vertical axis represents the impact group, shown by $D_i^{def} - R_i^{def}$.

4. Findings

In this study, the fuzzy DEMATEL method was used to determine the cause-and-effect relationships and the importance levels of the critical success factors that are effective in TQM implementation in SMEs. The data were collected in two steps. In the first step, quality managers from 20 different SMEs were informed about the study, and they were asked to select the most effective critical success factors for SMEs from those identified in the literature review. The quality managers consulted in this study are individuals responsible for carrying out quality management activities within their organizations and have received undergraduate or postgraduate education. The critical success factors to be evaluated in this study are shown in Table 3, along with their codes.

Table 3. Critical Success Factors

Code	Factor
C1	Establishment of Quality Targets and Policies
C2	Education and Training Activities
C3	Leadership and Support of Top Management
C4	Effectiveness of the Quality Department
C5	Teamwork
C6	Strategic Planning and Management of Quality
C7	Use of Measurement Systems in Quality Improvement
C8	Empowerment of Employees
C9	Establishment of a Continuous Improvement System
C10	Quality Management Systems (ISO 9001)
C11	Quality Management Activities of Suppliers
C12	Customer Focus and Satisfaction
C13	Employee Participation
C14	Reward Programs for Employee Incentive
C15	Organizational Culture

In the second step, pairwise comparison matrices were created for the 15 criteria identified by the quality managers. These pairwise comparison matrices were filled by 20 different quality managers using linguistic expressions based on the impact scores shown in Table 2. After converting these matrices into triangular fuzzy numbers, the average was taken, resulting in a single fuzzy direct relationship matrix, as shown in Table 4. A normalized fuzzy direct relationship matrix was then obtained based on Step 3, as shown in Table 5. Using the normalized fuzzy direct relationship matrix ($\tilde{X}$), the fuzzy total relationship matrix was obtained as shown in Table 6, following the process described in Step 4. Then, a clarification process was performed to convert the interactions and relationships between the criteria into net values. For this purpose, firstly ($\tilde{D}_i$-$\tilde{R}_i$) and ($\tilde{D}_i$+$\tilde{R}_i$) consisting of fuzzy numbers

were obtained and clarified net values specified as $D_i^{def} + R_i^{def}$ (relationship level order) and $D_i^{def} - \tilde{R}_i^{def}$ (effect groups according to interaction level) in Table 7 were reached. In the creation of the cause-effect graph shown in Figure 2, the $D_i^{def} + R_i^{def}$ value was located on the horizontal axis of the graph and the $D_i^{def} - \tilde{R}_i^{def}$ value was located on the vertical axis.

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Table 4: Fuzzy Direct Relationship Matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
C1	0;0;0	0,4500; 0,6875; 0,8625	0,5375; 0,7750; 0,9375	0,5; 0,7375; 0,875	0,4875; 0,725; 0,8625	0,5; 0,725; 0,8625	0,45; 0,675; 0,8125	0,475; 0,7125; 0,8875	0,4625; 0,6875; 0,8375	0,4125; 0,6375; 0,7875	0,325; 0,55; 0,75	0,5375; 0,775; 0,9125	0,5125; 0,7375; 0,8875	0,45; 0,6875; 0,8875	0,425; 0,65; 0,8125
C2	0,5125; 0,75; 0,8875	0;0;0	0,475; 0,725; 0,925	0,5625; 0,8125; 0,9375	0,5625; 0,8125; 0,9625	0,525; 0,75; 0,8875	0,55; 0,7875; 0,925	0,525; 0,775; 0,9375	0,5625; 0,8125; 0,95	0,475; 0,7; 0,875	0,475; 0,725; 0,9	0,5; 0,7375; 0,9	0,5125; 0,75; 0,8875	0,55; 0,8; 0,95	0,425; 0,65; 0,8125
C3	0,6250; 0,8625; 0,9500	0,5125; 0,7625; 0,9	0;0;0	0,5375; 0,7875; 0,9125	0,4875; 0,725; 0,9	0,55; 0,7875; 0,925	0,5375; 0,7875; 0,925	0,575; 0,8125; 0,9375	0,5875; 0,8375; 0,95	0,425; 0,65; 0,8	0,4; 0,6375; 0,825	0,5625; 0,8; 0,9375	0,5625; 0,7875; 0,8875	0,5625; 0,8125; 0,9375	0,5625; 0,8; 0,8875
C4	0,5500; 0,7875; 0,8875	0,4875; 0,725; 0,875	0,4625; 0,7125; 0,875	0;0;0	0,425; 0,675; 0,8625	0,5375; 0,7875; 0,925	0,4125; 0,65; 0,8625	0,4125; 0,6625; 0,875	0,5375; 0,7875; 0,925	0,4; 0,6375; 0,8125	0,425; 0,6625; 0,8625	0,4125; 0,6625; 0,8625	0,4; 0,6375; 0,8125	0,4375; 0,6875; 0,8875	0,45; 0,675; 0,8375
C5	0,4875; 0,7250; 0,8750	0,4875; 0,725; 0,8625	0,55; 0,8; 0,925	0,5; 0,75; 0,9125	0;0;0	0,5125; 0,7375; 0,8875	0,4875; 0,7375; 0,8875	0,55; 0,8; 0,95	0,5125; 0,7625; 0,95	0,4; 0,625; 0,8	0,375; 0,625; 0,8375	0,4625; 0,7125; 0,8875	0,5; 0,75; 0,875	0,4625; 0,7125; 0,9	0,55; 0,7875; 0,925
C6	0,6000; 0,8375; 0,9250	0,4875; 0,7375; 0,9	0,55; 0,8; 0,9	0,55; 0,8; 0,9	0,5375; 0,7625; 0,9	0;0;0	0,55; 0,8; 0,9375	0,525; 0,775; 0,925	0,4625; 0,7125; 0,8875	0,4; 0,625; 0,8125	0,45; 0,7; 0,875	0,4625; 0,7125; 0,9	0,475; 0,7125; 0,85	0,4625; 0,7; 0,8875;	0,5375; 0,7875; 0,9125
C7	0,5375; 0,7625; 0,8875	0,4125; 0,6625; 0,8625	0,4125; 0,6375; 0,8125	0,45; 0,6875; 0,85	0,45; 0,6875; 0,875	0,45; 0,6875; 0,8375	0;0;0	0,3875; 0,625; 0,825	0,45; 0,7; 0,85	0,375; 0,6; 0,7875	0,35; 0,6; 0,825	0,4125; 0,6625; 0,8625	0,4625; 0,7; 0,875	0,475; 0,725; 0,9375	0,45; 0,7; 0,875
C8	0,5250; 0,7625; 0,9000	0,4625; 0,7125; 0,9	0,5375; 0,775; 0,9	0,525; 0,775; 0,9125	0,425; 0,6625; 0,825	0,45; 0,675; 0,8375	0,3875; 0,5875; 0,775	0;0;0	0,425; 0,65; 0,85	0,475; 0,7125; 0,8875	0,3625; 0,6; 0,8	0,45; 0,675; 0,8625	0,4375; 0,6875; 0,8625	0,475; 0,725; 0,9375	0,4875; 0,725; 0,8875
C9	0,5625; 0,8000; 0,9500	0,5; 0,75; 0,925	0,575; 0,825; 0,975	0,5625; 0,8125; 0,95	0,45; 0,6875; 0,875	0,4875; 0,7375; 0,9	0,55; 0,8; 0,95	0,5125; 0,7625; 0,9375	0;0;0	0,4875; 0,725; 0,875	0,4375; 0,6625; 0,825	0,4875; 0,725; 0,9	0,5; 0,7375; 0,9	0,4625; 0,7125; 0,9125	0,5125; 0,75; 0,9125
C10	0,4625; 0,6750; 0,8375	0,5125; 0,7625; 0,925	0,5375; 0,7875; 0,9125	0,5; 0,7375; 0,8875	0,475; 0,725; 0,875	0,45; 0,6875; 0,8625	0,3875; 0,625; 0,8	0,475; 0,7125; 0,9125	0,5; 0,7375; 0,8875	0;0;0	0,4375; 0,6875; 0,875	0,5125; 0,7625; 0,925	0,5; 0,75; 0,9125	0,4625; 0,7125; 0,9125	0,4875; 0,725; 0,8875

C11	0,425; 0,65; 0,7875	0,3875; 0,6375; 0,8375	0,4; 0,6375; 0,8125	0,475; 0,7125; 0,8875	0,3625; 0,575; 0,7875	0,425; 0,675; 0,8625	0,4; 0,6375; 0,85	0,45; 0,6875; 0,8625	0,45; 0,6875; 0,8625	0,3625; 0,6125; 0,825	0;0;0	0,5125; 0,7625; 0,925	0,4125; 0,6375; 0,825	0,4; 0,6125; 0,825	0,475; 0,7; 0,8625
C12	0,5250; 0,7500; 0,8750	0,5; 0,75; 0,9	0,575; 0,8125; 0,925	0,5125; 0,75; 0,9	0,475; 0,7125; 0,875	0,5375; 0,7875; 0,925	0,375; 0,6; 0,8	0,5125; 0,7625; 0,9375	0,5625; 0,8; 0,9375	0,4125; 0,6625; 0,8375	0,4125; 0,625; 0,8125	0;0;0	0,4875; 0,725; 0,9125	0,45; 0,7; 0,9125	0,425; 0,6625; 0,8625
C13	0,5500; 0,7875; 0,9250	0,425; 0,6500; 0,8125	0,525; 0,775; 0,9	0,4875; 0,7125; 0,8625	0,4875; 0,725; 0,8625	0,4375; 0,6875; 0,85	0,3375; 0,5625; 0,7625	0,5; 0,75; 0,9125	0,475; 0,725; 0,9	0,4; 0,6375; 0,8375	0,325; 0,5625; 0,7875	0,4625; 0,7; 0,8625	0;0;0	0,4375; 0,6875; 0,8625	0,5125; 0,75; 0,9
C14	0,5125; 0,75; 0,8875	0,425; 0,6375; 0,825	0,5125; 0,7625; 0,9	0,4375; 0,675; 0,8625	0,45; 0,675; 0,8375	0,4625; 0,7125; 0,9125	0,4; 0,625; 0,825	0,5; 0,75; 0,9125	0,4875; 0,725; 0,8875	0,3875; 0,625; 0,8375	0,3; 0,5125; 0,725	0,45; 0,675; 0,875	0,55; 0,8; 0,9125	0;0;0	0,5375; 0,775; 0,9125
C15	0,5; 0,725; 0,85	0,4375; 0,6625; 0,8375	0,5125; 0,7625; 0,9	0,4625; 0,7; 0,875	0,4875; 0,7125; 0,85	0,4375; 0,675; 0,825	0,4; 0,6375; 0,8375	0,5125; 0,75; 0,9125	0,4875; 0,7375; 0,9	0,4625; 0,7; 0,875	0,425; 0,6375; 0,8125	0,5; 0,75; 0,9	0,5625; 0,8; 0,9125	0,5375; 0,775; 0,925	0;0;0

Table 5: Normalized Fuzzy Direct Relationship Matrix

	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**	**C13**	**C14**	**C15**
C1	0;0;0	0,0353; 0,0540; 0,0677	0,0422; 0,0608; 0,0736	0,0393; 0,0579; 0,0687	0,0383; 0,0569; 0,0677	0,0393; 0,0569; 0,0677	0,0353; 0,0530; 0,0638	0,0373; 0,0559; 0,0697	0,0363; 0,0540; 0,0658	0,0324; 0,0500; 0,0618	0,0255; 0,0432; 0,0589	0,0422; 0,0608; 0,0716	0,0402; 0,0579; 0,0697	0,0353; 0,0540; 0,0697	0,0334; 0,0510; 0,0638
C2	0,0402; 0,0589; 0,0697	0;0;0	0,0373; 0,0569; 0,0726	0,0442; 0,0638; 0,0736	0,0442; 0,0638; 0,0756	0,0412; 0,0589; 0,0697	0,0432; 0,0618; 0,0726	0,0412; 0,0608; 0,0736	0,0442; 0,0638; 0,0746	0,0373; 0,0550; 0,0687	0,0373; 0,0569; 0,0707	0,0393; 0,0579; 0,0707	0,0402; 0,0589; 0,0697	0,0432; 0,0628; 0,0746	0,0334; 0,0510; 0,0638
C3	0,0491; 0,0677; 0,0746	0,0402; 0,0599; 0,0707	0;0;0	0,0422; 0,0618; 0,0716	0,0383; 0,0569; 0,0707	0,0432; 0,0618; 0,0726	0,0422; 0,0618; 0,0726	0,0451; 0,0638; 0,0736	0,0461; 0,0658; 0,0746	0,0334; 0,0510; 0,0628	0,0314; 0,0500; 0,0648	0,0442; 0,0628; 0,0736	0,0442; 0,0618; 0,0697	0,0442; 0,0638; 0,0736	0,0442; 0,0628; 0,0697
C4	0,0432; 0,0618; 0,0697	0,0383; 0,0569; 0,0687	0,0363; 0,0559; 0,0687	0;0;0	0,0334; 0,0530; 0,0677	0,0422; 0,0618; 0,0726	0,0324; 0,0510; 0,0677	0,0324; 0,0520; 0,0687	0,0422; 0,0618; 0,0726	0,0314; 0,0500; 0,0638	0,0334; 0,0520; 0,0677	0,0324; 0,0520; 0,0677	0,0314; 0,0500; 0,0638	0,0343; 0,0540; 0,0697	0,0353; 0,0530; 0,0658
C5	0,0383; 0,0569; 0,0687	0,0383; 0,0569; 0,0677	0,0432; 0,0628; 0,0726	0,0393; 0,0589; 0,0716	0;0;0	0,0402; 0,0579; 0,0697	0,0383; 0,0579; 0,0697	0,0432; 0,0628; 0,0746	0,0402; 0,0599; 0,0746	0,0314; 0,0491; 0,0628	0,0294; 0,0491; 0,0658	0,0363; 0,0559; 0,0697	0,0393; 0,0589; 0,0687	0,0363; 0,0559; 0,0707	0,0432; 0,0618; 0,0726
C6	0,0471; 0,0658; 0,0726	0,0383; 0,0579; 0,0707	0,0432; 0,0628; 0,0707	0,0432; 0,0628; 0,0707	0,0422; 0,0599; 0,0707	0;0;0	0,0432; 0,0628; 0,0736	0,0412; 0,0608; 0,0726	0,0363; 0,0559; 0,0697	0,0314; 0,0491; 0,0638	0,0353; 0,0550; 0,0687	0,0363; 0,0559; 0,0707	0,0373; 0,0559; 0,0667	0,0363; 0,0550; 0,0697	0,0422; 0,0618; 0,0716
C7	0,0422; 0,0599; 0,0697	0,0324; 0,0520; 0,0677	0,0324; 0,0500; 0,0638	0,0353; 0,0540; 0,0667	0,0353; 0,0540; 0,0687	0,0353; 0,0540; 0,0658	0;0;0	0,0304; 0,0491; 0,0648	0,0353; 0,0550; 0,0667	0,0294; 0,0471; 0,0618	0,0275; 0,0471; 0,0648	0,0324; 0,0520; 0,0677	0,0363; 0,0550; 0,0687	0,0373; 0,0569; 0,0736	0,0353; 0,0550; 0,0687

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C8	0,0412; 0,0599; 0,0707	0,0363; 0,0559; 0,0707	0,0422;0 ,0608; 0,0707	0,0412; 0,0608; 0,0716	0,0334; 0,0520; 0,0648	0,0353; 0,0530; 0,0658	0,0304; 0,0461; 0,0608	0;0;0	0,0334; 0,0510; 0,0667	0,0373; 0,0559; 0,0697	0,0285; 0,0471; 0,0628	0,0353; 0,0530; 0,0677	0,0343; 0,0540; 0,0677	0,0373; 0,0569; 0,0736	0,0383; 0,0569; 0,0697
C9	0,0442; 0,0628; 0,0746	0,0393; 0,0589; 0,0726	0,0451; 0,0648; 0,0765	0,0442; 0,0638; 0,0746	0,0353; 0,0540; 0,0687	0,0383; 0,0579; 0,0707	0,0432; 0,0628; 0,0746	0,0402; 0,0599; 0,0736	0;0;0	0,0383; 0,0569; 0,0687	0,0343; 0,0520; 0,0648	0,0383; 0,0569; 0,0707	0,0393; 0,0579; 0,0707	0,0363; 0,0559; 0,0716	0,0402; 0,0589; 0,0716
C10	0,0363; 0,0530; 0,0658	0,0402; 0,0599; 0,0726	0,0422; 0,0618; 0,0716	0,0393; 0,0579; 0,0697	0,0373; 0,0569; 0,0687	0,0353; 0,0540; 0,0677	0,0304; 0,0491; 0,0628	0,0373; 0,0559; 0,0716	0,0393; 0,0579; 0,0697	0;0;0	0,0343; 0,0540; 0,0687	0,0402; 0,0599; 0,0726	0,0393; 0,0589; 0,0716	0,0363; 0,0559; 0,0716	0,0383; 0,0569; 0,0697
C11	0,0334; 0,0510; 0,0618	0,0304; 0,0500; 0,0658	0,0314; 0,05; 0,0638	0,0373; 0,0559; 0,0697	0,0285; 0,0451; 0,0618	0,0334; 0,0530; 0,0677	0,0314; 0,0500; 0,0667	0,0353; 0,0540; 0,0677	0,0353; 0,0540 0,0677;	0,0285; 0,0481; 0,0648	0;0;0	0,0402; 0,0599; 0,0726	0,0324; 0,0500; 0,0648	0,0314; 0,0481; 0,0648	0,0373; 0,0550; 0,0677
C12	0,0412; 0,0589; 0,0687	0,0393; 0,0589; 0,0707	0,0451; 0,0638; 0,0726	0,0402; 0,0589; 0,0707	0,0373; 0,0559; 0,0687	0,0422; 0,0618; 0,0726	0,0294; 0,0471; 0,0628	0,0402; 0,0599; 0,0736	0,0442; 0,0628; 0,0736	0,0324; 0,0520; 0,0658	0,0324; 0,0491; 0,0638	0;0;0	0,0383; 0,0569; 0,0716	0,0353; 0,0550; 0,0716	0,0334; 0,0520; 0,0677
C13	0,0432; 0,0618; 0,0726	0,0334; 0,0510; 0,0638	0,0412; 0,0608; 0,0707	0,0383; 0,0559; 0,0677	0,0383; 0,0569; 0,0677	0,0343; 0,0540; 0,0667	0,0265; 0,0442; 0,0599	0,0393; 0,0589; 0,0716	0,0373; 0,0569; 0,0707	0,0314; 0,0500; 0,0658	0,0255; 0,0442; 0,0618	0,0363; 0,0550; 0,0677	0;0;0	0,0343; 0,0540; 0,0677	0,0402; 0,0589; 0,0707
C14	0,0402; 0,0589; 0,0697	0,0334; 0,05; 0,0648	0,0402; 0,0599; 0,0707	0,0343; 0,0530; 0,0677	0,0353; 0,0530; 0,0658	0,0363; 0,0559; 0,0716	0,0314; 0,0491; 0,0648	0,0393; 0,0589; 0,0716	0,0383; 0,0569; 0,0697	0,0304; 0,0491; 0,0658	0,0236; 0,0402; 0,0569	0,0353; 0,0530; 0,0687	0,0432; 0,0628; 0,0716	0;0;0	0,0422; 0,0608; 0,0716
C15	0,0393; 0,0569; 0,0667	0,0343; 0,0520; 0,0658	0,0402; 0,0599; 0,0707	0,0363; 0,055; 0,0687	0,0383; 0,0559; 0,0667	0,0343; 0,0530; 0,0648	0,0314; 0,0500; 0,0658	0,0402; 0,0589; 0,0716	0,0383; 0,0579; 0,0707	0,0363; 0,0550; 0,0687	0,0334; 0,0500; 0,0638	0,0393; 0,0589; 0,0707	0,0442; 0,0628; 0,0716	0,0422; 0,0608; 0,0726	0;0;0

Table 6: The Fuzzy Total Relationship Matrix

	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**	**C13**	**C14**	**C15**
C1	0,0431; 0,2030; 1,7766	0,0721; 0,2400; 1,8119	0,0823; 0,2595; 1,8681	0,0789; 0,2542; 1,8530	0,0753; 0,2428; 1,8020	0,0773; 0,2473; 1,8224	0,0706; 0,2328; 1,7715	0,0763; 0,2504; 1,8809	0,0757; 0,2491; 1,8571	0,0658; 0,2235; 1,7297	0,0572; 0,2103; 1,7072	0,0797; 0,2504; 1,8531	0,0788; 0,2499; 1,8254	0,0728; 0,2435; 1,8741	0,0722; 0,2422; 1,8167
C2	0,0859; 0,2743; 1,9467	0,0417; 0,2035; 1,8519	0,0818; 0,2716; 1,9736	0,0875; 0,2750; 1,9630	0,0844; 0,2635; 1,9116	0,0830; 0,2641; 1,9282	0,0815; 0,2550; 1,8805	0,0838; 0,2702; 1,9916	0,0869; 0,2732; 1,9710	0,0738; 0,2416; 1,8346	0,0713; 0,2359; 1,8153	0,0808; 0,2628; 1,9578	0,0827; 0,2659; 1,9295	0,0838; 0,2663; 1,9854	0,0761; 0,2574; 1,9207
C3	0,0959; 0,2875; 1,9424	0,0819; 0,2648; 1,9093	0,0477; 0,2231; 1,8971	0,0874; 0,2784; 1,9526	0,0806; 0,2623; 1,8989	0,0864; 0,2717; 1,9222	0,0820; 0,2596; 1,8722	0,0892; 0,2779; 1,9828	0,0903; 0,2800; 1,9622	0,0716; 0,2427; 1,8213	0,0671; 0,2340; 1,8020	0,0870; 0,2722; 1,9517	0,0881; 0,2736; 1,9209	0,0864; 0,2722; 1,9757	0,0877; 0,2729; 1,9172

C4	0,0833; 0,2609; 1,8674	0,0738; 0,2424; 1,8381	0,0757; 0,2547; 1,8898	0,0401; 0,1992; 1,8146	0,0697; 0,2389; 1,8272	0,0790; 0,2514; 1,8522	0,0670; 0,2309; 1,7999	0,0707; 0,2466; 1,9063	0,0800; 0,2557; 1,8891	0,0640; 0,2232; 1,7557	0,0637; 0,2181; 1,7390	0,0696; 0,2423; 1,8755	0,0695; 0,2425; 1,8457	0,0709; 0,2432; 1,9003	0,0729; 0,2437; 1,8439
C5	0,0819; 0,2663; 1,9098	0,0765; 0,2514; 1,8797	0,0851; 0,2706; 1,9370	0,0808; 0,2643; 1,9249	0,0401; 0,1977; 1,8059	0,0800; 0,2571; 1,8923	0,0750; 0,2457; 1,8431	0,0836; 0,2658; 1,9555	0,0811; 0,2635; 1,9344	0,0665; 0,2308; 1,7954	0,0623; 0,2235; 1,7774	0,0760; 0,2551; 1,9206	0,0797; 0,2598; 1,8928	0,0756; 0,2542; 1,9452	0,0831; 0,2610; 1,8926
C6	0,0913; 0,2781; 1,9178	0,0776; 0,2560; 1,8868	0,0862; 0,2744; 1,9399	0,0856; 0,2717; 1,9287	0,0817; 0,2578; 1,8765	0,0425; 0,2062; 1,8318	0,0806; 0,2537; 1,8510	0,0829; 0,2678; 1,9585	0,0786; 0,2639; 1,9348	0,0675; 0,2342; 1,8006	0,0687; 0,2321; 1,7843	0,0772; 0,2589; 1,9262	0,0791; 0,2610; 1,8957	0,0767; 0,2571; 1,9490	0,0833; 0,2647; 1,8963
C7	0,0806; 0,2527; 1,8388	0,0667; 0,2319; 1,8090	0,0703; 0,2431; 1,8565	0,0724; 0,2440; 1,8483	0,0699; 0,2338; 1,8000	0,0709; 0,2382; 1,8178	0,0340; 0,1764; 1,7088	0,0671; 0,2377; 1,8736	0,0719; 0,2433; 1,8550	0,0607; 0,2150; 1,7270	0,0567; 0,2083; 1,7097	0,0679; 0,2362; 1,8468	0,0724; 0,2408; 1,8217	0,0720; 0,2397; 1,8746	0,0712; 0,2394; 1,8182
C8	0,0819; 0,2585; 1,8647	0,0724; 0,2410; 1,8363	0,0817; 0,2586; 1,8880	0,0801; 0,2560; 1,8779	0,0701; 0,2376; 1,8211	0,0731; 0,2430; 1,8427	0,0654; 0,2258; 1,7903	0,0397; 0,1967; 1,8384	0,0723; 0,2456; 1,8804	0,0699; 0,2281; 1,7575	0,0594; 0,2132; 1,7314	0,0728; 0,2427; 1,8720	0,0727; 0,2456; 1,8457	0,0741; 0,2454; 1,9002	0,0761; 0,2467; 1,8438
C9	0,0888; 0,2760; 1,9579	0,0788; 0,2574; 1,9263	0,0883; 0,2768; 1,9839	0,0868; 0,2732; 1,9708	0,0756; 0,2531; 1,9124	0,0796; 0,2615; 1,9358	0,0808; 0,2542; 1,8888	0,0822; 0,2675; 1,9986	0,0439; 0,2115; 1,9085	0,0741; 0,2418; 1,8410	0,0680; 0,2300; 1,8165	0,0792; 0,2603; 1,9647	0,0811; 0,2633; 1,9371	0,0769; 0,2585; 1,9898	0,0817; 0,2626; 1,9342
C10	0,0791; 0,2595; 1,8987	0,0776; 0,2512; 1,8757	0,0834; 0,2666; 1,9276	0,0800; 0,2604; 1,9147	0,0753; 0,2486; 1,8620	0,0747; 0,2507; 1,8823	0,0669; 0,2349; 1,8289	0,0774; 0,2566; 1,9444	0,0795; 0,2588; 1,9217	0,0354; 0,1813; 1,7284	0,0663; 0,2254; 1,7722	0,0789; 0,2557; 1,9148	0,0789; 0,2568; 1,8870	0,0747; 0,2513; 1,9374	0,0777; 0,2536; 1,8817
C11	0,0714; 0,2405; 1,8115	0,0641; 0,2263; 1,7873	0,0685; 0,2388; 1,8358	0,0734; 0,2417; 1,8304	0,0626; 0,2219; 1,7740	0,0682; 0,2333; 1,7994	0,0636; 0,2202; 1,7517	0,0708; 0,2380; 1,8553	0,0711; 0,2384; 1,8353	0,0591; 0,2123; 1,7104	0,0294; 0,1599; 1,6300	0,0744; 0,2392; 1,8305	0,0678; 0,2322; 1,7980	0,0656; 0,2278; 1,8461	0,0722; 0,2353; 1,7971
C12	0,0842; 0,2653; 1,9017	0,0771; 0,2508; 1,8744	0,0866; 0,2689; 1,9289	0,0814; 0,2618; 1,9160	0,0757; 0,2482; 1,8624	0,0815; 0,2581; 1,8870	0,0665; 0,2337; 1,8293	0,0805; 0,2606; 1,9465	0,0844; 0,2636; 1,9255	0,0671; 0,2312; 1,7905	0,0648; 0,2214; 1,7682	0,0406; 0,1996; 1,8474	0,0784; 0,2555; 1,8874	0,0742; 0,2508; 1,9378	0,0736; 0,2496; 1,8804
C13	0,0834; 0,2602; 1,8527	0,0694; 0,2365; 1,8167	0,0805; 0,2586; 1,8740	0,0771; 0,2515; 1,8605	0,0743; 0,2418; 1,8101	0,0718; 0,2437; 1,8298	0,0615; 0,2240; 1,7761	0,0772; 0,2522; 1,8911	0,0756; 0,2507; 1,8698	0,0642; 0,2227; 1,7411	0,0564; 0,2104; 1,7176	0,0734; 0,2443; 1,8581	0,0392; 0,1943; 1,7686	0,0710; 0,2426; 1,8809	0,0776; 0,2484; 1,8310
C14	0,0810; 0,2573; 1,8607	0,0696; 0,2353; 1,8280	0,0799; 0,2574; 1,8847	0,0737; 0,2485; 1,8712	0,0719; 0,2381; 1,8188	0,0739; 0,2451; 1,8446	0,0663; 0,2281; 1,7906	0,0775; 0,2519; 1,9019	0,0767; 0,2504; 1,8797	0,0635; 0,2216; 1,7510	0,0547; 0,2066; 1,7231	0,0727; 0,2422; 1,8695	0,0809; 0,2531; 1,8459	0,0381; 0,1911; 1,8283	0,0797; 0,2499; 1,8424
C15	0,0819; 0,2617; 1,8715	0,0722; 0,2428; 1,8420	0,0817; 0,2636; 1,8983	0,0773; 0,2564; 1,8856	0,0763; 0,2464; 1,8328	0,0738; 0,2484; 1,8519	0,0678; 0,2345; 1,8044	0,0802; 0,2579; 1,9157	0,0786; 0,2574; 1,8941	0,0705; 0,2322; 1,7663	0,0653; 0,2206; 1,7417	0,0781; 0,2534; 1,8848	0,0836; 0,2591; 1,8592	0,0803; 0,2543; 1,9097	0,0410; 0,1984; 1,7888

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Table 7: Cause-Effect Ranking Critical Factors

Rank	Factor	($\tilde{D}_i$)	($\tilde{R}_i$)	($\tilde{D}_i$+$\tilde{R}_i$)	($\tilde{D}_i$-$\tilde{R}_i$)	$D_i^{def} + R_i^{def}$	$D_i^{def} - R_i^{def}$	Cause/Effect
10.	**C1**	1,0781; 3,5988;27,2497	1,2138; 3,9017; 28,2190	2,2919; 7,5006; 55,4686	-0,1357; -0,3029;-0,9693	18,1904	-0,4277	Effect
3.	**C2**	1,1848; 3,8803; 28,8614	1,0714; 3,6313; 27,7733	2,2562; 7,5116; 56,6347	0,1135; 0,2490; 1,0881	18,4785	0,4249	**Cause**
1.	**C3**	1,2293; 3,9730; 28,7287	1,1796; 3,8863; 28,5832	2,4089; 7,8594; 57,3119	0,0498; 0,0867; 0,1454	**18,8599**	0,0921	**Cause**
7.	**C4**	1,0500; 3,5939; 27,6447	1,1625; 3,8360; 28,4123	2,2125; 7,4299; 56,0570	-0,1124; -0,2421; -0,7676	18,2823	-0,3411	Effect
9.	**C5**	1,1274; 3,7669;28,3067	1,0835; 3,6326; 27,6156	2,2110; 7,3995; 55,9223	0,0439; 0,1343; 0,6911	18,2330	0,2509	**Cause**
4.	**C6**	1,1596; 3,8375; 28,3779	1,1157; 3,7199; 27,9403	2,2752; 7,5574; 56,3182	0,0439; 0,1176; 0,4375	18,4271	0,1792	**Cause**
14.	**C7**	1,0046; 3,4805; 27,2060	1,0297; 3,5095; 27,1872	2,0343; 6,9900; 54,3932	-0,0251; -0,0290; 0,0188	17,6019	-0,0161	Effect
6.	**C8**	1,0618; 3,5844; 27,5904	1,1390; 3,7978; 28,8411	2,2008; 7,3822; 56,4315	-0,0772; -0,2134; -1,2507	18,3492	-0,4387	Effect
2.	**C9**	1,1659;3,8477; 28,9665	1,1465; 3,8051; 28,5188	2,3124; 7,6528; 57,4853	0,0194; 0,0426; 0,4478	18,7758	0,1381	**Cause**
13.	**C10**	1,1057; 3,7115; 28,1776	0,9736; 3,3822; 26,5505	2,0794; 7,0937; 54,7281	0,1321; 0,3294; 1,6272	17,7487	0,6045	**Cause**
15.	**C11**	0,9821; 3,4057; 26,8929	0,9115; 3,2497; 26,2356	1,8936; 6,6554; 53,1284	0,0705; 0,1560; 0,6573	17,0832	0,2599	**Cause**
5.	**C12**	1,1167; 3,7189; 28,1833	1,1081; 3,7154; 28,3735	2,2248; 7,4343; 56,5568	0,0086; 0,0034; -0,1903	18,4125	-0,0437	Effect
12.	**C13**	1,0525; 3,5818; 27,3782	1,1330; 3,7534; 27,9606	2,1856; 7,3352; 55,3388	-0,0805; -0,1717; -0,5825	18,0487	-0,2516	Effect
8.	**C14**	1,0601; 3,5766; 27,5403	1,0932; 3,6979; 28,7347	2,1533; 7,2745; 56,2751	-0,0331; -0,1214; -1,1944	18,2443	-0,3676	Effect
11.	**C15**	1,1084; 3,6871; 27,7466	1,1261; 3,7257; 27,9051	2,2345; 7,4128; 55,6518	-0,0177; -0,0385; -0,1585	18,1780	-0,0633	Effect

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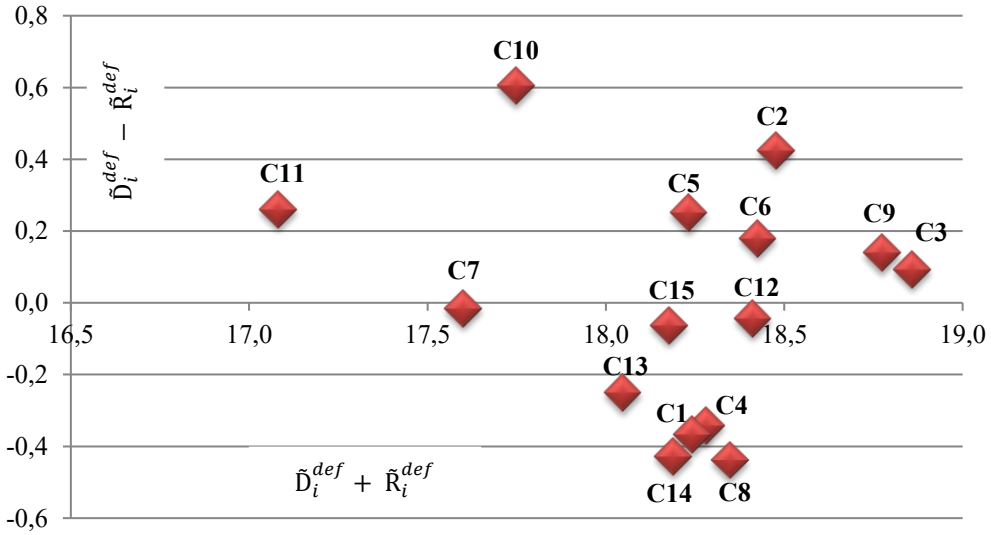
In the relationship level ranking determined according to the $D_i^{def} + R_i^{def}$ values specified in Table 7, the *C3 (Leadership and Support of Top Management)* criterion is the factor with the highest relationship level with other criteria, while the *C11 (Quality Management Activities of Suppliers)* criterion is the factor with the lowest relationship level.

Based on the cause-and-effect diagram shown in Figure 2, the values of $D_i^{def} - R_i^{def}$ include negative valueed citeria: *C1 (Establishment of Quality Targets and Policies), C4 (Effectiveness of the Quality Department), C7 (Use of Measurement Systems in Quality Improvement), C8 (Empowerment of Employees), C12 (Customer Focus and Satisfaction), C13 (Employee Participation), C14 (Reward Programs for Employee Incentive) and C15 (Organizational Culture) criteria are affected, and the positive values of C2 (Education and Training Activities), C3 (Leadership and Support of Top Management), C5 (Teamwork), C6 (Strategic Planning and Management of Quality), C9 (Establishment of a Continuous Improvement System), C10 (Quality Management Systems (ISO 9001)) and C11 (Quality Management Activities of Suppliers)* which are identified in impact group.

Figure 2. The Cause-Effect Relationship Diagram



5. Conclusions

The difficulties experienced by SMEs in adopting and implementing TQM constituted the driving force of this study. For this reason, the fuzzy DEMATEL method was used to rank the critical success factors effective in TQM practices in SMEs and to determine the cause-effect relationships between these factors.

According to the results obtained from the study, “Leadership and Support of Top Management” is the criterion with the highest level of relationship with other

criteria. This situation shows how important the support of top management is in preparing the institution for TQM practices and in effectively maintaining all other criteria. “Leadership and Support of Top Management” is followed by “Establishment of Continuous Improvement System” and “Education and Training Activities”. Therefore, it is seen that managers should focus more on these criteria. The factor with the lowest level of relationship with other factors was determined as “Quality Management Activities of Suppliers”.

In terms of the level of impact, “Quality management systems (ISO 9001)” is the criterion with the highest importance over other criteria. Then, “Education and training activities”, “Quality management activities of suppliers”, "Teamwork”, “Strategic planning and management of quality ”, "Establishment of a continuous improvement system" and “Leadership and support of top management” come in order. The factor most affected by these criteria is “Establishment of quality targets and policies”. Quality policies, which form a framework for establishing and reviewing quality objectives, are a guide that includes the vision, mission and core values of the organization. Top management has an important responsibility in determining these policies. Since quality is the responsibility of all other employees as well as top management within the scope of TQM practices, training and education activities should cover all employees in the organization. Trained employees will be able to make a conscious contribution to the determination of the organization’s goals and policies. In addition, the effectiveness of quality management systems that clearly state what is expected from employees will make a positive contribution to this process.

The first limitation of this study is that it was conducted on empirical data obtained from interviews with managers responsible for quality management of 20 different SMEs operating in Turkey. Therefore, the findings obtained from the study cannot be generalized in terms of effective elements in TQM applications in businesses of different countries and sizes. The second limitation of the study is that it was conducted on a sample of 20 SMEs without any sectoral distinction. The third limitation of this study is that only one multi-criteria decision-making method was used. In order to compare the results, other multi-criteria decision-making methods can be used together with the fuzzy DEMATEL method. In addition, the subjective evaluations of the experts whose opinions were consulted within the scope of the study may also affect the results of the study. In future studies, all these issues can be taken into consideration and the effective factors in the success of TQM applications can be evaluated. In addition, to account for sectoral differences, longitudinal studies can be conducted to evaluate how the CSFs influencing the implementation of TQM practices in SMEs change over time.

REFERENCES

Albayrak, Ö. and Erkayman, B. (2018). Bulanık DEMATEL ve EDAS Yöntemleri Kullanılarak Sporcular İçin Akıllı Bileklik Seçimi. *Ergonomi, 1*(1), 92-102.

Altuntaş, S., Selim, H. and Dereli, T. (2014). A Fuzzy DEMATEL-Based Solution Approach for Facility Layout Problem: A Case Study. *The International Journal of Advanced Manufacturing Technology, 73,* 749-771. https://link.springer.com/article/10.1007/s00170-014-5826-3

Aquilani, B., Silvestri, C., Ruggieri, A. and Gatti, C. (2017). A Systematic Literature Review on Total Quality Management Critical Success Factors and the Identification of New Avenues of Research. *The TQM Journal, 29*(1), 184-213. https://doi.org/10.1108/TQM-01-2016-0003

Arany, L. and Popovics, P. A. (2022). Characteristic Differences of an SME Leader and a Large Company Leader. *SEA- Practical Application of Science, 10*(29), 91-96.

Black, S. A. and Porter, L. J. (1996). Identification of the Critical Factors of TQM. *Decision Sciences, 27*(1), 1-21. https://doi.org/10.1111/j.1540-5915.1996.tb00841.x

Chang, B., Chang, C. W. and Wu, C. H. (2011). Fuzzy DEMATEL Method for Developing Supplier Selection Criteria. *Expert Systems with Applications, 38*(3), 1850-1858. https://doi.org/10.1016/j.eswa.2010.07.114

Chin, K. S., Pun, K. F., Xu, Y. and Chan, J. S. F. (2002). An AHP Based Study of Critical Factors for TQM Implementation in Shanghai Manufacturing Industries. *Technovation, 22*(11), 707-715. https://doi.org/10.1016/S0166-4972(01)00065-7

Çelik, M. T. and Arslankaya, S. (2023). Analysis of Quality Control Criteria in an Business with the Fuzzy DEMATEL Method: Glass Business Example. *Journal of Engineering Research, 11*(2), 100039. https://doi.org/10.1016/j.jer.2023.100039

Dalay, M. and Sarı, K. (2022). Tedarikçi Seçiminde Yeşil Kriterin Öneminin Araştırılması: Türk Gıda Sektörü Örneği. *Endüstri Mühendisliği, 33*(3), 500-513. https://doi.org/10.46465/endustrimuhendisligi.1152540

Dilber, M., Bayyurt, N., Zaim, S. and Tarım, M. (2005). Critical Factors of Total Quality Management and its Effect on Performance in Health Care Industry: A Turkish Experience. *Problems and Perspectives in Management, 4*(1), 220-234.

Dinçer, F. C. Y., Yirmibeşoğlu, G. and Alpar, M. Ö. (2022). Lisansüstü Eğitimde Lojistik Alan Seçiminin Bulanık DEMATEL Yöntemi ile Değerlendirilmesi. *Mehmet Akif Ersoy Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 9*(3), 1653-1676. https://doi.org/10.30798/makuiibf.979672

Efil, İ. (2016). *Toplam Kalite Yönetimi.* Bursa: Dora Basım-Yayın Dağıtım.

Ekşili, N., Ünal, Z. and Çetin, E. I. (2017). Beş Yıldızlı Otel İşletmelerinde Kriz Dönemlerinde Uygulanan Tasarruf Stratejilerinin Bulanık DEMATEL Yöntemiyle İncelenmesi. *Business & Economics Research Journal, 8*(2), 259-273.

Feng, C. and Ma, R. (2020). Identification of the Factors that Influence Service Innovation in Manufacturing Enterprises by Using the Fuzzy DEMATEL Method. *Journal of Cleaner Production, 253,* 120002. https://doi.org/10.1016/j.jclepro.2020.120002

Ghobadian, A. and Gallear, D. N. (1996). Total Quality Management in SMEs. *Omega, 24*(1), 83-106. https://doi.org/10.1016/0305-0483(95)00055-0

Goyal, S., Routroy, S. and Singhal, A. (2019). Analyzing Environment Sustainability Enablers Using Fuzzy DEMATEL for an Indian Steel Manufacturing Company. *Journal of Engineering, Design and Technology, 17*(2), 300-329. https://doi.org/10.1108/JEDT-02-2018-0033

Halim, F. A., Azman, A. and Malim, M. R. (2019). Prioritising Critical Success Factors of TQM in Malaysia Aerospace Industry Using Fuzzy AHP. *In Journal of Physics: Conference Series, IOP Publishing, 1366*(1), 012108. https://iopscience.iop.org/article/10.1088/1742-6596/1366/1/012108

Hossain, M. I., Al Amin, M., Baldacci, R. and Rahman, M. H. (2023). Identification and Prioritization of Green Lean Supply Chain Management Factors Using Fuzzy DEMATEL. *Sustainability, 15*(13), 10523. https://doi.org/10.3390/su151310523

Jalali, M., Feng, B. and Feng, J. (2022). An Analysis of Barriers to Sustainable Supply Chain Management Implementation: The Fuzzy DEMATEL Approach. *Sustainability, 14*(20), 13622. https://doi.org/10.3390/su142013622

Jamali, G., Ebrahimi, M. and Abbaszadeh, M. A. (2010). TQM Implementation: An Investigation of Critical Success Factors. *In 2010 International Conference on Education and Management Technology, IEEE (*pp. 112-116).

Jiang, L., Zhang, T., and Feng, Y. (2020). Identifying the Critical Factors of Sustainable Manufacturing Using the Fuzzy DEMATEL Method. *Applied Mathematics and Nonlinear Sciences, 5*(2), 391-404. https://doi.org/10.2478/amns.2020.2.00045

Joseph, I. N., Rajendran, C. and Kamalanabhan, T. J. (1999). An Instrument for Measuring Total Quality Management Implementation in Manufacturing Based Business Units in India. *International Journal of Production Research, 37*(10), 2201-2215. https://doi.org/10.1080/002075499190725

Ghadami, L., Masoudi Asl, I., Hessam, S. and Modiri, M. (2021). Developing Hospital Accreditation Standards: Applying Fuzzy DEMATEL. *International Journal of Healthcare Management, 14*(3), 847-855. https://doi.org/10.1080/20479700.2019.1702307

Gupta, H., Prakash, C., Vishwakarma, V. and Barua, M. K. (2017). Evaluating TQM Adoption Success Factors to Improve Indian Msmes Performance Using Fuzzy DEMATEL Approach. *International Journal of Productivity and Quality Management, 21*(2), 187-202. https://doi.org/10.1504/IJPQM.2017.083770

Irfan, S. M. and Kee, D. M. H. (2013). Critical Success Factors of TQM and its Impact on Increased Service Quality: A Case from Service Sector of Pakistan. *Middle-East Journal of Scientific Research, 15*(1), 61-74.

Iyer, A., Saranga, H. and Seshadri, S. (2013). Effect of Quality Management Systems and Total Quality Management on Productivity Before and After: Empirical Evidence from the Indian Auto Component Industry. *Production and Operations Management, 22*(2), 283-301. https://doi.org/10.1111/poms.12000

Khanna, H. K., Sharma, D. D. and Laroiya, S. C. (2011). Identifying and Ranking Critical Success Factors for Implementation of Total Quality Management in the Indian Manufacturing Industry Using TOPSIS. *Asian Journal on Quality, 12*(1), 124-138. https://doi.org/10.1108/15982681111140598

Kaur, P. and Sharma, S. K. (2014). Evaluating the Relationship and Influence of Critical Success Factors of TQM on Business Performance: Evidence from SMEs of Manufacturing Sector. *IUP Journal of Operations Management, 13*(4), 17-30.

Kuzu, A. C. (2023). Application of Fuzzy DEMATEL Approach in Maritime Transportation: A Risk Analysis of Anchor Loss. *Ocean Engineering, 273,* 113786. https://doi.org/10.1016/j.oceaneng.2023.113786

Lin, C. J. and Wu, W. W. (2008). A Causal Analytical Method for Group Decision Making Under Fuzzy Environment. *Expert Systems with Applications, 34*(1), 205-213. https://doi.org/10.1016/j.eswa.2006.08.012

Manhas, V. K., Gupta, P. and Gupta, H. (2015). Developing and Validating Critical Success Factors of TQM Implementation in Msmes of Punjab in India. *International Journal of Indian Culture and Business Management, 11*(4), 405-421. https://doi.org/10.1504/IJICBM.2015.072423

Mehralian, G., Nazari, J. A., Rasekh, H. R. and Hosseini, S. (2016). TOPSIS Approach to Prioritize Critical Success Factors of TQM: Evidence from the Pharmaceutical Industry. *The TQM Journal, 28*(2), 235-249. https://doi.org/10.1108/TQM-03-2014-0028

Mendes, L. A. F. (2002). Quality and the Relationship SME/Suppliers: The Experiences of two Portuguese SME. *International Council for Small Business 47th World Conference San Juan, Puerto Rico* (pp. 1-16).

Merdivenci, F. and Karakaş, H. (2020). Analysis of Factors Affecting Health Tourism Performance Using Fuzzy DEMATEL Method. *Advances in Hospitality and Tourism Research (AHTR), 8*(2), 371-392.

Mohammad Mosadegh Rad, A. (2006). The Impact of Organizational Culture on the Successful Implementation of Total Quality Management. *The TQM Magazine, 18*(6), 606-625. https://doi.org/10.1108/09544780610707101

Mohapatra, I. and Sundaray, B. K. (2018). Impact of Employee Empowerment on Employee Performance. *In International Journal of Advanced Technology and Engineering Research, National Conference on Recent Trends in Science, Technology and Management* (pp. 98-102).

Naktiyok, A. and Küçük, O. (2003). Küçük ve Orta Büyüklükteki İşletmelerde (KOBİ) Toplam Kalite Yönetimi (TKY) Kritik Faktörlerinin Örgütsel Performans Üzerine Etkileri. *Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 21,* 43-65.

Ömürgönülşen, M., Çekiç, B. and Ar, İ. (2020). Lojistik Firmalarında Endüstri 4.0 Uyum Sürecinde Dikkate Alınacak Faktörlerin Bulanık DEMATEL Yöntemi ile Değerlendirilmesi. *Uluslararası İktisadi ve İdari İncelemeler*

Dergisi. Prof. Dr. Talha Ustasüleyman Özel Sayısı, 167-184. https://doi.org/10.18092/ulikidince.581659

Parmar, P. S. and Desai, T. N. (2020). Evaluating Sustainable Lean Six Sigma enablers Using Fuzzy DEMATEL: A Case of an Indian Manufacturing Organization. *Journal of Cleaner Production, 265,* 121802. https://doi.org/10.1016/j.jclepro.2020.121802

Prajogo, D. I. and McDermott, C. M. (2005). The Relationship between Total Quality Management Practices and Organizational Culture. *International Journal of Operations & Production Management, 25*(11), 1101-1122. https://doi.org/10.1108/01443570510626916

Polat, Ç. and Merdivenci, F. (2022). Dış Ticaret Firmalarının Liman Seçim Kriterleri Üzerine Bulanık Dematel Yaklaşımı: Antalya Vaka Çalışması. *Dokuz Eylül Üniversitesi Denizcilik Fakültesi Dergisi, 14*(1), 122-150. https://doi.org/10.18613/deudfd.813822

Ponnambalam, S. G., Sankaranarayanan, B., Karuppiah, K., Thinakaran, S., Chandravelu, P. and Lam, H. L. (2023). Analysing the Barriers Involved in Recycling the Textile Waste in India Using Fuzzy DEMATEL. *Sustainability, 15*(11), 8864. https://doi.org/10.3390/su15118864

Potdar, P. K., Routroy, S. and Behera, A. (2017). Analyzing the Agile Manufacturing Barriers Using Fuzzy DEMATEL. *Benchmarking: An International Journal, 24*(7), 1912-1936.

Quazi, H. A. and Padibjo, S. R. (1998). A Journey Toward Total Quality Management through ISO 9000 Certification-A Study on Small- and Medium-Sized Enterprises in Singapore, International Journal of Quality & Reliability Management, *MCB University Press, 15*(5), 489-508.

Rahman, M. S. (2018). Determining the Critical Success Factors of Total Quality Management (TQM) for Sustainable Social Development. *UITS Journal of Humanities and Social Sciences, 6*(1), 65-80.

Raval, S. J., Kant, R. and Shankar, R. (2021). Analyzing the Critical Success Factors Influencing Lean Six Sigma Implementation: Fuzzy DEMATEL Approach. *Journal of Modelling in Management, 16*(2), 728-764. https://doi.org/10.1108/JM2-07-2019-0155

Rezazadeh, A., Najafi, S., Hatami-Shirkouhi, L. and Miri-Nargesi, S. (2012). Evaluating and Prioritising Critical Success Factors of TQM Implementation Based on Fuzzy AHP. *International Journal of Productivity and Quality Management, 9*(1), 1-24. https://doi.org/10.1504/IJPQM.2012.044009

Samal, A., Tripathy, S. and Aich, S. (2014). Study of Critical Success Factors of TQM in Indian Small and Medium Scale. *Enterprises International Journal of Research in Mechanical Engineering and Technology, 4*(2), 12-22.

Saraph, J. V, Benson, P. G. and Schroeder, R. G. (1989). An Instrument for Measuring the Critical Factors of Quality Management. *Decision Sciences, 20*(4), 810-829. https://doi.org/10.1111/j.1540-5915.1989.tb01421.x

Savaş, H. and Yacan, İ. (2022).Özel Hastaneler İçin Toplam Kalite Yönetimi Uygulamalarında Kritik Başarı Faktörlerinin Bulanık FUCOM Yöntemi ile

Değerlendirilmesi. *Pamukkale Üniversitesi İşletme Araştırmaları Dergisi, 9*(2), 278-294. https://doi.org/10.47097/piar.1126643

Seker, S. and Zavadskas, E. K. (2017). Application of Fuzzy DEMATEL Method for Analyzing Occupational Risks on Construction Sites. *Sustainability, 9*(11), 2083. https://doi.org/10.3390/su9112083

Sila, I. and Ebrahimpour, M. (2003). Examination and Comparison of the Critical Factors of Total Quality Management (TQM) Across Countries. *International Journal of Production Research, 41*(2), 235-268. https://doi.org/10.1080/0020754021000022212

Sin, K. Y. and Sin, M. C. (2019). Applying Multi-Criteria Decision Making Technique in Hospitality Quality Management System. *International Journal of Academic Research in Business and Social Sciences, 9*(11), 1-9. http://dx.doi.org/10.6007/IJARBSS/v9-i11/6511

Singh, M., Rathi, R., Jaiswal, A., Manishbhai, S. D., Gupta, S. S. and Dewangan, A. (2023). Empirical Analysis of Lean Six Sigma Implementation Barriers in Healthcare Sector Using Fuzzy DEMATEL Approach: An Indian Perspective. *The TQM Journal, 35*(8), 2367-2386. https://doi.org/10.1108/TQM-05-2022-0152

Singh, R. (2011). Analyzing the Interaction of Factors for Success of Total Quality Management in Smes. *Asian Journal on Quality, 12*(1), 6-19. https://doi.org/10.1108/15982681111140516

Thavi, R. R., Narwane, V. S., Jhaveri, R. H. and Raut, R. D. (2022). To Determine the Critical Factors for the Adoption of Cloud Computing in the Educational Sector in Developing Countries-A Fuzzy DEMATEL Approach. *Kybernetes, 51*(11), 3340-3365. https://doi.org/10.1108/K-12-2020-0864

Trang, T. V. and Do, Q. H. (2020). Critical Success Factors of TQM Implementation in Vietnamese Supporting Industries. *The Journal of Asian Finance, Economics and Business, 7*(7), 391-401.

Wali, A. A., Deshmukh, S. G. and Gupta, A. D. (2003). Critical Success Factors of TQM: A Select Study of Indian Organizations. *Production Planning & Control, 14*(1), 3-14. https://doi.org/10.1080/0953728021000034781

Wassan, A. N., Memon, M. S., Mari, S. I. and Kalwar, M. A. (2023). Identifying the Critical Success Factors of Total Quality Management Implementation in Manufacturing Industry of Pakistan: An Exploratory Factor Analysis. *Journal of Applied Research in Technology & Engineering, 4*(1), 37-53. https://doi.org/10.4995/jarte.2023.17969

Wu, W. W. and Lee, Y. T. (2007). Developing Global Managers' Competencies Using the Fuzzy DEMATEL Method. *Expert Systems with Applications, 32*(2), 499-507. https://doi.org/10.1016/j.eswa.2005.12.005

Wu, W. W. (2012). Segmenting Critical Factors for Successful Knowledge Management Implementation Using the Fuzzy DEMATEL Method. *Applied Soft Computing, 12*(1), 527-535. https://doi.org/10.1016/j.asoc.2011.08.008

Yadav, R. P., Kumar, J. and Gupta, J. P. (2016). Analysis of Critical Success Factor (CSFs) in TQM Implementation. *International Journal of Current Research in Multidisciplinary (IJCRM), 2*(9), 7-13.

Yeo, S. F., Tan, C. L., Tseng, M. L., Tam, S. and San, W. K. (2022). Factors Influencing Organic Food Purchase Decision: Fuzzy DEMATEL Approach. *British Food Journal, 124*(12), 4567-4591. https://doi.org/10.1108/BFJ-05-2021-0509

Yusof, S. R. M. and Aspinwall, E. M. (2000). Critical Success Factors in Small and Medium Enterprises: Survey Results. *Total Quality Management, 11*(4-6), 448-462. https://doi.org/10.1080/09544120050007760

Zhong, Q., Tang, H. and Zhou, W. (2023). Analyzing the Influence Factors of the Post-Earthquake Reconstruction Project Using Fuzzy DEMATEL. *Journal of Asian Architecture and Building Engineering,* 1-13. https://doi.org/10.1080/13467581.2023.2257265

Zhou, Q., Huang, W. and Zhang, Y. (2011). Identifying Critical Success Factors in Emergency Management Using a Fuzzy DEMATEL Method. *Safety Science, 49*(2), 243-252. https://doi.org/10.1016/j.ssci.2010.08.005

https://data.tuik.gov.tr/Bulten/Index?p=Kucuk-ve-Orta-Buyuklukteki-Girisim-Istatistikleri-2023-53543 (Access Date: 01.05.2025).