APPLICATION OF FUZZY AHP AND TOPSIS METHODS FOR MANAGER SELECTION

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Abstract- *The purpose of this study is to identify the criteria that are important for company owners operating in textile industry when selecting a manager. In order to determine these criteria, Multi-Criteria Decision Making (MCDM) techniques are uesd. In today's global and competitive market conditions, the selection of managers for company owners is a multivariate decision-making problem involving multiple criteria. In line with the purpose of the study, firstly, the criteria used in the selection of the managers were determined with a literature review. Four main criteria were determined by interviewing experts based on the determinant criteria. These criteria are determined as work experience, management skills, professional competence, and trust. These four criteria determined within the scope of the research were assessed by the company owners using linguistic variables. The weight of each criterion was determined by using the Fuzzy Analytical Hierarchy Process (FAHP) technique based on pairwise comparisons by means of linguistic variables. According to the results, it was determined that the most important criterion for manager selection in the textile industry is work experience. Then it was determined that trust, management skills, and professional competence came respectively. In the final stage of the implementation, a case study was performed using the fuzzy TOPSIS method and a sensitivity analysis and comparative comparison to check the robustness of the results. In order to test the validity of the proposed method, the decision problem is also analyzed with fuzzy EDAS and fuzzy SAW approaches. As a result, it has been determined that each method's ranking result is similar and offers realistic solutions. From this perspective, the study presents a new model proposal to the literature as it uses the fuzzy EDAS and fuzzy SAW methods as well as the integrated fuzzy AHP and fuzzy TOPSIS methods in the selection of professional managers in textile industry. With the help of expert opinions in the textile sector, the study has shown that the selection of manager process can be easily solved with MCDM techniques and that the fuzzy TOPSIS method generates logical and reliable results*

Keywords – *Manager Selection, Agency Theory, Textile Sector, FAHP, MCDM.*

BULANIK AHP VE TOPSIS YÖNTEMLERİNİN YÖNETİCİ SEÇİM PROBLEMİNE UYGULANMASI

Öz– *Bu çalışmanın amacı, tekstil sektöründe faaliyet gösteren firma sahiplerinin Çok Kriterli Karar Verme (MCDM) tekniklerini kullanarak yönetici seçiminde dikkate aldıkları kriterleri belirlemektir. Günümüzün küresel ve rekabetçi piyasa koşullarında şirket sahipleri için yönetici seçimi birden çok kriteri içeren çok değişkenli bir karar verme problemidir. Çalışmanın amacı doğrultusunda ilk olarak yönetici seçiminde kullanılan kriterler literatür taraması ile belirlenmiştir. Belirleyici kriterler esas alınarak uzmanlarla görüşülerek dört ana kriter belirlenmiştir. Bu kriterler iş deneyimi, yönetim becerileri, mesleki yeterlilik ve güven olarak belirlenmiştir. Araştırma kapsamında belirlenen bu dört kriter firma sahipleri tarafından dilsel değişkenler kullanılarak değerlendirilmiştir. Her bir kriterin ağırlığı, dilsel değişkenler aracılığıyla ikili karşılaştırma temelinde Bulanık Analitik Hiyerarşi Süreci (FAHP) tekniği kullanılarak belirlenmiştir. Elde edilen sonuçlara göre tekstil sektöründe yönetici seçimi için en önemli kriterin iş tecrübesi olduğu belirlenmiştir. Daha sonra sırasıyla güven, yönetim becerileri ve mesleki yeterliliğin geldiği tespit edilmiştir. Uygulamanın son aşamasında, bulanık TOPSIS yöntemi kullanılarak bir vaka çalışması ve sonuçların sağlamlığını kontrol etmek için duyarlılık analizi ve karşılaştırmalı analiz gerçekleştirilmiştir. Yöntem sonuçlarının geçerliğini ortaya koymak amacıyla karar problemi bulanık EDAS ve bulanık SAW yaklaşımları ile de analiz edilmiştir. Sonuçta, her bir yöntem sıralama sonucunun benzerlik gösterdiği ve gerçeğe uygun çözümler sunduğu tespit edilmiştir. Bu bakımdan çalışma, tekstil sektöründe profesyonel yönetici seçiminde bulanık EDAS ve bulanık SAW yöntemlerinin yanı sıra bütünleşik bulanık AHP ve TOPSIS yöntemlerini kullandığı için literatüre yeni bir model önerisi sunmaktadır. Tekstil sektöründe uzman görüşlerinin de yardımıyla yapılan çalışma, yönetici seçim sürecinin MCDM teknikleri ile kolaylıkla çözülebildiğini ve bulanık TOPSIS yönteminin mantıklı ve güvenilir sonuçlar ürettiğini göstermiştir.*

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1. INTRODUCTION

With globalization, businesses operate in an environment of change. Businesses that cannot keep up with the change and competition may face the risk of failure both financially (Kaygın et al., 2016: 148) and managerial aspects. This successful change can only be achieved through management styles and managers of family businesses in Turkey. Family businesses have a great impact on the Turkish economy. Considering the latest data, while 80% of registered businesses in the world are family businesses; in Turkey, it increases up to 95% in Turkey. (Kırtaş, 2018: 70). As a natural consequence of this situation, the managers of the companies consist of family members who are the owners or the partners of the company. (Yazıcıoğlu & Koç, 2009; Taş & Çavuş, 2010). Besides, businesses make capital investments in different regions in order to increase their profitibility. This situation brings along the need for professional managers that family businesses need. There are many reasons for this situation. Firstly, today's companies are getting more and more complex and they are growing. This situation requires company owners to have knowledge in every field, especially in the managerial field. However, with the congruence. of all functions, company owners now must appoint managers with these knowledge, skills, and abilities to the head of their organizations (Meydan & Çetin, 2015:157). Secondly, in family businesses, new generation managers have important responsibilities. These managers can bring an innovative and creative approach to companies with a different point of view, ensure the institutionalization of companies, and make good planning by using resources effectively and efficiently. In this respect, company owners may need professional managers who are researchers, experts in their fields and solution-oriented. Finally, due to the government incentives and investment supports provided to encourage development at the regional level applied in Turkey, company owners can move their investments outside the region where their businesses started their commercial activities. Although this obligation seems to be an effective This situation confronts the process of selecting professional managers who are in the position of agent of the company owners who are in the principal position within the framework of certain criteria. solution method, it brings about differentiation and problems between company owners and professional managers. Company owners sign up behavioural or output-oriented business contracts with their managers. These contracts can bring various moral risks and poor choice issues. Agency theory, as a regulatory mechanism between company owners and managers, offers mutual solutions by considering these problems.

Based on all these explanations, in today's competitive sector conditions, company owners may face the problem of selecting professional managers for their companies according to certain criteria. At this point, the purpose of the research is to determine which criteria the business owners give more weight in the selection of managers working in the textile sector. There are many reasons for research on the textile industry. Professional managers are employed in many different sectors in the globalizing economy conditions. Textile sector, which is our research subject, is one of them. The textile and garment industry is a sector of strategic importance for Turkey. As of 2019, the sector is the 7th largest garment exporter in the world with a share of 3.3%. According to data from the Social Security Administration in 2020 in Turkey manufacturing clothing, textiles, and leather, the number of firms operating in the sector is around 58,000. Approximately 1,100,000 registered people are employed in these companies (Ministry of Trade, 2020). Also, many companies operating in the sector choose the path of growth by making investments in line with government incentives and credit opportunities (Özbek, 2017). In this context, stated factors show that there are many company owners and managers in the sector who are in certain election processes.

Firstly, in the study, a literature review was carried out to identify the criteria used in the selection of managers (Taş & Çavuş, 2010; Ünal, 2011; Uçkun et al., 2013; Yıldız & Deveci, 2013; Özbek, 2014; İbicioğlu & Ünal, 2014; Dodangeh et al., 2014; Afshari, 2015). As a result of the literature review, interviews were made with the company owners to determine the most appropriate criteria for the sector characteristics. As a result of these interviews, 4 main criteria were determined. These criteria are determined as work experience, professional competence, trust, and management skills. The importance of the determining criteria in manager selection will be determined by using multi-criteria decision-making techniques. Selection criteria will be ranked according to the determined weights. Based on the findings, various suggestions will be made to manager candidates operating in the textile industry.

In case study section, the problem of manager selection is discussed with the help of the fuzzy TOPSIS method. In first step, five manager alternatives were evaluated by firm owners. After that, using the manager score matrix fuzzy TOPSIS phase was initiated to rank the alternatives. As a result of fuzzy TOPSIS procedure, it was found that M5 is the best alternative. To validate fuzzy TOPSIS ranking results, sensitivity analysis was performed. Test results showed that for the manager selection problem, fuzzy TOPSIS methodology can produce rational, reliable and robust outputs.

2. LITERATURE REVIEW

As a result of the literature review, it is seen that the research focuses on personnel selection in very different sectors and sample groups. As an example of this situation, it was determined that multiple decision-making techniques were used in different samples (Eroğlu et al., 2014; Doğan & Önder, 2014; Şimşek et al., 2014; Akın, 2016). Compared to personnel selection, there is a limited number of manager selection

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studies using multiple decision-making techniques. It has been determined that the studies on manager selection in the literature are mostly project manager/leader selection (Xing & Zhang, 2006; Zavadskas et al., 2008; Torfi & Rashidi, 2011; Chen & Hung, 2012; Hadad et al., 2013; Dodangeh et al., 2014; Afshari, 2015). Apart from the project manager, it has been determined that criteria weighting, and selection of managers are made on human resources manager, non-governmental organization manager, finance manager, academic unit manager, quality control manager, and site manager in the literature. The authors of the determined studies, the year of the study, the sample, and the selection criteria are presented in Table 1.

Table 1: Manager Selection Criteria in Different Studies

Researcher(s)	Sample	Criteria
Hauschildt et al. (2000)	Project Manager	**Organizing Under Conflict, Experience, Decision-Making, Productive Creativity, Organizing with Cooperation, Cooperative Leadership, Integrative Thinking**
Dainty et al. (2005)	Construction Managers	**Achievement Orientation, Initiative, Information Seeking, Focus on Client's Needs, Impact, and Influence, Directiveness, Teamwork and Cooperation, Team leadership, Analytical thinking, Conceptual thinking, Self-control, Flexibility**
Kelemenis et al. (2011)	Managers selection	**Creativity/Innovation, Problem Solving/Decision Making, Conflict Management/Negotiation, Empowerment/Delegation, Strategic Planning, Specific Presentation Skills, Communication Skill, Team Management, Diversity Management, Self-Management, Professional Experience, Educational Background**
Zolfani et al. (2012)	Quality Control Manager	**Knowledge of Product and Raw Material, Experience and Educational Background, Administrative Orientation, Behavioural Flexibility, Risk Evaluation Ability, Payment, Teamwork**
Dodangeh et al. (2014)	Project Manager	**Basic Requirements**: Experience, Education, Communication Skills, Computer Skills **Project Management Skills**: Time Management, Cost Management, Resource Management, Quality Management **Management Skills**: Planning, Organizing, Controlling **Interpersonal Skills**: Problem Solving, Decision Making, Team Development
İbicioğlu & Ünal (2014)	Human Resource Manager	**Institutional Criteria**: Corporate Culture, Representation Direction, Career Goal, Openness to Learning, Determination to Succeed, Reliability **Demographic Criteria:** Experience, Education Degree, Firm Scale, Stability, Foreign Language **Professional Criteria**: HR Knowledge, Legal Knowledge, Information Technology Knowledge **Communication Criteria**: The Ability of Expression and Persuasion, Active Listening, Empathy Ability, Being Social **Management Criteria**:

Researcher(s)	Sample	Criteria
		Subordinates Development, Planning, Organizing, Controlling **Mental Criteria**: Sceptical Thinking, Analytical Thinking, Synthesist Thinking, Social Thinking **Personality Criteria**: Self-confidence, Stress Resistance, Interest and Enthusiasm, Openness to Criticism, Cooperation, Flexibility, Extroversion, Leadership
Özbek (2014)	Non-Governmental Organization Manager	**Honesty and Reliability, Education, General Culture, Volunteering, Sense of Mission, Initiative and Decision Making, Responsibility, Social and Human Relations, Verbal and Written Expression Ability, Team Awareness, Objectivity and Well Adjusted**
Afshari (2015)	Project Manager	**Basic Requirements**: Experience, Education, Communication Skills, Computer Skills **Project Management Skills**: Time Management, Cost Management, Resource Management, Quality Management **Management Skills**: Planning, Organizing, Controlling **Interpersonal Skills**: Problem Solving, Decision Making, Team Development
Özbek (2015)	Academic Unit Manager	**Self-Confidence, Reliability, Objectiveness, Honesty, Personality, Volunteering, Analytical Thinking Ability, Risk Management, Vision, Task Awareness, Team Awareness, Decision-Making Ability, Communication Knowledge, Understanding and Expressing Ability and Social Relations**
Afshari & Kowal (2015)	Information and Communication Technology Sector Project Manager	**Foreign Language, Computer Knowledge, Experience, Age, Gender, Labor Shift, Non−Smoker, Education**
Uğur (2017)	Contruction Project Manager	**School of Graduation, Active Engineering Period, Age, Number of Projects Completed, Foreign Language, Reference, Communication Ability, Fee Request**
Akça et al. (2018)	Finance Manager	**Personal Equipment:** Education, Experience, Communication Skills **Up to Date:** Website Monitoring, Legislation Follow-up, Periodic Publication Follow-up **Technical Feature Information:** Computer Interest, Financial Information System, Accounting Automation Program
Erdin (2019)	Site Manager	**Creativity, Self-Confidence, Problem Solving and Decision Making, Education, Critical Approach, Human Relations, Experience**

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3.DETERMINATION OF MANAGER SELECTION CRITERIA IN THE TEXTILE SECTOR

In the studies where multiple decision-making criteria are used, it has been determined that each sector has its own manager selection criteria. This situation reveals the fact that manager candidates should have different professional skills depending on the sectoral differences. Based on this determination face-to-face, interviews were held with company owners(specialist) in the textile sector. All company owners interviewed

employ unrelated professional managers (not family members) in their companies. Four main selection criteria were determined by making evaluations with the company owners. These criteria are management skills, professional competence, work experience, and trust. The determining criteria are presented under basic headings.

3.1. Management Skills

In its simplest definition, management, which is accepted as the art of getting others to do business, is considered the oldest of the arts and the newest of the sciences. Based on this definition, the manager is expected to be able to direct a certain group of people (employees) for a specific purpose (Sabuncuoğlu & Tokol, 2013: 168). And management has a dynamic and pluralistic structure. Functionally, the manager is expected to use planning, organization, leadership and control functions and business resources effectively and efficiently and achieve organizational goals (Eren, 2011). For effective management, the manager should clearly reveal the management functions in his organization and fulfil them. Managers try to reach organizational goals by directing their activities according to these functions. Although there is no definite consensus, management scientists state that management has 5 basic functions. These are planning, organising, commanding, coordinating, controlling (Ünsalan & Şimşekler: 2012: 125). The management process expected from managers in organizations is shown in Figure 1 in detail.
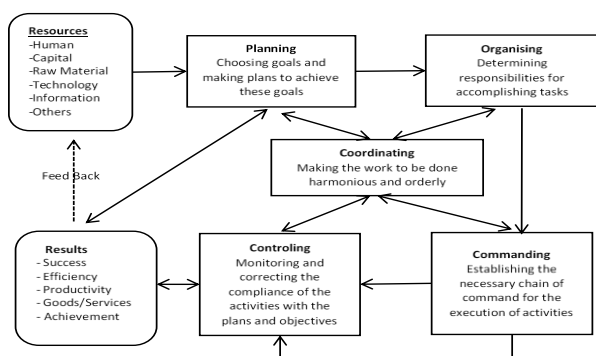

Figure 1: Management Process in Organizations
Source: Dinçer & Fidan, 1999:153

Apart from these factors, conceptual skills such as emotional and social intelligence level, communication skills, analytical thinking skills, logical thinking, problem-solving skills, and ability to analyse events can be evaluated within the scope of managerial skills.

3.2. Professional Competence

Professional competence are the knowledge of methods, processes, procedures, and techniques, tricks to carry out specialized activities, and the ability to use tools and materials related to this activity (Yukl, 2013). Top managers are not expected to have technical knowledge and skills as much as junior administrative officer and mid-level managers. However, the top manager should have basic knowledge about the work done for effective management. As managers move towards the upper level, their technical skill levels may decrease in proportion to human and conceptual skills (Eren, 2011: 13).

3.3. Work Experience

This criterion shows the experience of the manager candidate and the years of employment in the sector. It is predicted that the knowledge level of the manager, together with his work experience, improves depending on the duration of work. Also, the job history of the executive candidates means that they are compatible with the working environment in the sector and have the skills and methods required to improve their performance. In this way, thanks to the work experience, firm owners or stakeholders can review the work experiences of the manager candidate and determine the performance levels of the candidates in their jobs (Afshari, 2015).

3.4. Trust

Trust is defined as the psychological state of accepting that the intentions and behaviours of individuals in front of a person will be open and honest based on positive expectations (Rousseau et al., 1998: 395). The relationship between firm owners and managers can be taken with the agency theory approach. The agency theory consists of the mutual relations of principal and agent (Jensen & Meckling, 1976; Meydan & Çetin, 2015: 158). According to the theory, both the principal and the agent predict that they focus primarily on their own personal gain and that the agent will not always act in the interests of the noble. As an example of this situation, with the advantage of information asymmetry, the agent may exhibit opportunism, laziness, loafing, and behaviours that are not suitable for work ethics. In this respect, the trust to be determined between the principal and agent has been determined as an important manager selection criterion.

4. METHOD

Fuzzy Analytical Hierarchy Process is used to obtain relative weights of criterion. AHP is a highly useful and significant decision-making tool for presenting priorities between sets of criteria (Biswas, Akash , & Saha, 2018). The Analytic Hierarchy Process (AHP) proposed by Thomas L. Saaty (1971) is a Multi Criteria Decision Making (MCDM) technique applied under uncertain conditions or to overcome needed problems. By disparting the decision problem into sub sections that can each be interpreted separately and are more naturally understood, it reduces the risk of making

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wrong decisions and ensures the most appropriate decision. The research process is shown in Figure 2.
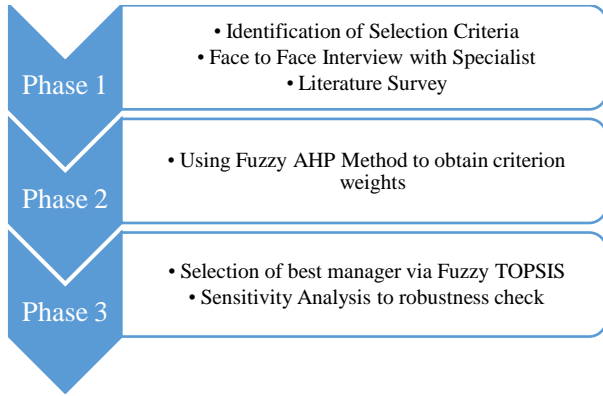

Figure 2: The Phases of Proposed Approach

First, ethics committe approval for this research was obtained from the Social and Human Sciences Research Ethics Committee of Tokat Gaziosmanpaşa University (Committee Decision Dated 05.02.2021 - No. 02.14). After that, in the study, the owners of five firms employing in the textile sector were contacted. Professionals assessed four basic variables designated with the help of the fuzzy scale. In the application section, the relative weights of the criterion were settled by the Fuzzy AHP technique. Fuzzy AHP method provides ease of modelling in uncertain and complex decision problems (Biswas, Akash , & Saha, 2018), (Torfi, Farahani, & Rezapour, 2010).

Table 2: Fuzzy Scale for Criterion

Statement	Fuzzy Numbers (FN)	Reverse FN
Equal Important	(1,1,1)	(1,1,1)
Little Important	(2,3,4)	(1/4,3,1/2)
Important	(4,5,6)	(1/6,1/5,1/4)
Very Important	(6,7,8)	(1/8,1/7,1/6)
AbsolutelyImportant	(8,9,9)	(1/9,1/9,1/8)

In this sub section fuzzy AHP methodology is presented briefly. The phases of the Chang's extent analysis as follows (Chang, 1996), (Kusumawardani & Agintiara, 2015),

- **Phase 1**: Fuzzy artificial value is computed according to i.

$$S_i = \sum_{j=1}^{m} M_{gi}^j \otimes \left[\sum_{i=1}^{n} \sum_{j=1}^{m} M_{gi}^j \right]^{-1}$$

For the matrix in the first part of the formula, the fuzzy summation of m extent solution is carried out.

$$\sum_{j=1}^{m} M_{gi}^j = \left(\sum_{j=1}^{m} l_j \sum_{j=1}^{m} m_j \sum_{j=1}^{m} u_j \right)$$

On the purpose of derive the second part of the formula, the reverse of the vector is computed by executing a fuzzy summation operation on the substituting for 'M' values.

$$\left[\sum_{i=1}^{n} \sum_{j=1}^{m} M_{gi}^j \right]^{-1} = \left(\frac{1}{\sum_{i=1}^{n} u_j}, \frac{1}{\sum_{i=1}^{n} m_j}, \frac{1}{\sum_{i=1}^{n} l_j} \right)$$

- **Step 2:** M_1 (l_1, m_1, u_1) and M_2 (l_2, m_2, u_2) is the triangular fuzzy numbers, $M_2 >= M_1$ probability value is calculated.

$$V(M_2 \geq M_1) = sup_{y \geq x} [min(\mu_{M_1}(x), \mu_{M_2}(y))]$$

$$V(M_2 \geq M_1) = hgt(M_1 \cap M_2) = \mu M_2(d)$$

$$V(M_2 \geq M_1) = \begin{cases} 1 & ; m_2 \geq m_1 \\ 0 & ; l_1 \geq u_2 \\ \frac{(l_1 - u_2)}{(m_2 - u_2) - (m_1 - l_1)} & ; in\ other\ cases \end{cases}$$

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- **Step 3:** The probability of a convex fuzzy number is bigger than k convex numbers is carried out.

$$d(A_i) = \min V(M_i \geq M_k)$$

Then the weight vector is calculated as shown below.

$$W = (d(A_1), d(A_2), d(A_3)...d(A_n))^T \qquad k = 1,2,3...n$$

After the normalization of weight vector, the relative weight of each criteria can be assigned as shown below.

$$\omega = (w_{A1}, w_{A2},...w_{An})$$

After the implementation of fuzzy AHP phase the relative weights of criterion can be obtained. Later determination the weights of criterion, a case study of manager selection problem was solved with fuzzy TOPSIS method. To implement fuzzy TOPSIS procedure decision makers evaluated each alternative with respect to criterion using linguistic terms shown in Table 3. Then, geometric mean is calculated for each decision maker assessment to obtain fuzzy decision matrix.

Table 3: Fuzzy Scale for Alternatives

Linguistic Terms	Triangular Fuzzy Number
Very Low	(0,0,1)
Low	(0,1,3)
Medium Low	(1,3,5)
Medium	(3,5,7)
Medium High	(5,7,9)
High	(7,9,10)
Very High	(9,10,10)

Basic steps of fuzzy TOPSIS method are presented in the following section (Rehman & Ali, 2021), (Dhiman & Deb, 2020), (Sirisawat & Kiatcharoenpol, 2018).

- **Step 1:** Decision makers use linguistic variables to assess the alternatives according to criterion. In the first step of fuzzy TOPSIS method decision matrix should be generated. Each row represents alternatives while each column represents the criterion. If there are m alternatives and n criterion, decision matrix can be expressed as follows.

$$\begin{bmatrix} x_{11} & x_{12} & x_{1n} \\ x_{21} & x_{22} & x_{2n} \\ x_{m1} & x_{m2} & x_{mn} \end{bmatrix} \quad and \quad x_{ij}=(a_{ij}, b_{ij}, c_{ij})$$

- **Step 2:** In decision matrix, there are various type of information with different scales on each criterion. To obtain a comparable scale and normalized fuzzy decision matrix, linear scale transformation is used as shown below.

$$\tilde{r}_{ij} = \left(\frac{a_{ij}}{c_j^*}, \frac{b_{ij}}{c_j^*}, \frac{c_{ij}}{c_j^*} \right), \quad \text{for benefit criterion}$$

$$c_j^* = \max c_{ij}$$

$$\tilde{r}_{ij} = \left(\frac{a_j^-}{c_{ij}}, \frac{a_j^-}{b_{ij}}, \frac{a_j^-}{a_{ij}} \right), \quad \text{for cost criterion}$$

$$a_j^- = \min a_{ij}$$

- **Step 3**: Since each criterion has different weight, weighted normalized fuzzy decision matrix is formed as:

$$V = \begin{bmatrix} \tilde{v}_{11} & \tilde{v}_{12} & \tilde{v}_{1n} \\ \tilde{v}_{21} & \tilde{v}_{22} & \tilde{v}_{2n} \\ \tilde{v}_{m1} & \tilde{v}_{m2} & \tilde{v}_{mn} \end{bmatrix} \quad \text{where} \quad \tilde{v}_{ij} = \tilde{r}_{ij} \times w_j$$

- **Step 4:** With the help of the decision matrix, fuzzy positive (FPIS) and fuzzy negative (FNIS) ideal point is determined as follow.

$$A^* = (\max \tilde{v}_{ij})$$
$$A^- = (\min \tilde{v}_{ij}) \quad \text{where} \quad i = (1,2,3,...,m) \quad \text{and}$$
$$j = 1,2,3,...,n$$

- **Step 5:** After calculation of the ideal solutions, the distance between ideal solution points and alternatives is carried as shown below.

$$d_i^* = \sum_{j=1}^n d(\tilde{v}_{ij}, \tilde{v}_j^*) \quad \text{where} \quad \tilde{v}_j^* = \max \tilde{v}_{ij} \quad \text{and}$$

$$d_i^- = \sum_{j=1}^n d(\tilde{v}_{ij}, \tilde{v}_j^-)$$

$$\tilde{v}_j^- = \min \tilde{v}_{ij}$$

- **Step 6:** In last step, a closeness coefficient is calculated to rank the alternatives. Higher coefficient corresponds to better ranking. Alternatives can be ranked according to their coefficient scores.

$$CC_i = \frac{d_i^-}{d_i^+ + d_i^-}$$

Results and Findings

In fuzzy AHP phase, four decision attributes are commentated by decision makers and owners of the firms. Then each assessment unified with the help of the geometric mean. Then, aggregated fuzzy decision matrix can be presented as follow.

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Table 4: Aggregated Pairwise Comparisons

	Work Experience			Professional Competence		
WE	1,000	1,000	1,000	1,797	2,028	2,307
PC	0,444	0,487	0,565	1,000	1,000	1,000
T	1,063	1,125	1,176	0,877	1,029	1,251
MS	1,325	1,476	1,644	0,601	0,725	0,891
	Trust			Management Skills		
WE	0,849	0,887	0,952	0,616	0,675	0,761
PC	0,809	0,966	1,149	1,131	1,380	1,683
T	1,000	1,000	1,000	0,807	0,884	1,012
MS	1,012	1,120	1,251	1,000	1,000	1,000

Then, artificial value of each criterion is derived as follows:

Table 5: Synthetic Values

Criteria	l	m	u
WE	0,229	0,274	0,327
PC	0,182	0,228	0,287
T	0,201	0,241	0,290
MS	0,211	0,257	0,312

M5	6,766	8,490	9,587	5,800	7,860	8,706

Comparing of criterion has implemented by the use of the vector values gained above. Comparison results can be seen in Table 6.

Table 6: Vector Numbers and Supremacy Comparisons

V(S1≥S2)	1	V(S2≥S1)	0,563	V(S3≥S1)	0,839	V(S4≥S1)	0,649
V(S1≥S3)	1	V(S2≥S3)	0,875	V(S3≥S2)	1	V(S4≥S2)	1
V(S1≥S4)	1	V(S2≥S4)	0,722	V(S3≥S4)	1	V(S4≥S3)	0,823

As a result of the comparing, the weight vector W '= (1, 0.563, 0.839, 0.649) is obtained. The importance level of each criteria obtained as a result of normalization are presented in Table 7.

Table 7: Importance Level of Criterion

Criteria	Weights
Work Experience	0,328
Professional Competence	0,185
Trust	0,275
Management Skills	0,213

Considering the findings in Table 7, it is seen that the most important selection criterion in the selection of managers is "Work Experience". While the least important criterion is seen to be "Professional Competence". These results clearly show that firm owners attach more importance to business experience in manager selection. For this reason, it is seen that candidates with more successful work experience may be more advantageous in the selection process of the company owners.

Using the criterion weights obtained by the fuzzy AHP method, a case study for manager selection process implemented using fuzzy TOPSIS method. The decision matrix was created with the aid of the decision makers' ratings. All decision makers assessment is aggregated using the geometric average of matrix cells. Aggregated initial fuzzy decision matrix is presented in Table 8.

Table 8: Initial Fuzzy Decision Matrix

	Work Experience			Professional Competence		
M1	5,524	7,610	9,117	3,160	5,431	7,391
M2	5,800	7,579	8,670	6,534	8,346	9,311
M3	4,663	7,017	8,524	5,165	7,237	8,927
M4	5,431	7,391	8,927	3,554	5,833	7,548
M5	6,534	8,346	9,311	6,423	8,106	9,117
	Trust			Management Skills		
M1	6,534	8,346	9,311	4,360	6,434	8,313
M2	5,809	7,432	8,524	5,431	7,391	8,927
M3	7,237	8,927	9,791	5,431	7,391	8,927
M4	5,431	7,391	8,927	7,610	9,117	9,791

In the following step, normalized fuzzy decision matrix is obtained using linear scale transformation presented as Table 9.

Table 9: Normalized Fuzzy Decision Matrix

	Work Experience			Professional Competence		
M1	0,593	0,817	0,979	0,339	0,583	0,794
M2	0,623	0,814	0,931	0,702	0,896	1,000
M3	0,501	0,754	0,915	0,555	0,777	0,959
M4	0,583	0,794	0,959	0,382	0,626	0,811
M5	0,702	0,896	1,000	0,690	0,871	0,979
	Trust			Management Skills		
M1	0,667	0,852	0,951	0,445	0,657	0,849
M2	0,593	0,759	0,871	0,555	0,755	0,912
M3	0,739	0,912	1,000	0,555	0,755	0,912
M4	0,555	0,755	0,912	0,777	0,931	1,000
M5	0,691	0,867	0,979	0,592	0,803	0,889

In next step, normalized matrix values are multiplicated with relative weights of each criterion. Then, weighted normalize decision matrix is obtained as shown in Table 10.

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Table 10: Weighted Normalized Fuzzy Decision Matrix

	Work Experience			Professional Competence		
M1	0,194	0,268	0,321	0,063	0,108	0,147
M2	0,204	0,267	0,305	0,130	0,165	0,185
M3	0,164	0,247	0,300	0,102	0,143	0,177
M4	0,191	0,260	0,314	0,070	0,116	0,150
M5	0,230	0,294	0,328	0,127	0,161	0,181
	Trust			Management Skills		
M1	0,183	0,234	0,261	0,095	0,140	0,181
M2	0,163	0,209	0,239	0,118	0,161	0,194
M3	0,203	0,251	0,275	0,118	0,161	0,194
M4	0,152	0,208	0,251	0,166	0,198	0,213
M5	0,190	0,238	0,269	0,126	0,171	0,189

After forming weighted normalized fuzzy decision matrix, FPIS and FNIS is determined. After that, the distance of each alternative from these points with respect to criterion is calculated. The distances and closeness coefficient of each alternative are presented in Table 11.

Table 11: Distances From FPIS, FNIS and Ranks of Alternatives

Alternatives	D*	D⁻	CC	Rank
M1	0,154	0,051	0,250	5
M2	0,101	0,107	0,515	2
M3	0,107	0,099	0,481	3
M4	0,121	0,089	0,423	4
M5	0,046	0,160	0,779	1

According to results seen from Table 11, "Manager 5" is the best alternative with 0,779 coefficient score. On the contrary, "Manager 1" is the worst alternative with 0,250 coefficient score. As a result, the rank order of alternatives M5> M2> M3> M4> M1.

To check the robustness of our proposed approach, we made further comparison with other fuzzy MCDM methods. To do this, same input variables and criterion weights are used. With the purpose of validation of results, we executed two more methods as fuzzy EDAS (F-EDAS) and fuzzy SAW (F-SAW). According to results in Table 12, all of the rankings results are reasonable in a harmony.

Table 12: Comparative Comparison of Other Techniques

	F-TOPSIS	F-EDAS	F-SAW
M1	5	5	5
M2	2	2	3
M3	3	4	2
M4	4	3	4
M5	1	1	1

When Table 12 is examined, alternative M5 has the first rank in all approaches. Besides, alternative M1 has the worst performance on ranking results. In F-EDAS method, the rankings of alternatives are M5>M2>M4>M3>M1. In addition, the ranking results of F-SAW approach are shapes as M5>M3>M2>M4>M1 respectively. Generally, it can be emphasized that all compared methods have almost the same ranking results. This result showed that, using fuzzy MCDM techniques like F-TOPSIS provides advantages, reasonable solutions and rationality for decision makers or firm owners who deal with problems in selecting appropriate manager in textile industry.

To check the robustness and validity of the proposed integrated approach sensitivity analysis is performed by changing the relative weights of criterion. Four different cases are used for sensitivity analysis. In first three cases the highest weight attained each criterion respectively. In last case, equal weighting approach is preferred. The result of the sensitivity analysis performed is presented as shown in Figure 3.
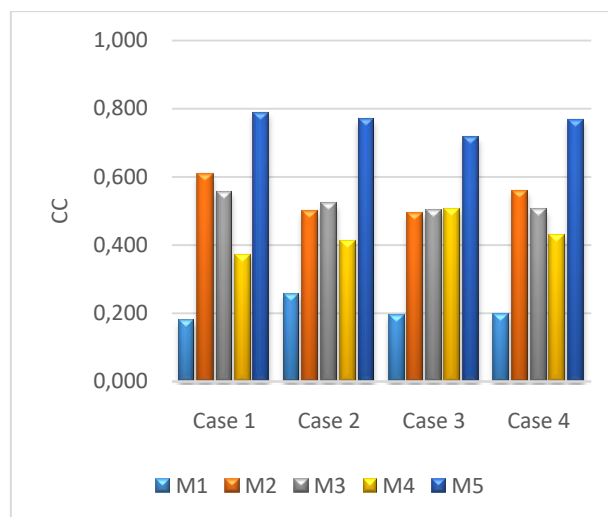

Figure 3: Sensitivity Results of Proposed Model

As can be seen on Figure 3, the ranking of alternatives has not change significantly. In all cases, M5 is the best ranking whereas M1 is the worst performing alternative. These results show that proposed integrated fuzzy AHP and fuzzy TOPSIS methods are robust and valid. Using these methods jointly as this type of MCDM problems can provide useful information, truthful and rational mechanism for decision makers, firm owners and managers.

5. CONCLUSION

It has been revealed from the research findings that work experience is the first criterion for company owners in textile sector when selecting managers and it takes precedence over trust criterion. This clearly indicates that when deciding on the manager, the first choice of company owners is an experienced manager candidate who knows the textile industry well. Work experience can actually be an important reason for preference that provides the trust criteria for company owners so that the company owner can have the opportunity to see the job performance and human relations of the manager candidate thanks to his/her work experience. In other words, the work experience of the manager candidate is the first step of trusting the manager to whom the company owner will entrust his company. Similarly, the reference point of management skills and professional competence is work experience. The company owner can determine how effectively the manager candidate can use these talents and abilities thanks to the information he/she will gain from his work experience. These statements can be expressed as the reasons why work experience has the highest criterion weight.

Regarding the trust criterion, we must explain that trust has two important dimensions: cognitive and emotional. In cognitive trust, the person seeks reasonable and concrete reasons to make a rational decision. The background of emotional trust is emotional investments. And the value given to the person is important in emotional investment (Arı, 2003: 6). When we consider

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the subject-specific to our research, as a result of this distinction, the company owner seeks reasonable and concrete reasons to trust the manager candidate in cognitive trust. At this point, the work experience of the manager candidate and the references he/she offers come out. Emotional trust is understood as the process that starts after one-on-one interviews between the company owner and the manager candidate and arises with the business relationships that develop as a result of recruitment.

Managerial skills can be mainly defined as the manager's effective and efficient fulfillment of management functions within the organization. In addition, the manager candidate's emotional intelligence, teamwork predisposition, creativity, decision-making and problem-solving skills, knowledge of human resources management, time and stress management skills can be considered as reasons for preference for company owners. All these skills are considered as the third selection criterion for company owners after work experience and trust.

For company owners, the professional competence of the manager candidate has been determined as the last selection criterion. In this respect, foreign language knowledge, knowledge of basic information technologies, educational background, general culture level of the manager candidate was determined as the last selection criteria. Based on all findings, it is clearly seen that the most important selection reason for the management profile of the textile industry in our country is having a good work experience. The education level, foreign language knowledge and managerial skills of the manager candidate cannot get ahead of his/her work experience. This supports the situation of managers with high school and associate degree level of education but working as business managers in the textile sector. Work experience can be considered as a selection criterion for company owners and partners, in which other criteria are tested. In this respect, manager candidates who want to progress as managers in the sector must increase their sector experience. In this way, they will have made an important step in ensuring the trust of the company owners. After a successful work experience, candidates should develop their managerial skills and professional competencies.

In the application part of study, after the criterion weights have been obtained by fuzzy AHP and by using expert evaluations, a manager selection problem is demonstrated. In this sample problem, five candidate managers and four decision criteria have been analysed with fuzzy TOPSIS method. When we examine the results of fuzzy TOPSIS method, it is seen that the best manager alternative is M5. The use of fuzzy TOPSIS method in such a decision problem is appropriate because there are many criteria and alternatives. After that, a sensitivity analysis has been performed to observe changes on rankings when the criterion weights

are changed. Sensitivity analysis showed that the ranking results do not change even criterion weights is changed.

The constraints of this study are the firms valuated in textile sector and criteria acquired from experts and firm owners. The results of this research will directly be changed according to different criteria and alternatives used. For the future research, we propose that using different criteria set or firm alternatives the manager selection problem can be evaluated. In addition, the subject of this research can be expanded by using other MCDM methods such as fuzzy MOORA, fuzzy GRA or fuzzyANP.

For this research, ethics committe approval (Commission Date 05.02.2021- Decision No. 02.14) was obtained from the Social and Human Sciences Ethics Committee of Tokat Gaziosmanpaşa University, and an informed consent form was signed.

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