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Determining the Importance Level of Effective Criteria in the Employees in the Defense Acquisition Process via Fuzzy DEMATEL Method

Savunma Tedarik Sürecinde Çalışanlarda Etkili Kriterlerin Önem Düzeyinin Bulanık DEMATEL Yöntemiyle Belirlenmesi

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Abstract

In today's globally competitive environment, sector managers are faced with various problems day by day. One of these problems is the selection of personnel, which is the most important element of an organization, in accordance with the job and workplace in terms of quality and quantity. The recruitment process consists of the stages of determining the expert group that will make the selection, determining the criteria to be used in the evaluation, and making a decision by evaluating the criteria. The most important step in this process is to determine the criteria in line with the needs of the sector. This situation becomes more special for sectors with long-term and strategic features such as the defense industry. In this study, it is aimed to determine the selection criteria with the group decision making method for the defense acquisition personnel, which is one of the keystones of the defense sector, and to examine the interaction of the criteria with each other. Comparisons of the experts on the criteria were made with a Multi-Criteria Decision Making (MCDM) method without discrimination of the working class (white, blue, gray, etc). The fuzzy DEMATEL (Decision Making Trial and Evaluation Laboratory) method was used in the study since the expert opinions on the criteria determined for the defense acquisition process are made with subjective expressions and it is used in the criteria analysis in various fields in the literature.

Özet

Günümüz küresel rekabet ortamında, sektör yöneticileri her geçen gün çeşitli sorunlarla karşı karşıya kalmaktadır. Bu sorunlardan biri de bir organizasyonun en önemli unsuru olan personelin nitelik ve nicelik olarak işe ve işyerine uygun seçilmesidir. İşe alım süreci, seçimi yapacak uzman grubunun belirlenmesi, değerlendirmede kullanılacak kriterlerin belirlenmesi ve kriterleri değerlendirerek karar verilmesi aşamalarından oluşmaktadır. Bu süreçteki en önemli adım sektörün ihtiyaçları doğrultusunda kriterlerin belirlenmesidir. Bu durum savunma sanayi gibi uzun vadeli ve stratejik özelliklere sahip sektörler için daha özel hâle gelmektedir. Bu çalışmada, savunma sektörünün temel taşlarından biri olan savunma tedarik personeli için grup karar verme yöntemi ile seçim kriterlerinin belirlenmesi ve kriterlerin birbirleri ile etkileşiminin incelenmesi amaçlanmıştır. Uzmanların kriterlere ilişkin karşılaştırmaları, işçi sınıfı (beyaz, mavi, gri vb.) ayrımı yapılmadan Çok Kriterli Karar Verme (ÇKKV) yöntemi ile yapılmıştır. Bulanık DEMATEL (Karar Verme Deneme ve Değerlendirme Laboratuarı) yöntemi, savunma edinim süreci için belirlenen kriterlere ilişkin uzman görüşlerinin sübjektif ifadelerle yapılması ve literatürde çeşitli alanlarda kriter analizinde kullanılması nedeniyle çalışmada kullanılmıştır.

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1. INTRODUCTION

The phenomenon of security has emerged as a basic need since the existence of humanity. In this context, defense and defense management have always been important issues for countries in history. However, especially in recent years, it has started to attract the attention of the public at a much higher rate. Defense management, which can be defined as the most effective use of all kinds of resources allocated by countries for defense, is a process in which basic management functions are implemented. The most important and indispensable of the resources used in this process is the human resource that includes people.

Effective and comprehensive defense management requires good strategic planning. This strategic defense planning requires Talent-Based Planning (TBP) today. (Bankston & Key, 2006; Altunok et al., 2010). The TBP approach makes important contributions to the development of a common perspective between forces by integrating important planning processes to facilitate strategic planning (Chim et al., 2010). For TBP, first of all, the defense needs must be determined correctly and then the process must be followed within a certain plan, program, and budget. The last stage is to meet the defense capability gaps (needs) by following the most suitable defense acquisition methods and strategies. Capability based approach (CBP) increases the effectiveness of defense expenditures by basing acquisition processes on real needs and contributes to facilitating the defense planning process. In this sense, defense acquisition is one of the most important keystones of defense planning. In addition, the modernization of the armed forces and the acquisition of advanced weapons systems constitute a fundamental element in the defense planning strategy of many countries. Depending on the developments in technology, the complexity of defense systems is increasing day by day. For this reason, it is expected that the decision mechanisms in the acquisition process will be better managed, have a systematic structure, and the personnel who will take part in the defense process will be qualified, experienced, and competent in meeting the defense needs. For this expectation, personnel selection and acquisition, which is an important stage in the Human Resources Management (HRM) process, is important. The selection and recruitment specifications of the personnel who will participate in the defense acquisition process is an issue that needs attention in terms of the country's survival, national interests, and future deterrence.

In this context, the main purpose of the study is to propose decision support by determining the criteria to be sought in the recruitment and assignment processes of the personnel to be assigned in the defense acquisition process, which is one of the indispensable steps for defense planning. The criteria were determined by the group decision-making method with the evaluations of the managers and experts in the sector. In decision analysis problems, the process of determining the weights of the criteria is often a difficult issue. In real-life problems, such as the defense sector, where it is inevitable to seek user experience and expert opinion, the opinions of group evaluations may not be clear. In order to cope with this problem, linguistic expressions can be used (Erdal & Korucuk, 2018). For this reason, fuzzy DEMATEL (FDEMATEL), which is one of the multi-criteria decision-making (MCDM) methods, was used in the study to determine the importance levels of the criteria. Although there are studies on personnel selection of enterprises in general in the literature, no study has been found specifically on the selection and recruitment processes of those who will work in the defense acquisition process. As it is known, the thought that defense and defense-related sectors differ from other sectors increases the importance of this study.

In the second part of the study, the importance of the personnel who will take place in the defense management and acquisition process, the personnel selection and recruitment processes and the literature review of the methods used in the third part, the application in the fourth part and the results in the last part are given.

2. THE IMPORTANCE OF MANPOWER IN DEFENSE MANAGEMENT AND ACQUISITION

Defense management can be defined as the supply of defense capabilities and the activities carried out in the process of realizing its objectives by using its resources within a certain strategic plan in order to protect the national interests of the countries and to take measures against all kinds of threats (Korkmazyürek, 2018).

The defense management process basically covers three main activities. These are strategic direction, defense planning, and defense acquisition (Begenirbas, 2022). For countries, good and effective defense management means strong armed forces. Military superiority is perceived as having a strong army. However, one of the most important conditions for a strong and highly operational army is to have a perfect logistics system. Like logistics, procurement, which is the basis of logistics, is also very important in the defense acquisition process. The rational management of the logistics and thus the defense acquisition and acquisition process is the primary step to be taken for the armed forces of the countries to be among the few armies of the world (DOD Directive 5000.01, 2020).

The defense acquisition planning process is the step in which the budgets of the capabilities that are decided to be acquired are allocated and the acquisition methods and strategies are determined (Harrison, 2022). Today's technological developments have started to be one of the main reasons that change defense plans (Begenirbas, 2022). In this context, a defense acquisition means the elimination of a deficiency in various ways, in the form of change, development, or modernization, from the perspective of the military system. Planning and organization are important in the effective management of defense acquisition. Especially during the organization process, the work to be done, people who will do this work, and the tools they will use are determined systematically, and resources are distributed accordingly. In this context, three important resources distributed in the organization are finance, manpower, and materials (Topçu, 2010). Regardless of the work it does, an organization is effective and strong only in proportion to the quality of its manpower. Employees, as human capital, are the most flexible, capable, intelligent, and possibly the most expensive resource an organization can have. In the organizing phase, appointing the right people in the right places, in sufficient numbers, is extremely critical and important for the organization to achieve its goals. These activities are evaluated within the scope of Human Resources Management (HRM). Human is the basis of defense activities. This situation places HRM in a very important position in terms of defense.

The main purpose of HRM is to assign the right person (having the qualifications, knowledge, skills, abilities, and other personality traits required by the job) at the right time, in the right place, by making the right job descriptions (duties, responsibilities, relationships, work conditions) as a result of job analysis (Bingöl, 2007). HRM is necessary for strategic, operational, and tactical operations at all levels (Ünlü & Begenirbaş, 2021). In this context, the task of a human resources (HR) unit is to coordinate manpower in a timely and effective manner, to strengthen the readiness and operational capabilities of the entire army for the commander at all levels, and to provide human resource support for the success of a wide range of military operations, from multinational operations to joint operations. Military HRM differs from HR functions in other institutions in some aspects. These differences briefly can be expressed in relatively stable job descriptions, recruitment of personnel at the entry-level, promotions from within the institution, performance evaluation, and remuneration according to some criteria such as rank, years of service, training within the institution, differentiation of career plans, planning social support applications for personnel and their families (Sayan, 2009). The trained manpower required in defense planning also includes the existence of citizens with strong national feelings, educated with a national upbringing, and loyally devoted to their homeland and nation.

The combat capability of an army largely depends on the manpower it has, and the advanced technology weapons/systems used. An effective defense requires firstly the determination of needs and then the provision of these needs and military capabilities by using appropriate acquisition methods and strategies within a certain plan, program, and budget. Because trained, adaptable to change, high decision-making and leadership skills, manpower is the focus of today's defense and security. (Bucur-Marcu, Fluri & Tagarev, 2010). In this context, the effective execution of acquisition, which has an important place in the successful execution of the defense planning process, is directly related to the correct selection and assignment of the personnel who will take part in the acquisition process (Orlando et al., 2001). Strategic manpower planning for defense acquisition ensures that the right people are provided with the quality and quantity that the armed forces will need depending on the defense acquisition method and strategy determined. In addition, it prioritizes the employment of the recruited personnel in the right staff positions and the retention of highly qualified personnel in the institution by providing these personnel with the skills required by the task. In this context, it is important to create a candidate pool that will meet the needs of the supply personnel of the armed forces and to select suitable candidates from this pool by using modern human resources acquisition and selection techniques. Training the selected candidates by using domestic and international training and development opportunities within the scope of expert personnel training plans, promoting the highly qualified ones, and bringing them to higher positions with a merit-based performance evaluation and promotion system constitute the basic steps of strategic manpower planning.

The USA attaches great importance to the human factor and its training in order to ensure that the defense acquisition is carried out in accordance with its objectives. Civil and military personnel, who will work in defense acquisition, undergo long-term and continuous training on all kinds of concepts, policies, methods, and management techniques required in the defense acquisition process (Peçen & Kaya, 2013). In order to provide acquisition training and specialization in this area, Law No. 101-510 includes the "Development of Defense Acquisition Personnel" section (Garcia et al., 1997). The US Department of Defense established the Defense Acquisition University in accordance with this law. The purpose of the establishment of this university is to increase the education level of the supply personnel and to ensure that they gain expertise. It is also among the duties of this university to conduct and publish academic research on defense acquisition and to open courses for acquisition personnel to be assigned to critical missions (Land, 1993).

3. PERSONNEL SELECTION AND RECRUITMENT CRITERIA

The recruitment process is one of the policies of human resources management. The most critical step of this process is the selection phase to be made among the candidate personnel (Vardarlier & Zafer, 2020). Employee selection is the activity of determining who will show the best individual harmony among the candidates applying for a certain position in the organization (Dursun, 2019). Determining the input quality of the personnel to be selected directly increases the importance of the subject for human resources (Dursun & Karsak, 2010; Baležentis et al., 2012). Personnel selection aims to bring the best candidates into the system to fill a defined gap in an organization and to do a job whose need has been determined. Effective design of the selection process is extremely important in terms of organizational policies.

Research on personnel selection shows that changes in the strategies of organizations, jobs, candidate personnel, the structure of society, laws, and laws affect personnel selection and recruitment processes (Borman, Hanson & Hedge, 1997; Robertson & Smith, 2001; Chien & Chen, 2008). In addition, global developments, technological innovations, and increased competition bring the need to examine the process well. For this reason, personnel selection processes in academic studies are increasing day by day and are examined from different aspects (Zavadskas, Turskis & Marina, 2008). In fact, in the literature, even different perspectives have been developed with studies that deal with recruiters' adoption of new technologies and their internalization in the personnel selection process, not through candidate personnel but through experts who will make the evaluation (Oostrom et al., 2013). In studies dealing with the subject from this perspective, the use of online surveys in the recruitment processes, the professional social networking websites of the candidate personnel and their behavior towards non-professionals compared to these, and the use of social networks in job postings and recruitments for organizations are examined by researchers (Voicu, 2014; Aguado et al., 2016; El Ourdi et al., 2016; Golovko & Schumann, 2019).

Although personnel selection and recruitment activities seem to be a simple process based on certain procedures, they have very sensitive points. One of these points is the harmony between the worker and the organization. Personnel hired to fulfill a job description must meet the requirements and expectations of the industry and organization. In the literature, there are studies that make concrete measurements with this concept-based test technique, which is considered as person-organization fit (Michaud, Durivage, & Stamate, 2016). In addition, some studies offer implications for creating a much longer-term person-organization harmony by examining candidate experiences (pre-recruitment, recruitment, selection, job offer, and post-job offer) (Doverspike, Flores & VanderLeest, 2019). In order to reveal the person-organization harmony in all details, there is a need for a detailed examination of the sector of the job to be worked and the criteria required by this sector for the candidate personnel. For this reason, clothing, academy, construction, security, education, mining, tourism, law, etc. belonging to personnel selection studies about the different industries some studies were conducted (Hassler, 2004; Celik, Kandakoglu, & Er, 2009; Gilan, Sebt & Shahhossesini, 2012; Hertig, Kling & Dannecker, 2015; Jiarakom, Suchiva & Pasipol, 2015; Chanakira, Mujere & Spiegel, 2019; García-Barrero & Erbina, 2021, Spain et al., 2022).

Recruitment and job search activities are activities that include multi-level integrated work that should be evaluated individually and organizationally (Acikgöz, 2019). Employee selection is defined as the decision-making process that includes the levels of assigning the right employee to the right job in the right sector for human resources (Gilan, Sebt & Shahhossesini, 2012). The determination of the evaluation criteria that organizations spend the effort to solve, the importance weights of the criteria and the selection process of the candidate personnel complicate this problem (Kabak, Burmaoglu & Kazancoglu, 2012; Santiago, Luis, & Ricardo, 2020). In the literature, it is seen that the multi-criteria decision-making approach has been frequently used in recent years in order to effectively solve the selection process (Urosevic et al., 2017; Karabasevic et al., 2018; Maghsoodi et al., 2020). Other analytical studies in the literature include personnel selection processes that cannot be thought of independently from current developments, a model proposal developed for global recruitment optimization, flexible working in the Covid-19 process, and studies evaluating wages, overtime, and similar issues in line with this structure (Pessach et. al., 2020; Ben-Gal, Forma & Singer, 2022)

There are studies in the literature examining the evaluations required for personnel selection and recruitment. Robertson and Smith (2001) conducted a comprehensive study examining the evaluations of the selection to be made among the candidate personnel. It is estimated that the future performance of the recruited personnel will be successful with the objective selection (Güngör, Serhadlıoğlu & Kesen, 2009). In order for the selection to be objective, basic methods such as personality factors (Salgado, 1997), written and verbal communication requirements for the job description (Jessop, 2004), interviews, and talent interviews (Cortina et al., 2000; Robertson & Smith, 2001) were adopted. Studies show that besides these basic methods, sectoral-based additions that deal with different criteria are also made with the teams formed by human resources managers and experts, and group decision-making techniques are also applied (Chen, 2000; Chen & Cheng, 2005; Shih, Shyur & Lee, 2007; Canós & Liern, 2008; Saremi et al., 2009; Zhang & Liu, 2011; Baležentis et al., 2012; Wan, Wang & Dong, 2013). When all these studies are examined, it is seen that the criteria examined with both basic and group decision-making techniques in personnel selection processes are handled with both quantitative and qualitative evaluations. Evaluation processes of candidate personnel, which is a field that is very open to interpretation with linguistic variables, are designed in a way that can evaluate the subjective judgments of decision-makers with research that integrates classical MCDM methods with fuzzy set theory (Sang, Liu & Quian, 2015; Ji, Zhang & Wang, 2018; Yeni & Özçelik; 2019; Krishankumar et al., 2020).

As a result, the criteria to be evaluated in the determination of the personnel to be recruited in the defense acquisition process were determined by the group decision-making method, making use of the examples in the literature. For the method selection of the study, the DEMATEL method, which has an appropriate analysis structure for group decision-making processes, was used among the many MCDM methods referenced in the literature. However, it was considered that it would be more accurate to use the FDEMATEL method, which is adapted to the fuzzy environment, and is stated to give better results for subjective evaluations due to the linguistic evaluations of the experts (Lin and Wu, 2008). The FDEMATEL method emerges as a method used in studies where the importance levels of the criteria to be used in different sectors are determined and analyzes are made (Chang et al., 2011; Organ, 2013; Mirmousa & Dehnavi, 2016; Muhammad & Cavus, 2017; Erdal & Korucuk, 2018; Oralhan., 2019; Kaymaz et al., 2021; Giri et al., 2022).

4. APPLICATION

The workers to be employed in line with the strategies of the businesses, regardless of the working class (white, blue, and grey collar workers etc.), must be carefully selected to meet the expectations of both the businesses and the workers. One of the most important problems encountered in this selection process, which is called the recruitment process, is to correctly determine the criteria by which the candidate will be evaluated and to reveal the importance levels of the criteria. This process step is inevitable to be shaped according to sectoral needs, gains even more importance in long-term and strategically important business lines such as the defense acquisition process. The aim of the study is to reveal the relationship between the criteria by examining the evaluation criterias determined for recruitment in the defense acquisition process. In order to analyze these relations, it will be possible for experts to come together and start the group decision-making process. An approach will be applied to select the most suitable personnel for the job in order to carry out the activities completely and optimally in the defense acquisition process. In the next step of the study, the process and criteria are explained in detail.

4.1 Defining the Criteria and Determining the Hierarchy

The study was carried out with a team of 17 people consisting of military, civilian, and academician experts working in the field for the criteria to determine the cadres that will take place in the defense acquisition process. Some personnel in the team have been working in the defense industry for more than 20 years. Some of them train personnel in line with the needs of the army in military schools. In addition, each team member continues to work actively and has an academic master's degree or higher. Initially, a pool of 30 criteria was created by making use of the criteria used in the studies in the literature and the sectoral experience based on many years. As a result of the interviews, 8 criteria were removed from the pool because there was a consensus that they did not directly affect the defense acquisition personnel although these criteria are among the criteria used in personnel selection. Then, some criteria were eliminated by considering the intertwined and representative structures of the criteria. It was decided that a hierarchical structure consisting of main and sub-criteria should be established. As a result, 3 main criteria and 18 sub-criteria were determined by using the literature (Borman, Hanson & Hedge, 1997; Robertson & Smith, 2001; Chien & Chen, 2008).

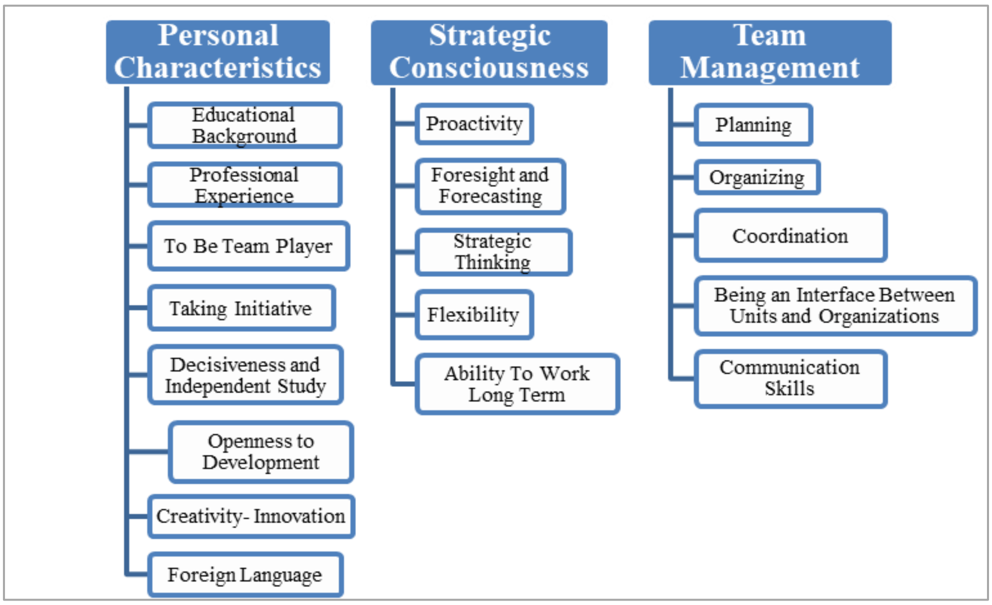

Figure 1. Criteria Hierarchy

As a result of expert interviews specific to the personnel who will work in the defense acquisition process, the criteria whose hierarchical structure is given were revealed. This section contains explanations of the criteria.

- **Personal Characteristics (P)**

- Educational Background (P1): It evaluates all of the educational skills about defense and supply.
- Professional Experience (P2): It considers previous duties and experiences in defense and supply.
- To Be Team Player (P3): The ability to act as "we", not "I", is evaluated in works that cannot be done alone / must be done as a team.

• Taking Initiative (P4): It refers to the ability of the personnel to speak up, make decisions and act on their own or on behalf of the group they represent when necessary.

• Decisiveness and Independent Study (P5): Making an effort to work without being affected by negative situations that may be experienced in order to fulfill the requirements of the job.

• Openness to Development (P6): It describes the ability to make necessary inputs to the system, when necessary, by following all kinds of developments in the world, especially in the field of defense.

• Creativity- Innovation (P7): It describes the ability to transform thoughts and ideas into a marketable product (good/service) or a concept that provides socially added value.

• Foreign Language (P8): It evaluates the ability to use a language other than the mother tongue, especially English, which is accepted as a world language, in terms of reading, writing, speaking and understanding.

▪ **Strategic Consciousness (S)**

• Proactivity (S1): It means taking action now and early to realize future defense and security considerations.

• Foresight and Forecasting (S2): To have an understanding of making more conscious policy decisions with the changes brought about by technology and innovation with a systematic view of the future in the field of long-term defense, especially science.

• Strategic Thinking (S3): It determines the modes of operation by being conscious of how these goals and objectives can be achieved by focusing on long-term goals and objectives.

• Flexibility (S4): Ability to adapt to all kinds of changes, especially in long-term activities.

• Ability to Work Long Term (S5): The power to reach the target in long-term activities and works and to keep the employees in the system in these activities until the end of the work.

▪ **Team Management (T)**

• Planning (T1): Determining how and by which alternatives these goals and objectives can be achieved by setting goals and objectives for employees within the scope of defense acquisition.

• Organizing (T2): Determining what tasks will be done with whom in order to achieve the determined goals and objectives.

• Coordination (T3): The succession of activities in order to achieve the common goal and any synchronization activities to ensure that they complement each other.

• Being an Interface Between Units and Organizations (T4): Establishing the coordination that will ensure being on the same level between the authority of need and the defense industry sector and R&D institutions in the process from the need to the operation of defense weapon/systems.

- Communication Skills (T5): The ability to interact with all relevant stakeholders in the defense acquisition process with all kinds of verbal and non-verbal (written, etc.) actions.

- The FDEMATEL method, which is the method used for the analysis of the criteria determined and explained, is given in Section 4.2.

4.2 Fuzzy DEMATEL Method

The DEMATEL method was first applied in a study conducted in 1973 at the "The Battelle Memorial Institute" at the Geneva Research Center. Then, the method was developed to analyze the interaction between complex criteria and to create a structural model (Chang et al., 2011; Yazdi et al., 2020). The method also helps to investigate the mutual relations of the elements with each other by rejecting the assumption that elements of classical MCDM approaches such as AHP are only in a hierarchical structure and independent from each other (Erdal & Korucuk, 2018). In this study, the DEMATEL method was used to examine the interaction between the determined criteria. However, triangular fuzzy numbers were used in order to eliminate the problems of unclear or linguistic expressions used by experts in the analyses (Tabatabaee et al., 2019). In the FDEMATEL method, there are n criteria, which are evaluated by k experts in accordance with the group-decision making method and interact with each other. After the decision makers and decision criteria are determined, evaluations are made by applying the calculation steps of the method. The application steps of the FDEMATEL method are presented in Figure 2 (Eroglu & Gencer, 2017; Erdal & Korucuk, 2018). In this section, the steps presented in Figure 2 will be mentioned and the application will be explained.

4.2.1 Determination of Recruitment Criteria and Determination of Fuzzy Scale

In this step, the criteria affecting the decision problem can be determined from the decision makers by questionnaire, interview method, or direct literature review methods. Triangular and trapezoidal fuzzy numbers can be used widely in the literature for the determination of the fuzzy scale.

4.2.2 Creating a Fuzzy Direct Relationship Matrix

At this stage, a pairwise comparison between the criteria is made by the decision-makers to determine the level of relationship between the decision criteria. According to the scale in Table 1, each decision maker gives his opinion on the question “Which criterion affects which criterion and to what extent?”.

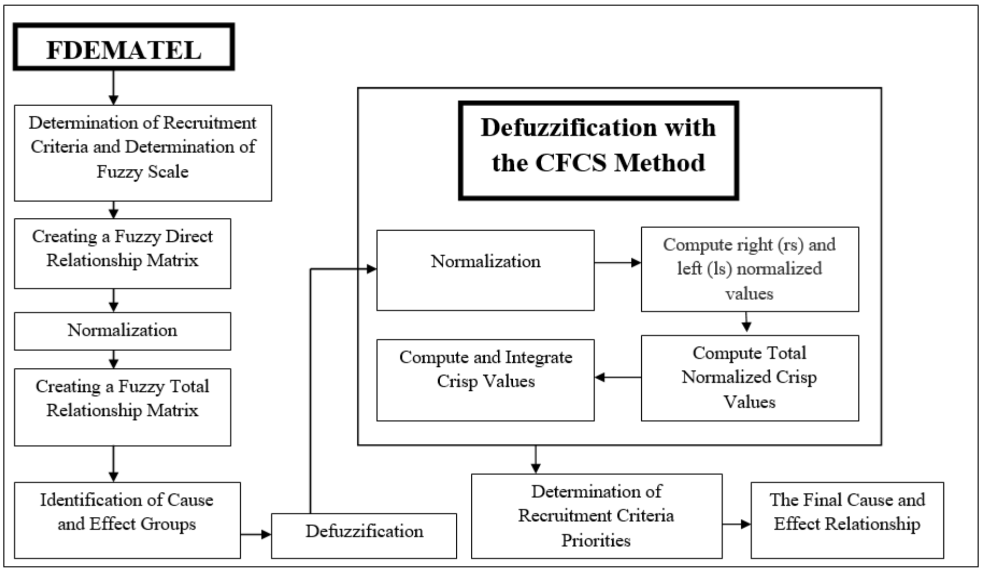

Figure 2. FDEMATEL Steps

Table 1. Linguistic Variables and Corresponding Fuzzy Numbers

Linguistic Variables	Point	Fuzzy Number Equivalent
No Effect	0	(0, 0, 0.25)
Very Low Effect	1	(0, 0.25, 0.5)
Low Effect	2	(0.25, 0.5, 0.75)
High Effect	3	(0.5, 0.75, 1)
Very High Effect	4	(0.75, 1, 1)

(Source: Eroglu & Gencer, 2017; Erdal & Korucuk, 2018).

In this way, each (i, j) element of the *nxn* dimensional fuzzy direct relation matrix (x_{ij}), criterion *i* from the criterion *j* represents a direct relationship. The fuzzy direct relationship matrix (X) given in Equation 1 is obtained as much as the number of decision-makers (k) by completing the evaluations of each decision maker (x_1, x_2, …, x_k).

$$X=\begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{n1} & \cdots & x_{nn} \end{bmatrix} \quad (1)$$

There is no symmetry in the direct relation matrix and the elements in the diagonals are 0. The fuzzy direct relation matrix is obtained by representing this matrix with fuzzy expressions. As a result of averaging the obtained matrices with Equation 2, the group decision average fuzzy direct relationship matrix (C) is formed.

$$a_{ij}\,\frac{1}{k}\sum_{n=1}^{k} x_{ij}^{n} \quad (2)$$

4.2.3 Creating a Normalized Fuzzy Direct Relationship Matrix

The fuzzy direct relation matrix obtained in the previous step is subjected to normalization using Equations (3) and (4) to form a normalized fuzzy relation matrix. In these equations, l_{ij} represents the smallest triangular fuzzy number, m_{ij} represents the middle value, and finally, u_{ij} represents the largest value.

$$\tilde{x}_{ij} = \frac{C}{r} = \left(\frac{l_{ij}}{r}, \frac{m_{ij}}{r}, \frac{u_{ij}}{r}\right) \tag{3}$$

$$r = \underbrace{max}_{1\le i\le n}\left(\sum_{j=1}^{n} l_{ij}\right), \quad r = \underbrace{max}_{1\le i\le n}\left(\sum_{j=1}^{n} m_{ij}\right), \quad r = \underbrace{max}_{1\le i\le n}\left(\sum_{j=1}^{n} u_{ij}\right) \tag{4}$$

4.2.4 Creating a Fuzzy Total Relationship Matrix

Equations (5) and (6) are used to construct the fuzzy sum relationship matrix (F). The (C) expressed in Equation (6) represents the decreasing indirect effects, and (I) the *nxn* dimensional unit matrix. Dividing fuzzy numbers into separate matrices provides convenience during calculations.

$$\lim_{k\to\infty} c + c^2 + \cdots + c^k \tag{5}$$

$$F = C + C^2 + \cdots + C^k = C(I - C)^{-1} \tag{6}$$

4.2.5 Identification of Effect and Cause Groups

In the F matrix created in the previous step, the sum of each row ($\tilde{D}_i$) is the sum of the direct and indirect effects from each decision criterion to the others; the sum of each column ($\tilde{R}_i$) represents the sum of the effects on the same decision criterion from other decision criteria. For each decision criterion, the total effect value effect and cause indicator ($\tilde{D}_i + \tilde{R}_i$) calculated with row-column sums, the ($\tilde{D}_i - \tilde{R}_i$) indicator also shows the net effect of the decision criterion *i* on the system. If the numerical value obtained is positive, the net decision criterion *i* is expressed as “Effect”, and if negative, it is expressed as “Cause”.

4.2.6 Defuzzification

A single numerical value is obtained by performing the clarification process with an (appropriate) defuzzification method determined from a fuzzy set in the defuzzification phase. It can be said that this stage is the opposite of blurring. There are various clarification procedures in the literature. In this study, CFCS (Converting Fuzzy Data into Crisps Scores) defuzzification method proposed by Opricovic and Tzeng (2003) is a defuzzification method in which fuzzy minimum and fuzzy maximum values are determined for right and left values. The clarification process has a five-step algorithm.

$\tilde{z}_{ij}^k = (l_{ij}^k, m_{ij}^k, u_{ij}^k)$ triangular fuzzy set:

- Step 1. Normalization

$$\Delta_{min}^{max} = max r_{ij}^k - min l_{ij}^k \tag{7}$$

$$xr_{ij}^k = \left(r_{ij}^k - min l_{ij}^k \middle/ \Delta_{min}^{max} \right) \tag{8}$$

$$xl_{ij}^k = \left(l_{ij}^k - min l_{ij}^k \middle/ \Delta_{min}^{max} \right) \tag{9}$$

$$xm_{ij}^k = \left(m_{ij}^k - min l_{ij}^k \middle/ \Delta_{min}^{max} \right) \tag{10}$$

- Step 2. Compute right (rs) and left (ls) normalized values

$$xrs_{ij}^k = xr_{ij}^k \middle/ (1 + xr_{ij}^k - xm_{ij}^k) \tag{11}$$

$$xls_{ij}^{k} = {xm_{ij}^{k}}\Big/{(1 + xm_{ij}^{k} - xl_{ij}^{k})} \quad (12)$$

- Step 3. Compute Total Normalized Crisp Values

$$x_{ij}^{k} = \left[xls_{ij}^{k}\left(1 - xls_{ij}^{k}\right) + xrs_{ij}^{k} * xrs_{ij}^{k}\right]/[1 - xls_{ij}^{k} + xrs_{ij}^{k}] \quad (13)$$

- Step 4. Compute Crisp Values

$$z_{ij}^{k} = minl_{ij}^{k} + x_{ij}^{k}\Delta_{min}^{max} \quad (14)$$

- Step 5. Integrate Crisp Values

$$z_{ij} = {1}\Big/{\left(z_{ij}^{1} + z_{ij}^{2} + \cdots + z_{ij}^{h}\right)} \quad (15)$$

4.2.7 Determination of Recruitment Criteria Priorities

The priorities of the recruitment criteria are determined by using Equation 16 and 17 (Organ, 2013).

$$w_i = \sqrt{[(\widetilde{D}_i + \tilde{R}_i)^{Def}]^2 + [(\widetilde{D}_i - \tilde{R}_i)^{Def}]^2} \quad (16)$$

$$w_i = \frac{w_i}{\sum_{i=1}^{n} w_i} \quad (17)$$

4.2.8 Calculating the Threshold Value and Obtaining the Effect Diagram

The direct determination of the threshold value by experts is a classic and common approach. However, it can be difficult to determine the threshold value due to the large number of decision-makers whose opinions were consulted for some decision problems. Another common use for obtaining the threshold value is to take the arithmetic mean of the clarified aggregate relationship matrix as used in this study. the specified threshold value is required in order to avoid the complexity of the resulting diagram. The greatness or smallness of the threshold value to be used by the interaction of the criteria with each other affects its size. This can provide complexity and simplicity of the solution. The effect diagram is obtained by representing the points ([$(\widetilde{D}_i + \tilde{R}_i)^{Def}$, $(\widetilde{D}_i - \tilde{R}_i)^{Def}$ on a coordinate plane with the horizontal axis $(\widetilde{D}_i + \tilde{R}_i)^{Def}$, and the vertical axis $(\widetilde{D}_i - \tilde{R}_i)^{Def}$. The suitability of the threshold value depends on obtaining a suitable diagram.

4.3 Determination of Recruitment Priorities with the Fuzzy DEMATEL Method

In this section, face-to-face interviews were conducted with 17 different managers working in the defense sector and actively involved in the defense acquisition process, using the fuzzy DEMATEL method. The method was applied by the decision makers by taking the opinions of the personnel who will take part in the defense acquisition process without making any distinction between the job position and the working class. The interactions of 18 sub-criteria belonging to the 3 main criteria determined by the experts were compared in a way to evaluate the common qualities to be sought in all of the personnel to be recruited, regardless of white, blue, or gray collar. In order to determine the fuzzy scale, triangular fuzzy numbers, which are widely used in the literature, and the fuzzy triangular scale given in Table 1 proposed by Li (1999) were used.

At this stage, in order to determine the level of relationship between the criteria to be used in recruitment in the defense acquisition process, a pairwise comparison was made between the objectives by each decision maker. In Table 2, as an example, the direct relationship matrix consisting of the score equivalents of the evaluations made by the first decision maker using linguistic expressions for 18 recruitment criteria is presented.

Table 2. Direct Relationship Matrix

	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**S1**	**S2**	**S3**	**S4**	**S5**	**T1**	**T2**	**T3**	**T4**	**T5**
P1	0	4	2	3	3	1	3	2	2	2	2	3	2	3	2	2	2	3
P2	1	0	3	4	4	2	3	2	3	3	3	3	2	4	3	3	3	3
P3	1	3	0	3	1	3	1	1	1	2	2	3	3	3	2	4	4	3
P4	1	2	4	0	3	1	3	0	1	1	3	3	1	3	2	1	1	1
P5	2	2	3	4	0	1	2	1	1	1	2	2	2	3	2	1	1	1
P6	3	2	2	3	2	0	3	2	3	2	3	2	2	3	2	2	0	0
P7	2	2	2	4	4	4	0	1	2	2	3	3	2	2	2	2	0	1
P8	3	3	1	3	1	4	2	0	3	3	3	4	2	1	3	3	3	3
S1	2	2	3	3	2	2	3	0	0	4	1	2	1	1	2	2	1	0
S2	2	2	3	3	3	2	3	0	4	0	2	2	1	1	2	2	1	1
S3	1	2	2	3	3	2	2	0	2	1	0	2	2	2	3	3	2	2
S4	1	2	2	2	1	3	1	0	2	1	1	0	2	2	2	2	1	1
S5	0	3	4	1	2	2	0	0	0	3	3	2	0	1	1	1	1	2
T1	1	3	3	4	3	3	2	1	2	2	4	2	3	0	4	3	2	2
T2	2	3	4	4	3	1	2	0	1	2	4	2	3	4	0	4	3	2
T3	2	3	4	3	3	1	2	0	1	2	3	2	3	4	4	0	3	2
T4	2	3	4	3	2	2	1	0	1	2	3	2	3	4	3	4	0	3
T5	3	3	4	3	1	2	1	2	1	2	3	2	3	4	3	4	4	0

According to the evaluation of the first decision maker presented in Table 2, using the scale in Table 1, while P1 affects P2 in a "High Impact" way; P2 affects P1 “Very Low”. As it can be understood from here, there is no symmetry in the direct relationship matrix and the elements in the diagonals are 0. By displaying this table with fuzzy expressions, a fuzzy direct relationship matrix was obtained, and the evaluations of the first decision maker were transformed into fuzzy expressions and presented in Appendix A as an example.

As a result of averaging the evaluations obtained from each decision maker using Equation 2, the C matrix, which is the group decision, was formed. Normalized Fuzzy Direct Relationship Matrix calculations were made by normalizing the obtained matrix using Equations 3 and 4.

Equations 5 and 6 were used to construct the fuzzy sum relationship matrix (F). During the calculations, the fuzzy numbers were divided into separate matrices. In this context, Tables 3, 4, and 5 were created by combining the right (L), middle (M) and left (U) values in the Normalized Fuzzy Direct Relationship

Matrix for ease of processing. The values in these tables and Equation 6 were used to obtain the Fuzzy Total Relationship Matrix.

Table 3. Normalized Fuzzy Direct Relationship Matrix (Edited Version- L)

	P1	P2	P3	P4	P5	P6	P7	P8	S1	S2	S3	S4	S5	T1	T2	T3	T4	T5
P1	0.000	0.048	0.044	0.038	0.065	0.073	0.059	0.067	0.032	0.040	0.042	0.020	0.024	0.061	0.063	0.057	0.057	0.069
P2	0.034	0.000	0.057	0.077	0.059	0.055	0.046	0.024	0.069	0.083	0.077	0.038	0.063	0.075	0.081	0.081	0.067	0.073
P3	0.022	0.051	0.000	0.038	0.022	0.034	0.040	0.006	0.018	0.036	0.040	0.069	0.075	0.053	0.065	0.083	0.073	0.091
P4	0.026	0.065	0.053	0.000	0.075	0.055	0.067	0.008	0.044	0.042	0.030	0.067	0.024	0.057	0.055	0.053	0.040	0.053
P5	0.038	0.055	0.040	0.079	0.000	0.036	0.044	0.034	0.046	0.044	0.059	0.038	0.040	0.055	0.032	0.020	0.024	0.028
P6	0.063	0.073	0.048	0.055	0.042	0.000	0.077	0.061	0.030	0.044	0.030	0.046	0.038	0.030	0.026	0.028	0.038	0.053
P7	0.042	0.051	0.024	0.055	0.059	0.087	0.000	0.051	0.032	0.036	0.042	0.057	0.020	0.038	0.038	0.024	0.030	0.051
P8	0.065	0.057	0.018	0.016	0.032	0.077	0.051	0.000	0.026	0.028	0.028	0.048	0.024	0.030	0.046	0.046	0.075	0.075
S1	0.042	0.063	0.028	0.071	0.044	0.038	0.046	0.024	0.000	0.091	0.055	0.040	0.036	0.063	0.057	0.051	0.024	0.020
S2	0.034	0.057	0.032	0.042	0.040	0.042	0.055	0.024	0.081	0.000	0.071	0.046	0.051	0.048	0.040	0.030	0.024	0.032
S3	0.026	0.059	0.026	0.063	0.059	0.048	0.061	0.030	0.057	0.061	0.000	0.032	0.053	0.085	0.059	0.061	0.036	0.026
S4	0.034	0.051	0.051	0.042	0.048	0.071	0.059	0.022	0.032	0.028	0.018	0.000	0.061	0.040	0.038	0.038	0.038	0.046
S5	0.014	0.067	0.063	0.042	0.044	0.026	0.032	0.002	0.044	0.057	0.055	0.055	0.000	0.057	0.040	0.048	0.036	0.059
T1	0.042	0.075	0.040	0.046	0.042	0.038	0.042	0.012	0.053	0.065	0.095	0.053	0.055	0.000	0.075	0.061	0.046	0.040
T2	0.024	0.057	0.081	0.044	0.048	0.018	0.032	0.024	0.036	0.040	0.065	0.024	0.048	0.079	0.000	0.091	0.061	0.061
T3	0.026	0.059	0.079	0.053	0.032	0.032	0.040	0.018	0.042	0.046	0.065	0.057	0.053	0.075	0.079	0.000	0.069	0.071
T4	0.032	0.042	0.075	0.053	0.042	0.046	0.032	0.030	0.024	0.044	0.040	0.053	0.040	0.053	0.057	0.075	0.000	0.079
T5	0.040	0.075	0.081	0.030	0.014	0.036	0.034	0.061	0.022	0.028	0.032	0.053	0.053	0.038	0.067	0.081	0.081	0.000

During the selection of the clarification method, it was determined that the Centroid and CFCS methods, which are among the methods used in the literature, are frequently used. Although the centroid method is widely used in the literature, its use has been abandoned because it cannot distinguish between two fuzzy numbers with the same values in different ways (Erdal & Korucuk, 2018). Since it is emphasized in many studies that the CFCS method, which is widely used in the literature and proven to be effective in the clarification process, is more suitable for obtaining precise values, the CFCS method was used in this study. Equation 7-15 is used to clarify our problem with the CFCS method. In this context, the total relationship matrix defuzzificated with CFCS is presented in Appendix B.

Table 4. Normalized Fuzzy Direct Relationship Matrix (Edited Version- M)

	P1	P2	P3	P4	P5	P6	P7	P8	S1	S2	S3	S4	S5	T1	T2	T3	T4	T5
P1	0.000	0.053	0.050	0.046	0.063	0.068	0.059	0.064	0.042	0.048	0.049	0.033	0.035	0.060	0.062	0.058	0.058	0.066
P2	0.041	0.000	0.058	0.071	0.059	0.057	0.049	0.032	0.066	0.075	0.071	0.044	0.062	0.069	0.073	0.073	0.064	0.068
P3	0.027	0.051	0.000	0.044	0.032	0.044	0.045	0.019	0.033	0.042	0.045	0.066	0.069	0.055	0.063	0.075	0.068	0.080
P4	0.033	0.060	0.050	0.000	0.069	0.055	0.064	0.018	0.050	0.049	0.041	0.064	0.032	0.053	0.057	0.055	0.048	0.055
P5	0.044	0.054	0.045	0.072	0.000	0.042	0.050	0.042	0.050	0.050	0.059	0.046	0.046	0.054	0.037	0.030	0.035	0.037
P6	0.059	0.068	0.053	0.057	0.049	0.000	0.071	0.060	0.035	0.050	0.036	0.046	0.044	0.031	0.036	0.035	0.039	0.054
P7	0.046	0.054	0.035	0.057	0.059	0.077	0.000	0.054	0.040	0.045	0.049	0.058	0.031	0.046	0.046	0.035	0.040	0.054
P8	0.060	0.058	0.024	0.028	0.041	0.071	0.054	0.000	0.028	0.037	0.035	0.051	0.032	0.037	0.051	0.050	0.069	0.069
S1	0.049	0.062	0.037	0.067	0.050	0.044	0.051	0.033	0.000	0.080	0.057	0.048	0.045	0.062	0.058	0.054	0.032	0.030
S2	0.046	0.058	0.037	0.046	0.048	0.046	0.057	0.035	0.073	0.000	0.067	0.051	0.051	0.053	0.048	0.039	0.035	0.042
S3	0.041	0.059	0.036	0.062	0.059	0.053	0.060	0.040	0.058	0.060	0.000	0.042	0.055	0.076	0.057	0.055	0.042	0.033
S4	0.036	0.054	0.054	0.049	0.051	0.067	0.059	0.033	0.042	0.040	0.033	0.000	0.060	0.048	0.046	0.046	0.046	0.051
S5	0.019	0.064	0.062	0.049	0.048	0.039	0.041	0.015	0.049	0.055	0.054	0.057	0.000	0.058	0.048	0.053	0.042	0.059
T1	0.049	0.069	0.045	0.051	0.046	0.046	0.049	0.024	0.055	0.063	0.082	0.055	0.057	0.000	0.069	0.060	0.051	0.048
T2	0.032	0.058	0.073	0.050	0.053	0.031	0.040	0.032	0.045	0.048	0.063	0.037	0.050	0.072	0.000	0.080	0.060	0.060
T3	0.036	0.059	0.072	0.055	0.041	0.040	0.048	0.026	0.049	0.051	0.063	0.058	0.055	0.069	0.072	0.000	0.066	0.067
T4	0.037	0.049	0.069	0.055	0.049	0.051	0.040	0.039	0.037	0.050	0.048	0.055	0.045	0.055	0.058	0.069	0.000	0.072
T5	0.045	0.069	0.073	0.041	0.028	0.045	0.044	0.060	0.033	0.037	0.042	0.055	0.055	0.046	0.064	0.073	0.073	0.000

Table 5. Normalized Fuzzy Direct Relationship Matrix (Edited Version- U)

	P1	P2	P3	P4	P5	P6	P7	P8	S1	S2	S3	S4	S5	T1	T2	T3	T4	T5
P1	0.000	0.055	0.056	0.053	0.063	0.064	0.060	0.063	0.049	0.052	0.053	0.043	0.044	0.062	0.062	0.059	0.060	0.064
P2	0.046	0.000	0.059	0.065	0.061	0.058	0.054	0.042	0.066	0.066	0.066	0.050	0.061	0.065	0.066	0.066	0.062	0.067
P3	0.036	0.055	0.000	0.051	0.042	0.051	0.052	0.032	0.043	0.048	0.049	0.063	0.066	0.058	0.062	0.067	0.064	0.068
P4	0.043	0.059	0.055	0.000	0.064	0.056	0.062	0.031	0.053	0.052	0.048	0.064	0.042	0.054	0.060	0.059	0.054	0.057
P5	0.048	0.057	0.049	0.064	0.000	0.048	0.054	0.048	0.054	0.056	0.062	0.053	0.053	0.057	0.046	0.040	0.044	0.046
P6	0.059	0.063	0.058	0.056	0.053	0.000	0.064	0.060	0.043	0.054	0.045	0.048	0.050	0.039	0.043	0.041	0.043	0.054
P7	0.050	0.056	0.044	0.055	0.061	0.066	0.000	0.057	0.046	0.052	0.054	0.058	0.041	0.053	0.053	0.044	0.048	0.058
P8	0.061	0.057	0.034	0.039	0.048	0.065	0.057	0.000	0.039	0.045	0.043	0.055	0.040	0.045	0.056	0.054	0.065	0.065
S1	0.055	0.062	0.046	0.063	0.054	0.049	0.055	0.043	0.000	0.068	0.059	0.053	0.052	0.059	0.059	0.056	0.042	0.040
S2	0.052	0.059	0.045	0.049	0.054	0.051	0.061	0.044	0.065	0.000	0.063	0.056	0.056	0.056	0.053	0.046	0.044	0.050
S3	0.047	0.060	0.044	0.059	0.060	0.056	0.061	0.048	0.057	0.058	0.000	0.050	0.058	0.065	0.056	0.055	0.050	0.042
S4	0.043	0.057	0.057	0.055	0.051	0.064	0.060	0.043	0.049	0.048	0.043	0.000	0.059	0.054	0.053	0.053	0.053	0.054
S5	0.032	0.063	0.061	0.053	0.050	0.046	0.049	0.029	0.055	0.059	0.055	0.058	0.000	0.061	0.052	0.055	0.048	0.058
T1	0.054	0.064	0.051	0.055	0.052	0.053	0.055	0.036	0.058	0.061	0.068	0.058	0.060	0.000	0.066	0.059	0.056	0.053
T2	0.041	0.059	0.066	0.054	0.054	0.041	0.046	0.042	0.052	0.052	0.062	0.046	0.055	0.066	0.000	0.068	0.060	0.060
T3	0.044	0.058	0.066	0.056	0.049	0.046	0.054	0.037	0.053	0.055	0.063	0.058	0.057	0.061	0.065	0.000	0.064	0.063
T4	0.046	0.053	0.062	0.058	0.054	0.057	0.050	0.045	0.046	0.056	0.053	0.060	0.052	0.056	0.058	0.064	0.000	0.066
T5	0.052	0.065	0.066	0.049	0.039	0.052	0.050	0.059	0.043	0.046	0.049	0.056	0.054	0.049	0.061	0.066	0.062	0.000

The defuzzificated total relationship matrix of the values given in Appendix B, $(\widetilde{D_i} + \tilde{R}_i)^{Def}$ and $(\widetilde{D_i} - \tilde{R}_i)^{Def}$ values calculated by row and column sums are given in Table 6.

Table 6. $(\widetilde{D_i} + \tilde{R}_i)^{Def}$ ve $(\widetilde{D_i} - \tilde{R}_i)^{Def}$ Values

Criteria	D_i	R_i	$(\widetilde{D_i} + \tilde{R}_i)^{Def}$	$(\widetilde{D_i} - \tilde{R}_i)^{Def}$
P1	-17.435	66.254	48.819	-83.690
P2	-16.214	-120.063	-136.277	103.849
P3	-15.336	-74.828	-90.164	59.492
P4	-12.429	-420.042	-432.471	407.613
P5	-15.255	-447.203	-462.458	431.948
P6	-11.594	-43.158	-54.752	31.564
P7	-17.602	-156.699	-174.301	139.097
P8	-12.206	240.745	228.539	-252.951
S1	-15.413	11.377	-4.036	-26.789
S2	-12.349	34.764	22.415	-47.113
S3	-16.235	153.899	137.664	-170.134
S4	-13.324	-129.976	-143.299	116.652
S5	-13.085	3.337	-9.748	-16.422
T1	-12.378	148.046	135.667	-160.424
T2	-13.551	105.433	91.881	-118.984
T3	-12.331	279.387	267.056	-291.718
T4	-16.155	71.267	55.112	-87.422
T5	-13.123	21.445	8.321	-34.568

Among the values in Table 6, those with positive values in column 3 and those with negative coefficients in column 4 represent the effect group, and those with negative values in column 3 and positive coefficients in column 4 represent the cause group. If the values in Column 3 and Column 4 are both positive or both negative, they are criteria in both the effect and cause groups. While the influencing criteria are included in the recruitment process at certain rates, the affected criteria affect the recruitment process more intensely by including other criteria. Recruitment priorities and values obtained by using Equations 16 and 17 are given in Figure 3.

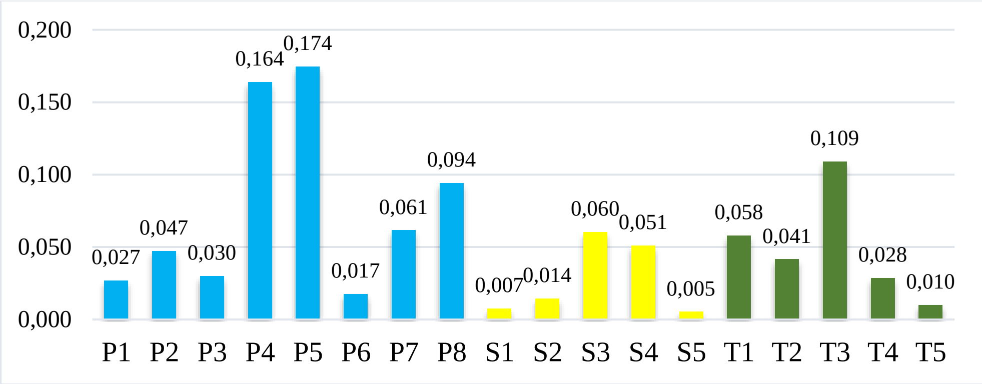

Figure 3. Defense Acquisition Personnel Recruitment Priorities

When Figure 3 is examined, the importance of the criteria for independent and determined work (P4) and taking initiative (P5) in the personal characteristics group draws attention. When the values of these two criteria in Table 6 are examined, it is concluded that they are the cause criteria and they have a significant impact on the recruitment process both on the basis of all criteria and within the criteria in the group they are included in. Strategic thinking (S3) and flexibility (S4) criteria in the strategic awareness group are also the most important criteria in their own group. When the values of these criteria in Table 6 are examined, it is seen that strategic thinking (S3) is included in the problem as the effect criterion and flexibility (S4) as the cause criterion. The criterion of being able to coordinate (T3) in the team management group has a higher degree of importance compared to the other criteria in the group in which it is located, and it is seen that it is the third most important criterion affecting the recruitment process among all criteria. The threshold value was calculated as 0.790 with the arithmetic mean of the Defuzzificated Total Relationship Matrix, defuzzificated by the CFCS method, and the effect diagram is presented in Figure 4.

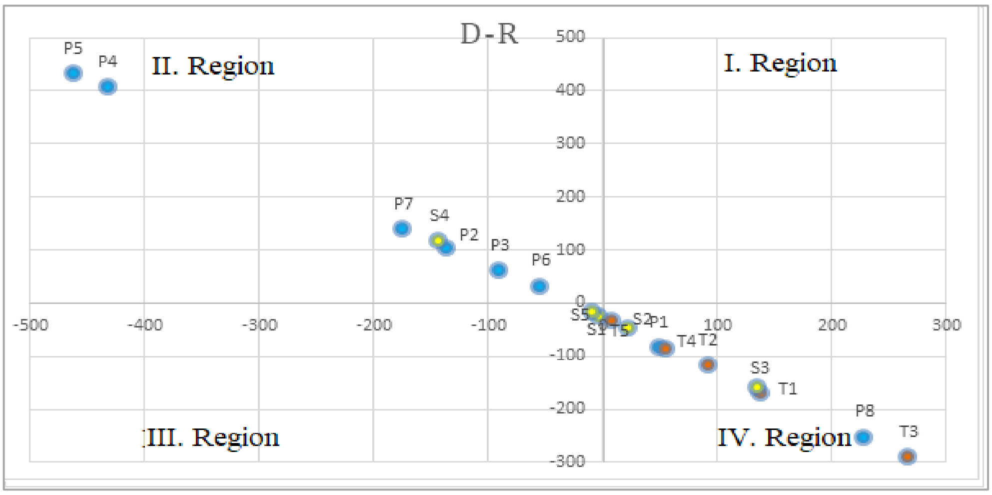

Figure 4. Impact Diagram

When the impact diagram given in Figure 4 is examined, it can be seen more clearly which criteria are effect, which are the cause, and which are both effect and cause criteria. In the impact diagram, those falling into the first and third regions are the criteria that both effect and are the cause, those that fall into the second region are the cause, and those that fall into the fourth region are the effect criteria. When the diagram is examined, it is seen that most of the criteria are gathered around the origin and generally fall into the second and fourth regions. Contrary to this situation, criteria P4 and P5 were significantly separated from other criteria in the cause group. This situation resulted in the interaction of these criteria with other criteria in personnel selection. Similarly, it is noteworthy that T3 and P8 criteria differ from other criteria in the effect group. Although it did not interact much with other criteria, it was seen that it was scored as the dominant criterion by the decision-makers. There are only S1 and S5 criteria falling into the third region. This situation enables us to conclude that these criteria are both effect and cause criteria. However, due to their proximity to the origin, they are not significantly differentiated. Another remarkable situation is that the points on the impact diagram show a linear distribution and do not diverge too much from each other. The reason for this situation is that the people who weigh the criteria are the personnel specialized in the defense sector and the defense acquisition process. It has been evaluated that since the relevant personnel has had many years of experience in this sector, the scoring they made in the criteria evaluations was due to their consensus. It is thought that the distribution may not be linear in the scoring of HRM experts from different sectors instead of those in the same sector.

5. CONCLUSIONS

In this study, the criteria that should be evaluated in the recruitment processes of the personnel who will work in the defense acquisition process have been put forward and a decision support proposal has been made. The criteria to be evaluated have been determined as 18 in total under 3 groups, namely personal characteristics, strategic awareness, and team management, by 17 people who have gained many years of experience in the sector and are experts in this field. The FDEMATEL method, which has been used frequently in the literature in recent years, has been used to analyze the importance of these criteria and the interaction between them.

When the results of the applied method were examined, it was concluded that the three criteria with the highest importance were determination and independent work, taking initiative, and being able to coordinate, respectively. In order to analyze the interactions between the criteria in more detail, an impact diagram was created. When the effect diagram created is examined, the most affected criteria are determination, independent work, and taking initiative among the two criteria with the highest degree of importance; criteria were determined. In addition to these, it was concluded that foreign language and coordination criteria were the most influential criteria. These results reveal that in order for the personnel to work in the defense acquisition process to operate the process effectively and efficiently, they must first be determined about the acquisition of defense, which is a long process, and take the initiative when necessary, while both managing their own decisions and taking responsibility on behalf of the team. The defense acquisition process is long-term and requires intensive coordination of many stakeholders, especially in projects and studies that require joint production and cooperation. The realization of these projects and studies with foreign partners on international platforms and the follow-up of developing defense technologies make it inevitable to use a foreign language at a high level. In this context, coordination and foreign language are among the most important issues that those who will work in the defense acquisition process should have, which were found to be the most important criteria affecting the acquisition process in the study. These results show that the defense industry differs from other personnel selection problems in the literature. It has been observed that criteria such as professional qualifications and communication skills, which are thought to be important for the personnel to be recruited in studies in other sectors such as tourism and manufacturing, have a lesser effect in the defense sector (Gilan et al., 2012; Urosevic et al., 2017; Demirci & Kılıç, 2019).

The findings obtained in the study are limited to the results obtained from the method used. The fact that the scores of the criteria will vary in the results obtained by the opinions of different experts or the use of different methods should be taken into consideration. In addition, similar future studies may address specific issues regarding what the selection criteria should be for those who will take part in certain stages of the process (such as identification of needs or design and product development) rather than the entire defense acquisition process. The study can be applied by integrating with another MCDM method in which candidate personnel are evaluated.

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Appendix A

Fuzzy Direct Relationship Matrix

	P1	P2	P3	P4	P5	P6	P7	P8	S1	S2	S3	S4	S5	T1	T2	T3	T4	T5
P1	0	(0.75, 1, 1)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0, 0.25, 0.5)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)
P2	(0, 0.25, 0.5)	0	(0.5, 0.75, 1)	(0.75, 1, 1)	(0.75, 1, 1)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.75, 1, 1)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.5, 0.75, 1)
P3	(0, 0.25, 0.5)	(0.5, 0.75, 1)	0	(0.5, 0.75, 1)	(0, 0.25, 0.5)	(0.5, 0.75, 1)	(0, 0.25, 0.5)	(0, 0.25, 0.5)	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.75, 1, 1)	(0.75, 1, 1)	(0.5, 0.75, 1)
P4	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0.75, 1, 1)	0	(0.5, 0.75, 1)	(0, 0.25, 0.5)	(0.5, 0.75, 1)	(0, 0, 0.25)	(0, 0.25, 0.5)	(0, 0.25, 0.5)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0, 0.25, 0.5)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0, 0.25, 0.5)	(0, 0.25, 0.5)	(0, 0.25, 0.5)
P5	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.75, 1, 1)	0	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0, 0.25, 0.5)	(0, 0.25, 0.5)	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0, 0.25, 0.5)	(0, 0.25, 0.5)	(0, 0.25, 0.5)
P6	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	0	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0, 0, 0.25)	(0, 0, 0.25)
P7	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.75, 1, 1)	(0.75, 1, 1)	(0.75, 1, 1)	0	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0, 0, 0.25)	(0, 0.25, 0.5)
P8	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0, 0.25, 0.5)	(0.5, 0.75, 1)	(0, 0.25, 0.5)	(0.75, 1, 1)	(0.25, 0.5, 0.75)	0	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.75, 1, 1)	(0.25, 0.5, 0.75)	(0, 0.25, 0.5)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.5, 0.75, 1)
S1	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0, 0, 0.25)	0	(0.75, 1, 1)	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0, 0.25, 0.5)	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0, 0.25, 0.5)	(0, 0, 0.25)
S2	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0, 0, 0.25)	(0.75, 1, 1)	0	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0, 0.25, 0.5)	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0, 0.25, 0.5)	(0, 0.25, 0.5)
S3	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0, 0, 0.25)	(0.25, 0.5, 0.75)	(0, 0.25, 0.5)	0	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)
S4	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0, 0.25, 0.5)	(0.5, 0.75, 1)	(0, 0.25, 0.5)	(0, 0, 0.25)	(0.25, 0.5, 0.75)	(0, 0.25, 0.5)	(0, 0.25, 0.5)	0	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0, 0.25, 0.5)	(0, 0.25, 0.5)
S5	(0, 0, 0.25)	(0.5, 0.75, 1)	(0.75, 1, 1)	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0, 0, 0.25)	(0, 0, 0.25)	(0, 0, 0.25)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	0	(0, 0.25, 0.5)	(0, 0.25, 0.5)	(0, 0.25, 0.5)	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)
T1	(0, 0.25, 0.5)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.75, 1, 1)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0.75, 1, 1)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	0	(0.75, 1, 1)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)
T2	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.75, 1, 1)	(0.75, 1, 1)	(0.5, 0.75, 1)	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0, 0, 0.25)	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0.75, 1, 1)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.75, 1, 1)	0	(0.75, 1, 1)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)
T3	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.75, 1, 1)	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0, 0, 0.25)	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.75, 1, 1)	(0.75, 1, 1)	0	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)
T4	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.75, 1, 1)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.25, 0.5, 0.75)	(0, 0.25, 0.5)	(0, 0, 0.25)	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.75, 1, 1)	(0.5, 0.75, 1)	(0.75, 1, 1)	0	(0.5, 0.75, 1)
T5	(0.5, 0.75, 1)	(0.5, 0.75, 1)	(0.75, 1, 1)	(0.5, 0.75, 1)	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0, 0.25, 0.5)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)	(0.75, 1, 1)	(0.5, 0.75, 1)	(0.75, 1, 1)	(0.75, 1, 1)	0

Appendix B

Total Relationship Matrix Defuzzificated with CFCS

	P1	P2	P3	P4	P5	P6	P7	P8	S1	S2	S3	S4	S5	T1	T2	T3	T4	T5
P1	4.084	-7.983	-5.198	-30.958	-33.635	-2.825	-11.322	17.542	1.054	3.408	10.843	-8.686	0.752	10.428	7.276	20.754	4.840	2.189
P2	5.193	-7.980	-6.214	-30.780	-33.469	-2.563	-11.805	18.587	0.386	2.974	11.831	-10.165	-1.107	11.953	8.230	21.645	5.065	2.006
P3	5.022	-7.206	-3.984	-23.921	-24.974	-3.168	-9.169	13.264	0.756	1.614	9.190	-8.448	-0.337	8.925	6.422	15.918	4.089	0.673
P4	3.870	-5.490	-4.881	-22.511	-24.335	-1.781	-8.526	13.900	0.176	1.543	8.689	-7.913	-1.290	8.658	6.211	15.835	4.006	1.411
P5	3.781	-7.116	-3.605	-24.101	-25.694	-2.593	-8.877	13.119	0.927	2.305	8.511	-6.786	1.162	8.062	5.541	15.426	3.658	1.026
P6	2.635	-5.422	-3.610	-17.638	-18.825	-2.080	-6.530	10.474	0.503	1.218	6.464	-5.451	0.072	6.156	4.589	11.632	3.340	0.877
P7	4.092	-8.253	-3.921	-29.037	-30.324	-3.151	-10.567	15.422	1.127	2.876	9.837	-7.366	1.870	9.309	6.150	18.455	4.128	1.751
P8	2.919	-5.687	-3.365	-20.161	-21.703	-2.015	-7.517	11.117	0.622	1.721	7.333	-6.000	0.355	7.035	4.951	13.492	3.484	1.212
S1	3.718	-7.438	-3.355	-22.613	-22.994	-2.982	-7.899	11.920	0.659	1.502	8.061	-6.520	0.976	7.584	5.315	14.232	3.656	0.766
S2	3.183	-5.449	-4.832	-23.133	-26.162	-1.471	-9.232	14.329	0.195	2.272	8.654	-7.276	-0.298	8.708	6.192	16.453	3.910	1.608
S3	4.249	-7.564	-4.720	-28.195	-30.539	-2.606	-10.309	15.988	0.981	2.719	9.682	-8.184	0.316	9.800	6.804	19.143	4.349	1.850
S4	2.603	-6.120	-4.298	-24.223	-26.963	-1.814	-9.050	14.036	0.752	3.083	8.266	-6.657	0.860	8.012	5.801	16.438	4.014	1.936
S5	3.547	-6.197	-3.257	-18.529	-18.763	-2.328	-6.743	10.565	0.556	0.490	7.246	-6.543	-0.169	6.359	4.832	11.786	3.592	0.472
T1	2.690	-5.914	-3.832	-18.845	-20.093	-1.999	-7.360	10.880	0.514	1.712	6.984	-5.561	0.365	6.438	5.016	12.241	3.765	0.622
T2	3.982	-6.412	-3.799	-19.951	-20.274	-2.500	-7.409	11.886	0.484	0.657	7.978	-7.667	-0.190	7.023	5.198	12.996	3.860	0.609
T3	3.034	-5.845	-4.110	-19.789	-21.218	-1.888	-7.688	11.758	0.269	1.574	7.438	-6.260	-0.330	7.604	5.310	13.097	3.870	0.842
T4	4.661	-7.691	-4.179	-25.189	-25.725	-3.006	-9.095	14.402	0.728	1.331	9.528	-8.557	0.144	8.703	6.577	16.238	4.020	0.956
T5	2.991	-6.297	-3.666	-20.470	-21.512	-2.388	-7.600	11.558	0.688	1.787	7.363	-5.936	0.186	7.289	5.016	13.607	3.620	0.639