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RESEARCH ARTICLE

Recruitment Model Proposal for IT Manager with SWARA, ARAS and GRA Methods

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ABSTRACT
In the information age, one of the most strategic departments for modern businesses is the information technology department. Modern businesses receive the necessary support from the information technology department to keep up with the digital age and follow technological developments. Therefore, managers working in these departments must have the necessary skills in both informatics and management. In this study, a model was proposed using multi-criteria decision-making methods for the selection of an information technology manager for a food company. In the first stage of the model, criteria were determined according to the test subjects applied by the company under different titles to measure the professional and academic knowledge of the applicant candidates and the criteria were weighted with the SWARA method. In the second stage, an objective decision matrix was created by using the test scores of the candidates. In the last stage, the best candidate for the company was determined with the ARAS and Gray Relational Analysis method. The greatest contribution of the study to the literature is to show the applicability of a model that combines the objective decision matrix and subjective evaluations.

Keywords: Information Technology Manager, Multi-Criteria Decision Making, SWARA, ARAS, Grey Relational Analysis

1. Introduction

Developments in information technology have changed business structures and organizational processes. Today, every organization knows the benefits of information technologies to businesses and their ability to create competitive advantage. The current worldwide mobility shows that information technologies will continue to be an important source for the development of businesses. The intensive use of information technologies has made businesses more innovative, accelerated business processes and increased their competitive power. For this reason, information technologies are seen as a competitive tool for businesses. In the future, only organizations with technological solutions will be able to have competitive advantage [1].

Due to the increasing competition conditions, the survival of companies becomes possible by quickly adapting to new methods and information technologies. Information technologies used in companies can be summarized as computers, communication technologies, internet, robots, office automation systems, management information systems, expert systems, decision support systems, artificial intelligence and electronic data exchange systems [2]. An expert workforce is needed to use these technologies in business activities. It is extremely important for individuals working in the information technologies department to have the necessary skills in both informatics and management in order to meet the technological needs of companies and to ensure the functioning of the department.

In this study, a model for the selection of an information technology manager for a food company is proposed. A new recruitment model has been developed for the information technology department, which is one of the most strategic departments for modern businesses, by using multi-criteria decision making (MCDM) methods. The difference of the study from other recruitment models is that both an objective assessment is made during the recruitment process, and the subjective opinions of the company managers are also taken into account. In the study, the criteria weights were determined by the SWARA (Step - Wise Weight Assessment Ratio Analysis) method, while the selection of the information technology manager was determined by the ARAS (AdditiveRatioASSessment) and GRA (Grey Relational Analysis) methods and the results were compared.

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The study consists of 6 sections in total. In the second section following the introduction, general information about information technologies is presented. In the third section, a literature review is conducted on the subject and studies conducted in this field are examined. In the fourth section, the methods used in the study are explained in detail. In the fifth section, the analysis process of the study is modeled, and its findings are given. In the last section, the study results are evaluated, and suggestions are made for researchers who will conduct studies on similar subjects.

2. Information Technologies Manager

With the effect of globalization, developments in computer and communication technologies and increasing competition conditions have made it necessary for companies to use information technologies more. Today, information technologies are used in many areas such as education, health, trade, entertainment, communication and transportation. The use of information technologies brings many advantages for both individuals and businesses. In particular, the use of the most widely used internet makes life easier for individuals and quickly brings the work done to a conclusion. Information technologies are very important in creating a more secure environment for the acquisition, storage and transmission of information and for businesses to control and manage their processes more effectively and efficiently. In addition, information technologies make great contributions to companies in order to reduce the costs of businesses and increase their efficiency [3].

The main duties of IT (Information Technology) managers in private companies are to manage the company's information technology infrastructure and develop strategic solutions to increase efficiency by digitizing business processes. IT managers determine information technology policies and data security standards, and undertake the planning, installation, maintenance and optimization of the company's entire technology infrastructure (networks, servers, databases, software). In this context, they take precautions against cyber threats for data security and create risk management strategies. In addition, their job descriptions include integrating corporate applications such as ERP (Enterprise Resource Planning) and CRM (Customer Relationship Management) into the company's business processes and ensuring their effective use, training and supporting users on these systems. They automate manual processes by managing the digital transformation process and try to increase the efficiency of the company by adapting new technologies (cloud solutions, artificial intelligence, IoT) to business models.

IT managers manage the company's IT budget, ensure efficient use of resources, and evaluate the technology needs of departments by constantly communicating with business units. They work in compliance with legal regulations (e.g. KVKK - Personal Data Protection Law) and implement procedures to ensure data security and confidentiality. Thus, they support the competitive advantage of the company with multifaceted tasks such as strategic IT planning, digital transformation, and process optimization. Thanks to these efforts, the company's technological infrastructure is both secure and constantly evolving, which allows IT to create value in line with the company's general goals.

MCDM methods enable the evaluation of decision alternatives by solving decision problems that include many criteria. These methods are frequently used to solve decision problems that include many criteria in the process, such as personnel selection.

3. Literature Research

It is possible to find many different studies with different methods on personnel selection in the literature. Some of the studies conducted using multi-criteria methods are given in Table 1.

4. Methods

In this study, SWARA was used to weight the criteria, and ARAS and GRA methods were used to determine the performance of the candidates.

4.1. SWARA Method

The SWARA method, which can be translated into Turkish as "Step-by-Step Weight Assessment Ratio Analysis", was developed by Keršulienė, Zavadskas and Turskis in 2010. This method has been successfully applied to solve many MCDM problems to date. It has been widely used in many fields in recent years due to reasons such as being very suitable for working with experts and being very easy to use [30], [31], [32], [33].

In this method, the decision maker first ranks the criteria in decreasing order of importance. In the presence of more than one decision maker, each decision maker ranks the criteria in decreasing order of importance. Accordingly, the criterion ranking is obtained as many as the number of decision makers. In the group decision application, the general ranking is determined by taking the geometric mean of the criterion rankings determined by the decision makers. Based on the general ranking, the criteria are compared with the previous criterion starting from the 2nd criterion by the decision makers. Each decision maker individually compares the criteria in the general ranking. The weights of the criteria are determined according to the SWARA method after the comparisons of the decision makers. As a result, priority vectors showing the weights of the criteria as many as the number of decision makers emerge. As the last step, the geometric mean of the priority value of each criterion is taken and the final general priority values are obtained [30], [33], [34].

In the SWARA method, the required comparison rates are significantly lower compared to other flares, so the separation parts made through the survey provide much more accurate answers, allowing the SWARA method to be more accurate. In the SWARA method, the criteria can be evaluated freely without any parts [35].

The process of determining the weight of the criteria using the SWARA distribution includes the following steps [31], [35].

Table 1. Literature Research

Year	Author(s)	Method	Application Area
2024	B. Tezcan and T. Eren [4]	Defense industry project manager AHP- Pisagor Fuzzy TOPSIS	Defense industry project manager selection
2024	E. Genç, et al. [5]	Grey MAUT and Grey MOORA	Personnel selection in the tourism sector
2022	G. Elmas [6]	Fuzzy TOPSIS	Selection of sales representative for the maritime department
2021	A. Taş and P. Ç. Karataş [7]	AHP and TOPSIS	Selection of a project manager in a software company
2021	M. Popović [8]	SWARA and CoCoSo	Personnel selection
2020	E. Ayçin [9]	CRITIC and MAIRCA	Selection of personnel for the information systems department
2020	C. T. Chen and W.Z. Hung [10]	TOPSIS and PROMETHEE	Selection of overseas marketing manager
2020	A. Raj Mishra et al.[11]	IF and ARAS	Selection of information technologies personnel
2020	G. Elidolu et al. [12]	Fuzzzy AHP	Selection of the ship crew
2019	C. Erdin [13]	Fuzzy TOPSIS	Site manager selection
2019	A. Ulutaş [14]	Entropi and MABAC	Marketing manager selection
2019	B. Yıldırım et al. [15]	ARAS	Personnel selection in the aviation sector
2019	A. O. Kuşakçı et al. [16]	MULTIMOORA, AHP and TOPSIS	Selection of expert personnel in the airline company
2018	N. Akça et al. [17]	Analytical Network Process	Selection of a financial manager
2018	Y. Çelikbilek [18]	Grey AHP and MOORA	Selection of managers in the healthcare sector
2018	A. Ulutaş et al. [19]	Fuzzy AHP and Fuzzy GRA	Production planning manager selection
2018	A. Tuş and E.A. Adalı [20]	CRITIC, CODAS and PSI	Selection of marketing personnel in the textile sector
2018	D. Karabašević et al. [21]	SWARA and EDAS	Personnel selection in the information systems sector
2017	M. D. Kenger and A. Organ [22]	Entropy and ARAS	Personnel selection in the banking sector
2017	L. O. Uğur [23]	MOORA	Construction project manager selection
2015	D. Karabašević et al. [24]	SWARA and ARAS	Selection of sales managers in the telecommunications sector
2015	R. M. Alguliyev et al. [25]	Fuzzy VIKOR	Selection of information technologies personnel
2015	R. P. Kusumawardani and M. Agintiara [26]	Fuzzy AHP and TOPSIS	Human resources manager selection
2015	A. Özbek [27]	MOORA	Academic unit manager selection

SWARA Process Steps

- The criteria are ranked in decreasing order of importance. In cases where there is more than one decision maker, each decision maker ranks the criteria individually in decreasing order and an overall ranking is created by taking the geometric mean of the rankings [31], [36].
- Starting from the 2nd criterion; (j+1) criterion is compared with the jth criterion and the importance level s_j of the jth criterion is determined.
- The variable k_j, shown in equation (1), is obtained by pairwise comparison of the criteria and expresses how important the jth criterion is compared to the (j+1)th criterion.

$$k_j = \begin{cases} 1 & j = 1 \\ s_j + 1 & j > 1 \end{cases} \quad (1)$$

- The q_j variable, which shows the corrected value, is calculated as shown in Equation 2 and takes a value between 1 and 0 [37].

$$q_j = \begin{cases} 1 & j = 1 \\ \frac{q_{j-1}}{k_j} & j > 1 \end{cases} \quad (2)$$

- The relative weights w_j of the criteria are determined as shown in Equation 3.

$$w_j = \frac{q_j}{\sum_{k=1}^{n} q_k} \quad (3)$$

4.2. ARAS Method

The ARAS method is a method developed by Zavadskas and Turskis for solving MCDM problems and compares the benefit function value ratios of the decision options with the most appropriate benefit function value [33].

ARAS Process Steps [38]

- The decision matrix is created. The rows of the decision matrix represent the options, and the columns represent the criteria.
- A row of the decision matrix consisting of optimal values is placed in the matrix as the first row.
- The decision matrix is normalized using Equality 4 for benefit-oriented criteria and 5 for cost-oriented criteria.

$$\bar{x}_{ij} = \frac{x_{ij}}{\sum_{i=0}^{m} x_{ij}} \quad (4)$$

$$x_{ij} = \frac{1}{x_{ij}^*}; \qquad \bar{x}_{ij} = \frac{x_{ij}}{\sum_{i=0}^{m} x_{ij}} \quad (5)$$

- Each criterion $\bar{x}_{ij}$ of the normalized matrix is weighted by multiplying it with the corresponding criterion weight w_j as shown in Equation 6.

$$\hat{x}_{ij} = \bar{x}_{ij}\, w_j; \quad i = 0, \dots, m; \quad j = 1, \dots, n \quad (6)$$

- The optimality function value of the decision options is calculated using Equation 7.

$$S_i = \sum_{j=1}^{n} \hat{x}_{ij}; \quad i = 0, \dots, m; \quad j = 1, \dots, n \quad (7)$$

- The largest S_i value indicates the best option and the smallest S_i value indicates the worst option [38], [39].
- Equality 8 is used to calculate the benefit levels and sort them from largest to smallest.

$$K_i = \frac{S_i}{S_0}; \quad i = 0, \dots, m \quad (8)$$

4.3. Grey Relational Analysis

GRA is a method used to determine the degree of relationship between each criterion in a grey system and the reference series compared. The degree of relationship calculated as a result of the applied operations takes a value between 0 and 1 and is defined as the grey relationship degree [31].

Process steps of the GRA method [31], [40]

- The decision matrix is created. The rows of the decision matrix show the options x_i, and the performance value of the options according to each criterion is $x_i(j)$.
- The reference series is determined and placed in the first row of the decision matrix.
- The matrix is normalized according to the benefit, cost or most suitable situation of the criteria [31]. Equality (9) is used in the case of benefit, (10) in the case of cost and (11) in the most suitable situation.

$$x_i^* = \frac{x_i(j) - \min_j x_i(j)}{\max_j x_i(j) - \min_j x_i(j)} \quad (9)$$

$$x_i^* = \frac{\max_j x_i(j) - x_i(j)}{\max_j x_i(j) - \min_j x_i(j)} \quad (10)$$

$$x_i^* = \frac{|x_i(j) - x_{0b}(j)|}{\max_j x_i(j) - x_{0b}(j)} \tag{11}$$

- After the normalization process, the decision matrix is formulated as shown in Equation 12.

$$X_i^* = \begin{bmatrix} x_1^*(1) & x_1^*(2) & \cdots & x_1^*(n) \\ x_2^*(1) & x_2^*(2) & \cdots & x_2^*(n) \\ \vdots & \vdots & \ddots & \vdots \\ x_m^*(1) & x_m^*(2) & \cdots & x_m^*(n) \end{bmatrix} \tag{12}$$

- By determining the difference $\Delta_{0i}(j)$ of the absolute value between x_0^* and x_i^*, the absolute value matrix is created as formulated in Equation 13.

$$X_i^* = \begin{bmatrix} \Delta_{01}(1) & \Delta_{01}(2) & \cdots & \Delta_{01}(n) \\ \Delta_{02}(1) & \Delta_{02}(2) & \cdots & \Delta_{02}(n) \\ \vdots & \vdots & \ddots & \vdots \\ \Delta_{0m}(1) & \Delta_{0m}(2) & \cdots & \Delta_{0m}(n) \end{bmatrix} \tag{13}$$

- The grey relationship coefficient matrix is created with the help of Equation 14.

$$\gamma_{0i}(j) = \frac{\Delta \min + \zeta \Delta \max}{\Delta_{0i}(j) + \zeta \Delta \max} \tag{14}$$

The parameter ζ in Equation 14 regulates the difference between Δ_{0i} and Δ_{max} by taking a value in the range [0,1] and is called the Separating Coefficient [31].

- Grey relationship degrees are determined by Equality (15) when the criteria weights are equal, and by Equality (16) when they are different.

$$\Gamma_{0i} = \frac{1}{n}\sum_{j=1}^{n} \gamma_{0i}(j), \quad i = 1, \dots, m \tag{15}$$

$$\Gamma_{0i} = \sum_{j=1}^{n} [w_i(j)\gamma_{0i}(j)], \quad i = 1, \dots, m \tag{16}$$

Γ_{0i} shows the grey relationship degree, while w_i shows the importance degree of the ith criterion. After the grey relationship degree is calculated, it is sorted from largest to smallest. At the end of the sorting, it is determined that the option in the first place is the most suitable alternative.

5. Model, Dataset and Findings

In this study, an information technology manager selection was made for a food company operating in Turkey using the SWARA, ARAS and GRA methods in an integrated manner. The model developed for the selection process is given in the form of a flow chart in Figure 1.

Each part represents different stages of the process. This model aims to effectively evaluate IT manager candidates by providing a systematic approach.

The operation of the model is as follows:

- Determination of criteria according to test topics,
- Weighting of criteria,
  - The SWARA survey is applied to three managers of the company and the importance weights of the criteria are obtained. (General manager, chief technology officer and human resources manager)
- Receiving test scores of candidates,
- Creation of an objective decision matrix with test scores,
- Evaluation of candidates using MCDM methods.

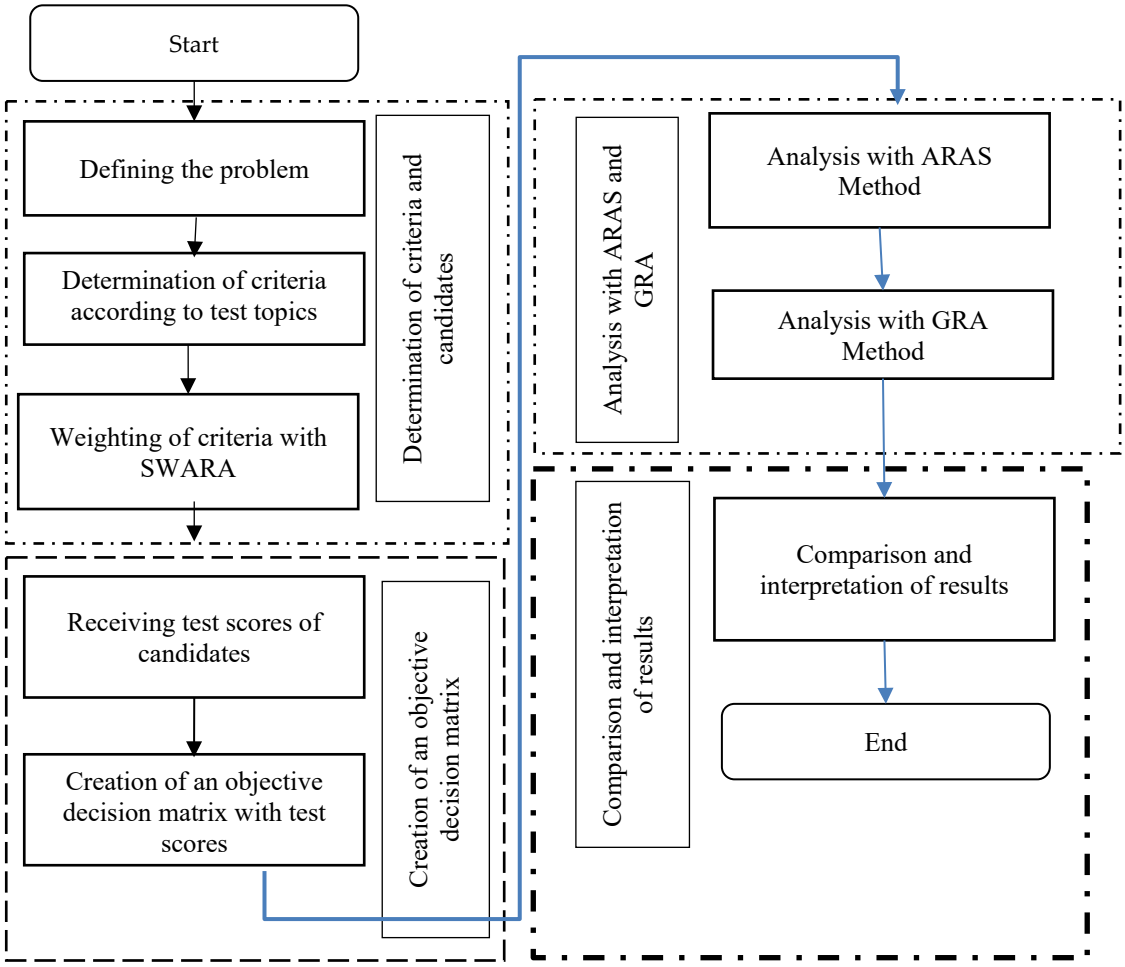

Figure 1: Proposed Model

5.1. Determination of Criteria

The criteria used in the study were determined according to the test titles applied by the company to the candidates. The criteria to be used in the analysis are given in Table 2.

Table 2. Decision Criteria

Decision Criteria	**Abbreviations**
Graduating from any of the Computer Science departments	C1
Foreign language knowledge	C2
Sectoral experience	C3
Ability to think systematically	C4
Process management skills	C5
Project management skills	C6
Linux system mastery	C7
Mastery of server operating systems	C8
Ability to manage database servers	C9
Ability to set up and manage networks	C10
Ability to set up and manage firewalls	C11
Ability to set up and manage virtual servers	C12
Ability to provide user support	C13
Monitoring and threat detection skills	C14
Interdepartmental harmony	C15
Problem solving skills	C16
Ability to follow and adapt to technological innovations	C17
Leadership	C18
Professional ethics	C19

5.2. Calculating Criteria Weights with SWARA Method

In the first stage of the study, 19 decision criteria were weighted. In the study, a subjective method, SWARA method, was used to weight the criteria. The importance of the criteria was determined by the subjective opinions of the company managers. The importance levels of the criteria were calculated by the comparisons made by the general manager, the chief technology officer and the human resources manager. The reason for this is to benefit from the opinions of the company managers for the selection of the most appropriate candidate.

In the first step of the method, three managers were asked to rank 19 criteria according to their importance levels. Table 3 shows the criteria ranking of each manager, the geometric mean of each criterion and the ranking of the criteria based on this mean, which will form the basis of the SWARA analysis.

Table 3. Ranking of Criteria According to Importance by Managers

Criterion	M1	M2	M3	Geometric Mean	Order
C1	2	1	19	3,362	3
C2	3	18	10	8,143	8
C3	1	2	9	2,621	2
C4	15	5	5	7,211	5
C5	14	6	7	8,378	9
C6	13	10	8	10,132	12
C7	12	15	15	13,925	17
C8	5	7	14	7,884	7
C9	6	8	13	8,545	10
C10	18	9	12	12,481	15
C11	7	11	16	10,720	13
C12	8	12	17	11,774	14
C13	17	16	11	14,410	18
C14	9	13	18	12,818	16
C15	19	19	2	8,971	11
C16	10	14	3	7,489	6
C17	11	4	4	5,604	4
C18	16	17	6	11,774	14
C19	4	3	1	2,289	1

Table 4. Comparison of Criteria by Managers

Criterion	Point	Order	M1	M2	M3
C19	2,289	1			
C3	2,621	2	0,45	0,20	0,2
C1	3,362	3	0,50	0,25	0,5
C17	5,604	4	0,35	0,50	0,4
C4	7,211	5	0,30	0,25	0,4
C16	7,489	6	0,25	0,20	0,4
C8	7,884	7	0,30	0,20	0,4
C2	8,143	8	0,25	0,25	0,4
C5	8,378	9	0,40	0,25	0,4
C9	8,545	10	0,35	0,10	0,4
C15	8,971	11	0,30	0,10	0,3
C6	10,132	12	0,25	0,10	0,2
C11	10,720	13	0,30	0,20	0,2
C12	11,774	14	0,25	0,10	0,2
C18	11,774	14	0,35	0,15	0,2
C10	12,481	15	0,30	0,10	0,2
C14	12,818	16	0,20	0,10	0,2
C7	13,925	17	0,2	0,10	0,2
C13	14,410	18	0,15	0,10	0,2

All criteria were ranked separately by each manager. According to Table 3, the most important criterion for the first manager was C3, for the second manager it was C1, and for the third manager it was C19. Then, the geometric means of the ranking scores given by the managers for each criterion were calculated. For example, the C19 criterion was ranked fourth for the first manager, third for the second manager, and first for the third manager. The geometric mean for the criterion was calculated as 2.289. According to this score, the C19 criterion ranked first among the other criteria.

In the second stage of the method, the criteria ranked according to their importance by taking the geometric mean, starting from the (i+1)th criterion, were compared with the previous criterion, and it was determined how much more important the ith criterion was than the (i+1)th criterion. Table 4 shows the comparisons made by the managers.

As a result of the application of the SWARA method, three different criteria weight series (w_i) were obtained. The final weights of the criteria were found by taking the geometric average of the elements with the same index of these series (Table 5).

Table 5. Final Weights of Criteria According to SWARA Method

Criterion	w_1	w_2	w_3	Arithmetic Mean	Geometric Mean
C19	0,275	0,196	0,260	0,24367	0,24109
C3	0,190	0,163	0,217	0,19000	0,18871
C1	0,127	0,131	0,145	0,13433	0,13412
C17	0,094	0,087	0,103	0,09467	0,09444
C4	0,072	0,070	0,074	0,07200	0,07198
C16	0,058	0,058	0,053	0,05633	0,05628
C8	0,044	0,048	0,038	0,04333	0,04313
C2	0,036	0,039	0,027	0,03400	0,03359
C5	0,025	0,031	0,019	0,02500	0,02451
C9	0,019	0,028	0,014	0,02033	0,01953
C15	0,014	0,026	0,011	0,01700	0,01588
C6	0,012	0,023	0,009	0,01467	0,01354
C11	0,009	0,019	0,007	0,01167	0,01062
C12	0,007	0,018	0,006	0,01033	0,00911
C18	0,005	0,015	0,005	0,00833	0,00721
C10	0,004	0,014	0,004	0,00733	0,00607
C14	0,003	0,013	0,004	0,00667	0,00538
C7	0,003	0,012	0,003	0,00600	0,00476
C13	0,002	0,010	0,002	0,00467	0,00342

When Table 5 and Figure 2 are examined together, the C19 (Professional Experience) criterion is the criterion with the highest weight among the 19 criteria. The C3 (Sectoral Experience) criterion is in second place, and the C1 (graduate from any computer science department) criterion is in third place. The C13 (Ability to provide user support) criterion has the least weight and is the criterion with the lowest level of importance.

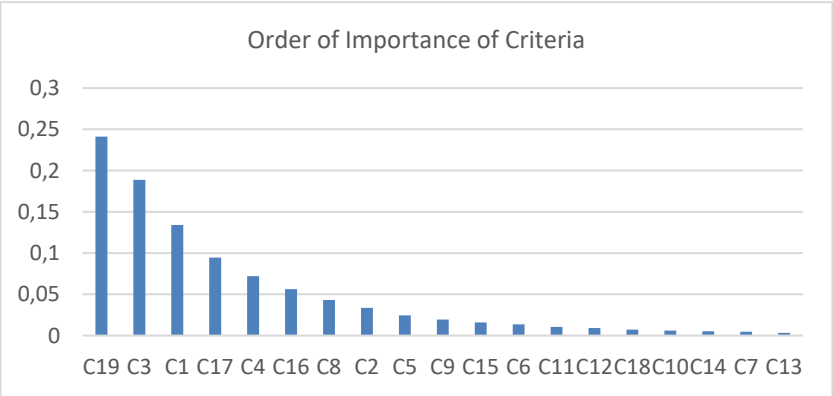

Figure 2. Order of Importance of Criteria

5.3. Selection of IT Manager with ARAS Method

In this study, MCDM methods were used to select an information technology manager for a food company. The company applied tests to 12 applicants according to certain criteria and an initial decision matrix was created based on the scores they received from the tests. Grading was done for the first three criteria in the matrix, and test scores were used for the other 16 criteria.

Among the criteria specified in Table 1, scoring for the C1 criterion was done with three grades according to the candidates' graduation (undergraduate, graduate and doctorate). Scoring for the C2 criterion was done with six grades according to the candidates' foreign language proficiency (A1, A2, B1, B2, C1, C2). Scoring for the C3 criterion was done with three grades according to their experience (1-5 years, 5-10 years, over 10). For the other 16 criteria, the scores of the answers to the test questions prepared by the company to measure the academic and professional knowledge of the candidates were used. For example, the C7 criterion is "Linux system mastery". A multiple-choice test was applied to understand the candidate's mastery of the Linux system and the scores they received are shown as the relevant criterion score in the initial decision matrix.

In the first step of the ARAS method, the initial decision matrix that will form the basis of the analysis is created. This created matrix will be considered as the initial decision matrix in other methods. For example, A1 (Candidate 1) received a total of 30 points from the test scores for the C5 criterion and 80 points from the C9 criterion. The initial decision matrix is shown in Table 6.

Table 6. Initial Decision Matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19
A1	2	5	1	30	30	20	40	50	80	60	50	50	40	10	10	80	30	10	40
A2	3	5	1	20	50	20	20	20	70	40	10	80	40	90	40	30	10	40	40
A3	3	6	2	10	40	10	70	40	40	50	70	20	80	30	20	40	40	50	50
A4	2	6	1	30	20	60	40	60	50	70	70	10	30	20	60	40	20	50	80
A5	1	5	3	40	30	50	70	80	10	60	30	40	70	90	60	40	50	60	40
A6	1	4	2	40	40	60	50	20	20	10	30	50	70	70	80	50	30	50	40
A7	1	5	3	20	50	30	30	30	70	50	60	50	10	30	20	30	50	10	30
A8	1	6	3	50	60	20	30	30	60	40	10	30	20	40	30	30	40	30	20
A9	2	5	2	20	70	60	70	30	30	20	40	10	30	50	50	40	60	40	40
A10	3	6	1	30	80	60	50	40	60	50	10	20	40	50	40	40	10	20	50
A11	2	4	2	40	90	50	70	40	40	20	50	40	40	30	10	20	40	60	40
A12	2	6	3	40	50	50	70	80	50	20	40	60	30	30	40	50	60	70	50

The initial decision matrix shown in Table 6 was analyzed according to the ARAS method and the results are given in Table 7. When Table 7 is examined, it is seen that the most suitable candidate for the food business is A12. However, A2 is at the bottom of the ranking and is determined to be the candidate that the company should not prefer. The first three candidates are A12, A5 and A4. The last three are A1, A6 and A2.

Table 7. Ranking of Candidates According to the ARAS Method

	Si	Ki	Order
Optimum	0,1205	1,000	
A1	0,0655	0,544	10
A2	0,0598	0,496	12
A3	0,0761	0,631	4
A4	0,0786	0,652	3
A5	0,0793	0,658	2
A6	0,0654	0,543	11
A7	0,0670	0,556	8
A8	0,0658	0,546	9
A9	0,0727	0,603	5
A10	0,0689	0,572	7
A11	0,0711	0,590	6
A12	0,0926	0,769	1

In the ARAS application without considering the criteria weights, no significant changes were observed in the candidates' rankings compared to the application with the criteria weights. When the criteria weights were taken into account, A12 ranked first and A5 ranked second; when the criteria weights were not taken into account, A5 ranked first and A12 ranked second. In other words, there was a change of place between the two candidates. In addition, A6 ranked 11th when the criteria weights were taken into account, but ranked 6th when the criteria weights were not taken into account. Apart from these, no significant change was observed in the general ranking according to both applications.

5.4. Selection of IT Manager with Grey Relational Analysis Method

The Grey relationship coefficient matrix in Table 8 was obtained by using the initial decision matrix shown in Table 6 and Equations (9)-(14).

Table 8. Grey Relationship Coefficient Matrix

A1	0,50	0,50	0,33	0,50	0,37	0,38	0,45	0,50	1,00	0,75	0,60	0,54	0,47	0,33	0,33	1,00	0,45	0,33	0,43
A2	1,00	0,50	0,33	0,40	0,47	0,38	0,33	0,33	0,78	0,50	0,33	1,00	0,47	1,00	0,47	0,38	0,33	0,50	0,43
A3	1,00	1,00	0,50	0,33	0,41	0,33	1,00	0,43	0,47	0,60	1,00	0,37	1,00	0,40	0,37	0,43	0,56	0,60	0,50
A4	0,50	1,00	0,33	0,50	0,33	1,00	0,45	0,60	0,54	1,00	1,00	0,33	0,41	0,36	0,64	0,43	0,38	0,60	1,00
A5	0,33	0,50	1,00	0,67	0,37	0,71	1,00	1,00	0,33	0,75	0,43	0,47	0,78	1,00	0,64	0,43	0,71	0,75	0,43
A6	0,33	0,33	0,50	0,67	0,41	1,00	0,56	0,33	0,37	0,33	0,43	0,54	0,78	0,67	1,00	0,50	0,45	0,60	0,43
A7	0,33	0,50	1,00	0,40	0,47	0,45	0,38	0,38	0,78	0,60	0,75	0,54	0,33	0,40	0,37	0,38	0,71	0,33	0,38
A8	0,33	1,00	1,00	1,00	0,54	0,38	0,38	0,38	0,64	0,50	0,33	0,41	0,37	0,44	0,41	0,38	0,56	0,43	0,33
A9	0,50	0,50	0,50	0,40	0,64	1,00	1,00	0,38	0,41	0,38	0,50	0,33	0,41	0,50	0,54	0,43	1,00	0,50	0,43
A10	1,00	1,00	0,33	0,50	0,78	1,00	0,56	0,43	0,64	0,60	0,33	0,37	0,47	0,50	0,47	0,43	0,33	0,38	0,50
A11	0,50	0,33	0,50	0,67	1,00	0,71	1,00	0,43	0,47	0,38	0,60	0,47	0,47	0,40	0,33	0,33	0,56	0,75	0,43
A12	0,50	1,00	1,00	0,67	0,47	0,71	1,00	1,00	0,54	0,38	0,50	0,64	0,41	0,40	0,47	0,50	1,00	1,00	0,50

After the Grey Relationship Coefficient Matrix was created, the Grey Relationship degrees showing the ranking of the candidates were obtained using Equality (16) and are given in Table 9. The graphical representation of the ranking of the candidates is given in Figure 3.

Table 9. Ranking of Candidates According to the GRA Method

	Degree	**Order**
A1	0,4697	11
A2	0,4800	10
A3	0,5635	5
A4	0,5989	3
A5	0,6031	2
A6	0,4584	12
A7	0,5368	6
A8	0,5654	4
A9	0,5139	8
A10	0,5338	7
A11	0,4890	9
A12	0,6916	1

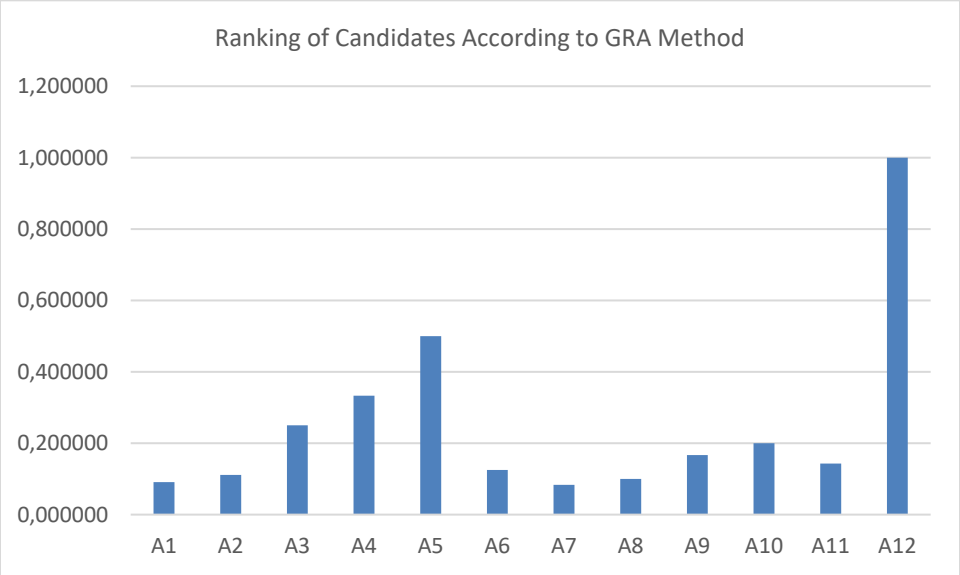

Figure 3. Ranking of Candidates According to GRA Method

The initial decision matrix shown in Table 6 was analyzed according to the GRA method and the results are given in Table 9. When Table 9 and Figure 3 are examined together, it is seen that the most suitable candidate for the food business is A12. However, A6 is at the bottom of the ranking and is determined to be the candidate that the company should not prefer. The first three candidates are A12, A5 and A4. The last three are A2, A1 and A6.

In the GRA application without considering the criteria weights, no significant changes were observed in the candidates' rankings compared to the application with the criteria weights. In the application with the criteria weights taken into account, A6 ranked 12th, A7 ranked 6th and A8 ranked 4th; in the application without considering the criteria weights, A6 ranked 8th, A7 ranked 12th and A8 ranked 10th. Apart from these, no significant changes were observed in the general ranking according to both applications.

When the applications made according to ARAS and GRA methods were compared (Figure 4), it was seen that the candidates' rankings were very similar. Only very small changes were observed in the candidates' rankings. The rankings of the first three candidates according to ARAS and GRA methods did not change. According to the ARAS method, A3 was in fourth place, while according to GRA method, A8 was in fifth place. According to the ARAS method, A9 was in fifth place, while according to the GRA method, A3 was in fifth place. According to the ARAS method, the last three places were A1, A6 and A2, while according to the GRA method, A2, A1 and A6 were in third place.

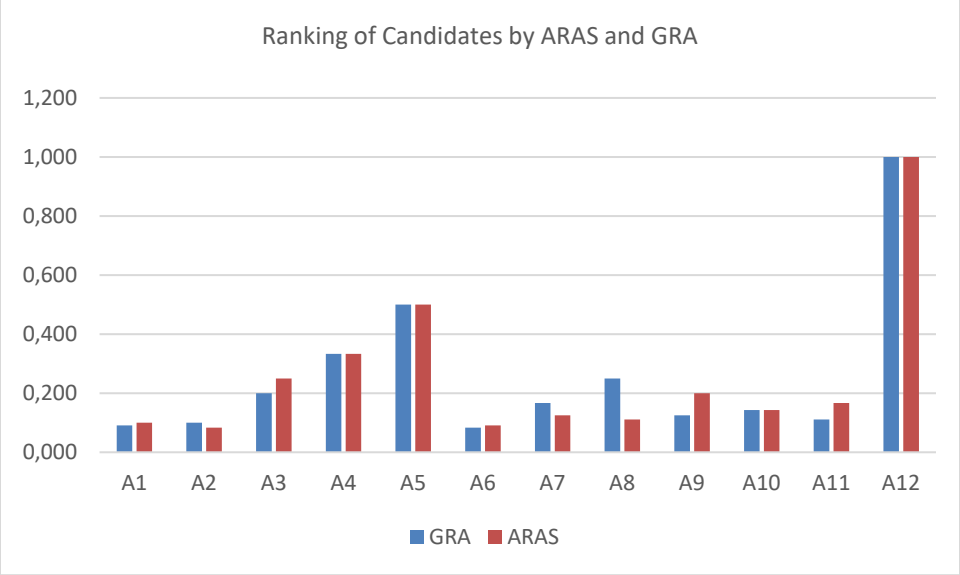

Figure 4. Ranking of Candidates According to ARAS and GRA Methods

6. Results

In recent years, the most important way for businesses to gain competitive advantage is to adapt to the requirements of the digital age and use technology accordingly. Information technologies make numerous contributions to the acceleration of business processes, increased efficiency and reduced operating costs. The most important task in this process falls on the information technology manager. For this reason, managers who will work in the information technology department should have both professional equipment and management skills.

In this study, 12 candidates were evaluated according to 19 criteria to be employed as an information technology manager in the information systems department of a company operating in the food sector. Since many criteria that may affect the decision are taken into consideration during the evaluation process, the most suitable candidate was determined by using MCDM methods. A new recruitment model was developed for the food company by using SWARA, ARAS and GRA methods in an integrated manner.

In the first stage of the model, criteria were determined according to the test subjects that the company applied under different headings to measure the professional and academic knowledge of the applicants and the criteria were weighted by SWARA method. According to the findings obtained with this method, the criterion with the highest weight among the 19 criteria was K19 (Professional ethics). The second criterion was K3 (Sectoral experience) and the third criterion was K1 (Graduating from any of the Computer Science departments). The criterion with the least weight and the lowest level of importance was K13 (Ability to provide user support).

In the next stage, an objective decision matrix was created by utilizing the test scores of the candidates and the best candidate was determined by ARAS and GRA methods. According to the analysis conducted using the ARAS method, A12 was found to be the most suitable candidate for the food business. However, A2 was at the bottom of the ranking and was determined as the candidate that the company should not prefer. The first three candidates were A12, A5 and A4. The last three places were A1, A6 and A2. There was no significant change in the ranking of the candidates in the ARAS application without taking into account the criteria weights compared to the application with the criteria weights. When criterion weights were taken into account, A12 ranked first and A5 ranked second; when criterion weights were not taken into account, A5 ranked first and A12 ranked second. In other words, there was a change in ranking between the two candidates. In addition, A6 ranked 11th when criterion weights were taken into account, while it ranked 6th when criterion weights were not taken into account. Apart from these, no significant change was observed in the overall ranking according to both applications.

According to the GRA method, A12 was found to be the most suitable candidate for the food business. However, A6 was at the bottom of the ranking and was determined as the candidate that the company should not prefer. The first three candidates were A12, A5 and A4. The last three places were A2, A1 and A6. There was no significant change in the ranking of the candidates in the GRA application made without taking into account the criteria weights compared to the application made with the criteria weights. In the application with criterion weights, A6 ranked 12th, A7 6th and A8 4th; in the application without criterion weights, A6 8th, A7 12th and A8 10th. Apart from these, there was no significant change in the overall ranking according to both applications.

When the applications made according to the ARAS and GRA methods were compared, it was observed that the ranking of the candidates was very similar. Only very small changes were observed in the ranking of the candidates. According to ARAS and GRA methods, the ranking of the first three candidates did not change. A3 ranked fourth according to the ARAS method and A8 ranked fifth according to the GRA method. According to the ARAS method, A9 ranked fifth, while A3 ranked fifth according to the GRA method. According to the ARAS method, A1, A6 and A2 took the last three places, while A2, A1 and A6 took the third place according to the GRA method.

The major contribution of the study to the literature is to demonstrate the applicability of a model that combines an objective decision matrix with subjective evaluations. A recruitment model that includes a scoring system that measures the professional and academic knowledge of candidates, and the subjective evaluations of managers can guide firms to identify the best candidate. However, since there are very few studies in the national literature in which SWARA-ARAS-GRA methods are applied in an integrated manner, it is thought that the study will contribute to the literature in this regard. Future researchers can apply the proposed recruitment model with different MCDM methods.

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Ethical Approval and Informed Consent: The test scores required for the objective decision matrix in the study were obtained from the company as secondary data under confidentiality. The data obtained from the company does not contain any information about the candidates. Only test scores were used. In addition, the comparisons made by the managers for the calculation of the criteria weights are given as a table in the study. Scientific and ethical principles have been followed and all sources utilized are shown in the bibliography section.

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