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Personnel Selection Based on Step-Wise Weight Assessment Ratio Analysis and Multi-Objective Optimization on the Basis of Ratio Analysis Methods

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***Abstract*—**Personnel selection process is considered as one of the most important and most difficult issues in human resources management. At the stage of personnel selection, the applicants are handled according to certain criteria, the candidates are dealt with, and efforts are made to select the most appropriate candidate. However, this process can be more complicated in terms of the managers who will carry out the staff selection process. Candidates should be evaluated according to different criteria such as work experience, education, foreign language level etc. It is crucial that a rational selection process is carried out by considering all the criteria in an integrated structure. In this study, the problem of choosing the front office manager of a 5 star accommodation enterprise operating in Antalya is addressed by using multi-criteria decision-making methods. In this context, SWARA (Step-wise weight assessment ratio analysis) and MOORA (Multi-Objective Optimization on the basis of ratio analysis) methods, which have relatively few applications when compared with other methods, have been used together. Firstly SWARA method was used to calculate the weights of the criteria and subcriteria that were determined by the business. After the weights of the criteria were obtained, the MOORA method was used to rank the candidates using the ratio system and the reference point approach. Recruitment processes differ from sector to sector, from operation to operation. There are a number of criteria that must be taken into consideration by businesses in accordance with the structure of each sector. It is of utmost importance that all candidates are evaluated objectively in the framework of these criteria, after these criteria have been carefully selected in the selection of suitable candidates for employment. In the study, staff selection process was handled by using SWARA and MOORA methods together.

***Keywords*—**Accommodation establishments, human resource management, MOORA, multi criteria decision making, SWARA

I. Introduction

IN the enterprises that have modern business approaches personnel management has been replaced by human resources management. This management is an approach that sees the "human" element at the center of the organization and brings it to the foreground [1]. In other words, human resource is the most important element in enterprises.

Human resource management is aimed at recruiting capable, flexible and committed people, managing and rewarding performance and developing key competencies [2].

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One of the functions of human resources management is the selection of human resources. This function, which is expressed as personnel selection, plays an important role in the success of the enterprises. Therefore enterprises aim to hire employees with the most suitable qualifications. The function that includes selection processes is used to employ suitable people at work [3].

Human resources have an important position in the accommodation industry that performs service production within the tourism sector. Since employees communicate directly with customers during service production, personnel selection requires a rigorous process [4]. The accommodation sector is a sector that is obliged to employ qualified labor force [5]. Personnel selection includes finding the most suitable employee with qualifications that suit the job requirements by examining the candidates regarding their personalities, interests, education, experience, skills etc. [6]. In this study, personnel selection process which is important for accommodation establishment is examined.

II. Personnel Selection Process in Accommodation Enterprises

Personnel selection function within human resources management is considered as the most important and difficult issue [7]. The aim of this function is to determine the personnel who possess the appropriate skills and abilities to the qualifications required by the position [8]. Personnel selection is a process culminating in a decision to one or more applicants for employment [9]. Personnel selection process is critical to the success of the accommodation enterprises [10]. Accommodation establishments have some characteristics. These can be listed labor-intensive features, simultaneous production and consumption, communication and interaction between personnel and guest [11]. The level of quality of service has been changed on personnel qualification in enterprises. For this reason, it is necessary to recruit the right employee in the right position. This requirement can only be ensured by proper operation of the personnel selection process.

Personnel selection process differs from enterprise to enterprise. Some enterprises prefer more elaborate ways, while others use less costly and less time consuming routes. The process of staff selection with the difference in enterprises consists of five steps in generally. These steps are listed criteria development, application and résumé review, interviewing, test administration, selection (Fig. 1).

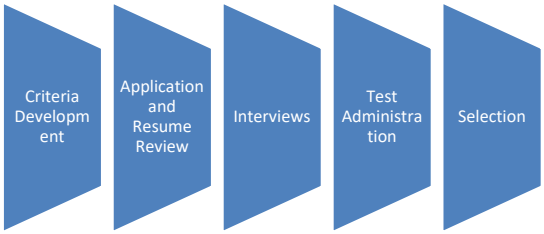

Fig. 1 Personnel Selection Process [12]

Enterprises need criteria in personnel selection process. Selection criteria are used to help select the most capable, effective, suited, experienced, qualified person for the job. Afterwards candidates' applications and CVs are examined. Various tests are used as a screening tool so candidates can be interviewed. Personnel selection process ends with job interviews and selection of the candidates suitable for the job. The most suitable candidates are selected [10]. Two mistakes can be made in the personnel selection process. These are the selection of the candidates to be rejected or the rejection of candidates suitable for the job. In order to avoid these mistakes, reliable and valid measuring instruments must be used in the personnel selection process [13]. For this reason, it is important to correctly determine the criteria to be used in the election process [14].

Personnel selection problem is one of real life applications of multi criteria decision making (MCDM) [15]. MCDM methods deal with problems of selection of the best solutions from the set of available alternatives according to certain conflicting objectives [16]. In this study SWARA and MOORA are used together to select the best front office manager from 10 candidates according to human resources decision maker's expectations and needs in a sample accommodation enterprise situated in Antalya.

III. Methodology

A. SWARA

Weight assessment is an important issue in many multi objective decision making problems. There are many weight assessment approaches in the literature. SWARA method is one of the new MCDM methods developed by Kersuliene et al. in 2010 [17].

The process of determining the relative weights of criteria by using SWARA method are explained in detail [17], [18]: In the first step the evaluation criteria should be sorted in descending order based on their expected significances.

In the second step, the decision makers or the experts determine the ratio SJ value, called by [17] as comparative importance of an average value. In order to determine this ratio, the respondent must indicate the relative importance of criterion j with respect to the previous criterion (j-1), starting from the second criterion. It should be made for each particular criterion.

Coefficient k_j should be calculated in the third step by:

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

In the fourth step, the recalculated weight q_j should be calculated as:

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

In the last step the relative weights w_j of the evaluation criteria can be determined as:

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

where w_j denotes the relative weights of the j_{th} criterion, n denotes the number of such criteria.

B. MOORA

MOORA method was introduced by Brauers and Zavadskas in 2006 [19]. The MOORA Method consists of ratio system and the reference point approach.

The MOORA method begins with a decision making matrix which includes alternatives and criteria. For normalization this matrix this method uses the ratio system as square root of the sum of squares of each alternative per attribute. The ratio can be expressed as;

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad (4)$$

r_{ij} is a dimensionless number which belongs to the interval $r_{ij} \in [0,1]$ representing the normalized performance of *i*th alternative on *j*th objective [19].

In the ratio system approach, the performance can be calculated as [20]- [22];

$$Q_i = \sum_{j \in \Omega_{max}} w_j r_{ij} - \sum_{j \in \Omega_{min}} w_j r_{ij} \quad (5)$$

where Q_i denotes the ranking index of *i*th alternative, w_j denotes weight of the *j*th criterion r_{ij} denotes the normalized performance of the *j*th criterion. Ω_{max} and Ω_{min} denote the sets of benefits and cost criteria respectively. m is the number of alternatives and n is the criteria. In this method the ternatives are ranked on the basis of their Q_i in ascending order, the highest value of Q_i is the best ranked one.

The second approach in MOORA method is the reference point approach. Bauers and Zavadskas [19] proposed the following form in the reference point approach [20]-[22];

$$\min_i \{\max_j (w_j | r_j - r_{ij} |\} \quad (6)$$

where r_j denotes the normalized performance of the *j*th coordinate of the reference point, and it can be determined as:

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$$r_j = \begin{cases} \max_i r_{ij}, & j \in \Omega_{max} \\ \min_i r_{ij;} & j \in \Omega_{min} \end{cases} \quad (7)$$

The best ranked alternative, based on the reference point approach A^*_{RP}, can be determined as;

$$A^*_{RP} = \left\{ A_i = \min_i \left\{ \max_j \left(w_j \left| r_j - r_{ij} \right| \right) \right\} \right\} \quad (8)$$

IV. Numerical Example

The aim of this study is to develop a quantitative model for personnel selection. For this purpose, the problem of choosing the front office manager in the accommodation enterprises is addressed. In this study, SWARA method was used firstly to calculate the weights of the criterion and sub criteria that were determined by the accommodation enterprise which situated in Antalya. After the weights of the criteria were obtained by SWARA, the MOORA method was used to rank the front office manager candidates using the ratio system and the reference point approach.

The criterion selected from the human resource decision maker of the accommodation enterprise can be seen in Table I.

TABLE I
Selected Criteria for Front Office Manager Selection

	Work Experience
WE1-	Experience as front office manager
WE2-	Experience at front office, reservation or guest relations departments
WE3-	Working period in the same hotel group
	Foreign Language Knowledge
FL1-	English language knowledge
FL2-	German language knowledge
FL3-	Russian language knowledge
	Education
E1-	Graduated from university
E2-	Graduated from tourism and hospitality schools
E3-	Master degree
	Computer skills
CS1-	MS Office program skills
CS2-	Front office computer package program skills
	Personal Characteristics
PC1-	Team player susceptibility
PC2-	Strong communication skills
PC3-	Leadership future
	Interview score

A. Determination the Weights of the Evaluation Criteria Based on SWARA

TABLE II
The Relative Weights of Criterion

	S_j	$k_j = s_j + 1$	$q_j = \frac{k_{j-1}}{k_j}$	$w_j = \frac{q_j}{\sum q_j}$
Foreign language knowledge (FLK)		1	1,000	0,342
Education (E)	0,6	1,6	0,625	0,214
Work experience (WE)	0,3	1,3	0,481	0,164
Personal Characteristics (PC)	0,4	1,4	0,343	0,117
Interview score (IS)	0,2	1,2	0,286	0,098
Computer skills (CS)	0,5	1,5	0,191	0,065

As can be seen in Table II, the most important criteria for this example are foreign language knowledge, education and work experience respectively.

The weights of sub criteria calculated by using SWARA are shown in Tables III-VII.

TABLE III
The Relative Weights of Work Experience

Criterion	S_j	$k_j = s_j + 1$	$q_j = \frac{k_{j-1}}{k_j}$	$w_j = \frac{q_j}{\sum q_j}$
WE3		1	1,000	0,433
WE1	0,4	1,4	0,714	0,309
WE2	0,2	1,2	0,595	0,258

TABLE IV
The Relative Weights of Foreign Language Knowledge

	S_j	$k_j = s_j + 1$	$q_j = \frac{k_{j-1}}{k_j}$	$w_j = \frac{q_j}{\sum q_j}$
FL4		1	1,000	0,391
FL5	0	1	1,000	0,391
FL6	0,8	1,8	0,556	0,217

TABLE V
The Relative Weights of Education

	S_j	$k_j = s_j + 1$	$q_j = \frac{k_{j-1}}{k_j}$	$w_j = \frac{q_j}{\sum q_j}$
E2		1	1,000	0,480
E1	0,5	1,5	0,667	0,320
E3	0,6	1,6	0,417	0,200

TABLE VI
The Relative Weights of Computer Skills

	S_j	$k_j = s_j + 1$	$q_j = \frac{k_{j-1}}{k_j}$	$w_j = \frac{q_j}{\sum q_j}$
CS2		1	1,000	0,667
CS1	1	2	0,500	0,333

TABLE VII
The Relative Weights of Personal Characteristics

	S_j	$k_j = s_j + 1$	$q_j = \frac{k_{j-1}}{k_j}$	$w_j = \frac{q_j}{\sum q_j}$
PC1	1	1	1,000	0,333
PC2	0	1	1,000	0,333
PC3	0	1	1,000	0,333

After all the calculations by using SWARA method, weights of front office manager selection criteria are summarized on Table VIII.

As seen in Table VIII, the most important criteria are English and German language knowledge, graduation from tourism and hospitality schools and interview score respectively.

MOORA method helps to decision maker for ranking the alternatives according to their attributes. The first step in the MOORA method is defining the initial decision making matrix. The 10 candidates and their score according to criterion can be seen in Table IX.

After making the normalization with using the weights obtained from SWARA method, the candidates can be ranked by using ratio system and reference point approach (Table X).

As can be seen in Table X, candidate 10, candidate 5 and candidate 9 are the best alternatives respectively. Human resource manager can use these results for the hiring process.

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TABLE VIII
THE RELATIVE WEIGHTS OF FRONT OFFICE MANAGER SELECTION CRITERIA BY CALCULATING SWARA

		Sub Criteria	General
Work Experience (0,164)			
WE1-	Experience as front office manager	0,309	0,051
WE2-	Experience at front office, reservation or guest relations departments	0,258	0,042
WE3-	Working period in the same hotel group	0,433	0,071
Foreign Language Knowledge (0,342)			
FLK1-	English language knowledge	0,391	0,134
FLK2-	German language knowledge	0,391	0,134
FLK3-	Russian language knowledge	0,217	0,074
Education (0,214)			
E1-	Graduated from University	0,320	0,068
E2-	Graduated from tourism and hospitality schools	0,480	0,103
E3-	Master degree	0,200	0,043
Computer skills (0,065)			
CS1-	MS Office program skills	0,333	0,022
CS2-	Front office computer package program skills	0,667	0,043
Personal Characteristics (0,117)			
PC1-	Team player susceptibility	0,333	0,039
PC2-	Strong communication skills	0,333	0,039
PC3-	Leadership future	0,333	0,039
Interview score (0,098)		1	0,098

TABLE IX
THE INITIAL DECISION MAKING MATRIX

	CRITERION															
ALTERNATIVE CANDIDATES		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	A1	10	22	9	60	90	0	1	1	0	1	1	70	60	80	70
	A2	0,33	9	3	70	60	30	1	0	0	1	1	80	60	80	70
	A3	8	13	8	70	80	0	0	0	0	1	0	70	50	80	60
	A4	15	28	5	60	90	0	1	0	0	1	1	60	50	70	60
	A5	3	19	8	90	60	90	1	1	0	1	1	60	70	90	90
	A6	10	23	10	60	90	0	1	0	1	1	1	60	70	90	80
	A7	2	15	4	60	90	60	0	0	0	1	1	70	60	80	70
	A8	10	20	20	90	90	40	1	0	0	1	1	60	60	60	60
	A9	23	25	4	90	60	60	1	1	0	1	1	60	70	60	60
	A10	15	23	6	90	80	60	1	1	0	1	1	80	80	90	90

TABLE X
RANKING OF THE 15 CANDIDATES BY THE TWO PARTS OF MOORA

Ranking	Ratio System		Reference point approach	
*1*th	Candidate 10	0,364	Candidate 10	0,043
*2*th	Candidate 5	0,350	Candidate 5	0,043
*3*th	Candidate 9	0,310	Candidate 9	0,043
*4*th	Candidate 6	0,310	Candidate 1	0,046
*5*th	Candidate 1	0,300	Candidate 6	0,051
*6*th	Candidate 8	0,292	Candidate 8	0,051
*7*th	Candidate 7	0,272	Candidate 7	0,051
*8*th	Candidate 2	0,266	Candidate 2	0,051
*9*th	Candidate 4	0,254	Candidate 4	0,051
*10*th	Candidate 3	0,215	Candidate 3	0,051

V. CONCLUSION

This study focused on personnel selection problem by using MCDM in accommodation enterprises. The front office manager selection problem for 5 star accommodation enterprises was investigated by using MCDM methods. For this context, SWARA is used to calculate weights of the criterion. This method has fewer applications when compared with the other weight assessment approaches such as AHP, SAW, Entropy etc. This method is uncomplicated and useful for various fields. In the second part of the numerical example, MOORA is used for ranking the candidates to the front office manager position. The weights obtained from SWARA are used in MOORA calculations. MOORA consists of two methods named ratio analysis approach and reference point approach. In this study, both of them are used for ranking the candidates.

In future, the model can be used for personnel selection problems in same or different areas. The criteria can be changed according to characteristics and needs of the job description. The personnel selection problem can be solved with other MCDM problems.

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