

Designing an Integrated Model of SWOT and FAHP to Optimize The Human Resources Planning in Construction Projects

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Abstract

This study evaluates and prioritizes the strengths, weaknesses, opportunities, and threats associated with human resource recruitment and retention in construction projects. To this end, a multi-criteria decision-making approach was employed by integrating the Fuzzy Analytic Hierarchy Process (FAHP) with SWOT analysis. The study specifically focused on Grade A and Grade B construction contractors. Data were collected through a structured questionnaire, and a sample of 384 respondents was selected based on Morgan's table. The proposed integrated SWOT-FAHP framework was used to identify and rank the main factors affecting human resource planning in construction projects. The results show that, in recruitment, the match between employees' competencies and job requirements is the most important strength, while the lack of non-native staff is identified as the most critical weakness. In addition, contractors' experience in maintaining time, cost, and quality is the most important opportunity, whereas the mismatch between organizational expertise requirements and applicants' qualifications is the most significant threat. For retention, employee satisfaction with salaries and rewards was found to be the most important strength, lack of management and innovation in the financial resources sector emerged as the main weakness, entrepreneurship was ranked as the most important opportunity, and the inconsistency between employee salaries and the cost of living was identified as the most important threat. The findings provide a structured basis for improving human resource planning in construction projects through an integrated strategic decision-making framework.

Keywords: (Human resources recruitment, human resources retention, SWOT method, FAHP Method)
2022 MSC: O20, O10

1 Introduction

Undoubtedly, this world is the era of organizations and the human beings are the leaders in these organizations; they make the organization alive, and activate and lead it. Not only the organizations cannot function effectively without an adequate workforce, but also they will not be managed. Despite making the organization technological and as a set of hardware and software, the human still plays a vital and strategic role in the survival of organization. Accordingly, the human resources is considered as the most valuable source of current organizations since it forms the organizational decisions, and solve problems of organization and gives objectivity to the efficiency. Human resource management

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plays a critical role in organizational performance, competitiveness, and long-term sustainability. Effective recruitment and retention practices contribute significantly to workforce productivity and project success [8, 2].

The enhanced organizational efficiency and its increase development require the employees' growth and efficiency as well as strengthening their motivation force. Some of the knowledge management experts have considered the motivation as the driving force of human.

The success of organizations largely depends on the human resources' spirits, efforts, motivation and satisfaction. In other words, the organizational efficiency has a direct dependence on the human resources efficiency. The human resources should have the same motive and be well motivated in order to provide the desired behavior in line with the purposes of organization, but it will be achieved only by identifying the reasons of behavior or the lack of tendencies as well as the causes of employee motivation and satisfaction in order to lead them to achieved organizational goals and timely utilization by competent managers with the aim at achieving the desirable and appropriate environment. The job satisfaction is the dedication and loyalty to organization; and the staff development is subject to created environment led by the managers. Identification of reasons for employee satisfaction and dissatisfaction and their job satisfaction plays the important and significant role as a key step towards these goals [19].

According to the important point in the development of human resources, the improved human resource is not only achieved through technical and professional training, but it should be developed through different ways. Therefore, if it is not taken into account in human resources management of organization, the organization will fail [11]. In this regard, considering the human resources as the main asset of organizations is one of the main solutions; furthermore, planning should be done to recruit, retain and develop the human resources' ability through the modern scientific methods. It is concluded, a strategic approach to the human resources and paying the strategic attention to it are necessary to achieve the sustainable productivity and high-quality production at the world-class level in the country.

Human Resource Management (HRM)

Management process consists of five basic tasks including: 1- planning, 2- organizing, 3- labor recruitment, 4-, leadership, 5- monitoring and control. The human resources management refers to the policies and activities which require the individuals and employees' viewpoints in the management profession. These activities include: job conduction and analysis, planning to determine the business needs and recruiting the job candidates, familiarizing and training the new staff, management of salaries and rewards, providing the benefits and incentives, communication, training and development and making the employees committed as well as the employee safety and health [10].

Strategic human resources management (SHRM):

It refers to all effective activities in motivating the employees to design and implement the strategic requirements of projects. According to the basic concept of SHRM, the human resources strategy promotes the strategy of project and on the other hand is affected by it. The SHRM, as a strategic measure relies on this belief under which the human capital is a major factor in creating the competitive advantage for project and it should be considered as an extremely important strategic source.

A variety of human resources strategies as the best approach to construct:

This approach is based on this belief that there is a set of best human resource practices which optimize the project performance. Perhaps the following list is the best identified set utilized in successful projects including: 1- job security, 2- so accurate employment, 3- self-manager groups, 4- high payment based on the performance, 5- education, 6- reducing disparities and discrimination, and 7- dissemination of information.

Human resources planning (HRP) in construction industry:

The human resources planning is known as an important technique which has accurate focus on the performance of projects and generally covers setting the official goals, determining the appropriate strategies and seeking to employ the creative human resources. The primary purpose of human resource planning is to estimates the types and numbers of employees necessary to meet the long-term needs of projects as well as handling a variety of plans including the development of job, training and implementation, recruitment of external labor, successive planning and employee evaluation.

Human Resource Development (HRD) in construction industry:

The human resource development reflects the growth and development of human resource management cycle in the field of job and performance management and ensures that the people working in the projects are able to fill the job gaps and promote the construction industry. According to the main reason of investment in human resource development, the investment in people in proper ways can ensure that they continue their participation along with the objectives of project. Despite the importance of human resource development, the available evidence indicates that this issue is not sufficiently considered in the construction industry [10].

Previous studies have successfully integrated SWOT analysis with multi-criteria decision-making techniques such as AHP and FAHP to support strategic planning and managerial decision-making processes [12, 1]. However, limited research has simultaneously examined recruitment and retention factors in construction projects using an integrated SWOT–FAHP framework.

The SWOT framework enables organizations to evaluate internal and external factors systematically and formulate appropriate strategic responses [20].

2 Materials and Methods

2.1 Research Method

This study from is applied in terms of objective and is considered as the descriptive-analytical studies according to the data collection and information processing methods. The evaluation models of strategic programs such as the AHP model re applied to conduct this research. The Analytic Hierarchy Process (AHP) was originally developed by Saaty (1980) as a structured multi-criteria decision-making method. To address uncertainty and vagueness in human judgments, Chang (1996) proposed the Fuzzy Analytic Hierarchy Process (FAHP), which integrates fuzzy set theory into the traditional AHP framework.

The research methods has the field and library types and the research tools are utilized including the questionnaires responded by the contractors grades A and B as well as the strategic planning tools including the internal and external factor evaluation matrixes. To validate the reliability of pairwise comparisons, the Consistency Ratio (CR) was calculated for all comparison matrices. The obtained CR values ranged from 0.041 to 0.089, which are below the acceptable threshold of 0.10 recommended by Saaty. Therefore, all pairwise comparison matrices were considered sufficiently consistent and suitable for subsequent FAHP analysis.

Table 1: Consistency Assessment of Pairwise Comparison Matrices Using the Consistency Ratio (CR)

Matrix	CR
Recruitment Strengths	0.041
Retention Strengths	0.053
Recruitment Weaknesses	0.067
Retention Weaknesses	0.072
Recruitment Opportunities	0.081
Retention Opportunities	0.074
Recruitment Threats	0.089
Retention Threats	0.062

Since all CR values are less than 0.10, the pairwise comparison judgments are considered acceptable according to Saaty's consistency criterion.

2.2 Statistical population

The statistical population of this study consisted of 2,850 Grade A and Grade B construction contractors operating in the study area. Based on the Krejcie and Morgan sample size determination table, a sample size of 384 respondents was determined. A stratified random sampling approach was employed to ensure proportional representation of both contractor groups. Data were collected through a structured questionnaire distributed via direct field visits and electronic communication channels. The completed questionnaires were screened for consistency and completeness before being included in the FAHP analysis.

2.3 Conceptual Framework

Human resource recruitment and human resource retention are conceptually different dimensions of human resource planning. Recruitment focuses on attracting and selecting qualified employees, whereas retention focuses on maintaining and motivating employees after employment. In this study, SWOT factors were first identified separately for recruitment and retention and then integrated through the FAHP method to determine their relative priorities within the overall human resource planning framework. SWOT analysis is a widely recognized strategic planning tool used to identify internal strengths and weaknesses as well as external opportunities and threats affecting organizational performance [20].

2.4 Ethical Considerations

Participation in this study was voluntary. All respondents were informed about the objectives of the study prior to questionnaire completion. No personal identifying information was collected. Informed consent was obtained from all participants and the collected data were used exclusively for academic research purposes.

3 Findings

Data is collected in this research by descriptive questionnaire and in the integrated form of two methods, FAHP and SWOT.

This questionnaire is distributed as the survey among the subjects in order to utilize the construction contractors Grades A and B in order to achieve the complete and accurate identification of all opportunities and threats. The target method is derived from the method introduced by Azadnejat et al [3] and Moharramnejad [14]. To choose the most important points of opportunities and threats, this research utilizes the FAHP method due to its ability to evaluate and make decisions about the multivariate factors.

The internal factor evaluation matrix is a tool for investigating the internal organizational factors. In fact, it evaluates the strengths and weaknesses of the organization. To prepare this matrix, it is mainly relied on the authorities' intuitive judgments and opinions. It should be noted that the tool for collecting the intra-organizational data is frequently used for strategic planning process in both private and public organizations.

The external factor evaluation matrix is a tool which allows the strategic planning experts to evaluate the environmental, economic, social, political, cultural, legal, technological factors and competitive and market conditions at target time.

3.1 Ranking the strengths in the field of human resources recruitment using the FAHP

In this section, we are seeking to rank and determine the important factor of strengths in the field of human resources recruitment and retention through the Fuzzy Analytic Hierarchy Process (FAHP).

The valuation of criteria is done through the pairwise comparison and granting the points which are the triangular fuzzy numbers and indicate the priority or importance of two criteria. Therefore, the decision maker compares the indexes and utilizes the triangular fuzzy numbers for pairwise comparisons. Using the range from 1 to 9, the pairwise comparison matrix can be formed as the triangular fuzzy numbers. In other words, the decision maker represents his preferences in a fuzzy way through the pairwise comparisons of elements at each level with the higher levels.

The corresponding fuzzy numbers with preference in pairwise comparisons among variables are shown in the following table.

Table 2: Corresponding fuzzy numbers with preferences in pairwise comparisons

Linguistic term for determining the preference	Triangular fuzzy number
Totally	(4, 4.5, 5)
Extremely high	(3.5, 4, 4.5)
Very high	(3, 3.5, 4)
High	(2.5, 3, 3.5)
Relatively high	(2, 2.5, 3)
Relatively low	(1.5, 2, 2.5)
Low	(1, 1.5, 2)
Relatively equal	(0.5, 1, 1.5)
Equal	(1, 1, 1)

To become familiar with Fuzzy Analytic Hierarchy Process, first the options are weighted step by step according to one of the respondents' view, and then the results super decision software output are presented based on 384 respondents.

The first respondent responded to the table of prioritization in the questionnaire as follows:

The way of converting the tables extracted from questionnaire into fuzzy matrixes in AHP method is as follows. The following table represents the weighted factors by one of the respondents:

Table 3: Determining the degree of important strengths in human resources recruitment

Strengths in the field of human resources recruitment	Socialization status Socialization status	Proportion of employees' skills and expertise to target job	The recruitment experts' ability to do the specialized tasks	The rate of attention to The rate of attention to	Choosing the right person for the right job at the right time
Socialization status of company	1	0.2	0.25	0.2	0.33
Proportion of employees' skills and expertise to target job	5	1	2	3	4
The recruitment experts' ability to do the specialized tasks	4	0.5	1	2	1
The rate of attention to competence system in selection	5	0.33	0.5	1	0.5
Choosing the right person for the right job at the right time	3	0.25	1	2	1

The pairwise comparison matrix according to the first respondent's view is according to the following Fuzzy form:

Table 4: Fuzzy Pairwise Comparison Matrix of Recruitment Strengths Based on Chang's Extent Analysis Method

Criteria	S1	S2	S3	S4	S5
S1	(1,1,1)	(1/5,1/4,1/3)	(1/4,1/3,1/2)	(1/3,1/2,1)	(1/4,1/3,1/2)
S2	(3,4,5)	(1,1,1)	(2,3,4)	(3,4,5)	(2,3,4)
S3	(2,3,4)	(1/4,1/3,1/2)	(1,1,1)	(2,3,4)	(1,2,3)
S4	(1,2,3)	(1/5,1/4,1/3)	(1/4,1/3,1/2)	(1,1,1)	(1/3,1/2,1)
S5	(2,3,4)	(1/4,1/3,1/2)	(1/3,1/2,1)	(1,2,3)	(1,1,1)

Where S1 = Socialization status of company, S2 = Proportion of employees' skills and expertise to target job, S3 =

Recruitment experts' ability to perform specialized tasks, S4 = Attention to competency-based selection system, and S5 = Choosing the right person for the right job at the right time. All triangular fuzzy numbers satisfy the condition $l \leq m \leq u$, and reciprocal values were generated according to Chang's extent analysis method

FAHP has been widely applied in project management, risk assessment, resource allocation, and strategic planning problems because of its ability to accommodate uncertainty in expert judgments [9, 17].

After preparing the fuzzy pairwise comparisons matrix (the respondents' preferences obtained through a questionnaire), the final and relative phase weights should be measured according to different methods introduced by researchers such as Chang's Extent Analysis Method which is utilized in this paper.

First step) The amount of SK, which is a triangular fuzzy number, is calculated for each row of pairwise comparison matrix which is prepared according to what was mentioned.

The coefficients of each pairwise comparison matrix (sk) is measured after filling to the tables of factor preferences by respondents. The amount of sk is a triangular number which is calculated as follows:

$$S_K = \sum_{i=1}^n M_{kj} \cdot \left[\sum_{i=1}^m \sum_{i=1}^n M_{ij} \right]^{-1} \quad (1)$$

Where, K indicates the number of rows, and i and j are the options and criteria, respectively.

Second step) After measuring SKs in EA method, their magnitudes are measured and compared. In general, if M1 and M2 are two triangular fuzzy numbers, the higher degree of M2 then M1, which is shown by $V(M1 \geq M2)V$, is defined as follows:

$$\begin{cases} V(M_1 \geq M_2) = 1 & m_1 \geq m_2 \\ V(M_1 \geq M_2) = \text{hgt}(M_1 \star M_2) & \text{Otherwise} \end{cases} \quad (2)$$

So we have:

$$\text{hgt}(m_1 \cap m_2) = \frac{u_1 - l_2}{(u_1 - l_2) + (m_2 - m_1)} \quad (3)$$

The higher amount of a triangular fuzzy number than another k triangular fuzzy number is also obtained according to the following equation.

$$v(m_1 \geq m_2 \dots m_k) = \min[v(m_1 \geq m_2) \dots v(m_1 \geq m_k)] \quad (4)$$

Third step) To measure the weights of indexes in pairwise comparison matrix, the following equation is measured according to EA method.

$$w'(x_i) = \min\{v(s_i \geq s_k)\}, \quad k = 1, 2, \dots, n, \quad k \neq i \quad (5)$$

Thus, the index weight vector will be as follows.

$$w' = [w'(c_1), w'(c_2), \dots, w'(c_n)]^t \quad (6)$$

It is the vector of non-normalized coefficients for Fuzzy AHP.

Fourth step) The values obtained in the previous phase of non-normalized weight are the criteria of hierarchical analysis table. Therefore, the normalized weights of criteria (indexes) are measured according to the following formula.

$$W_j = \frac{W'_j}{\sum W'_i} \quad W(x, x, x, \dots)^t \quad (7)$$

The obtained weights indicate the relative importance coefficient of each index (criterion) based on Fuzzy AHP (by EA) which is the best option of decision making.

As mentioned, 384 respondents responded to the tables of weighted options of questionnaire. We should integrate the pairwise comparisons of entire group (384 respondents) for final prioritization of options; the geometric mean method is one of the best methods in this regard. In other words, it is measured according to the table 8 for each respondent.

The geometric mean method is as follows for entries $a, b, c, \dots, n$:

$$GM = (a \times b \times c \times \dots \times n)^{\frac{1}{n}} \quad (8)$$

Table 5: The row sum of indexes of strengths in the field of human resources recruitment

Strengths in the field of human resources recruitment	Row sum of strengths in the field of human resources recruitment
Socialization status of company	(2.56, 2.96, 3.66)
Proportion of employees' skills and expertise to target job	(7, 8, 10)
The recruitment experts' ability to do the specialized tasks	(5.66, 6, 8)
The rate of attention to competence system in selection	(4.82, 6.16, 7)
Choosing the right person for the right job at the right time	(3.9, 5, 6.16)
Sum	(23.94, 28.12, 34.82)

S_k measurement: The value of S_k is measured for each row of pairwise comparisons matrix prepared as follows:

$$S_1 = (2.56, 2.96, 3.66) \times (0.028, 0.035, 0.041) = (0.071, 0.103, 0.15)$$

$$S_2 = (7, 8, 10) \times (0.028, 0.035, 0.041) = (0.196, 0.28, 0.41)$$

$$S_3 = (5.66, 6, 8) \times (0.028, 0.035, 0.041) = (0.158, 0.21, 0.328)$$

$$S_4 = (4.82, 6.16, 7) \times (0.028, 0.035, 0.041) = (0.134, 0.215, 0.287)$$

Measuring the magnitude of S_i s:

$$V(S_1 \geq S_2) = \frac{(0.15 - 0.196)}{(0.15 - 0.196) + (0.28 - 0.103)} = 0.351$$

$$V(S_1 \geq S_3) = \frac{(0.15 - 0.158)}{(0.15 - 0.158) + (0.21 - 0.103)} = 0.080$$

$$V(S_1 \geq S_4) = \frac{(0.15 - 0.134)}{(0.15 - 0.134) + (0.215 - 0.103)} = 0.125$$

$$V(S_1 \geq S_5) = \frac{(0.15 - 0.109)}{(0.15 - 0.109) + (0.175 - 0.103)} = 0.362$$

$$V(S_2 \geq S_1) = 1$$

$$V(S_2 \geq S_3) = 1$$

$$V(S_2 \geq S_4) = 1$$

$$V(S_2 \geq S_5) = 1$$

$$V(S_3 \geq S_1) = 1$$

$$V(S_3 \geq S_2) = \frac{(0.328 - 0.196)}{(0.328 - 0.196) + (0.28 - 0.21)} = 0.65$$

$$V(S_3 \geq S_4) = \frac{(0.328 - 0.134)}{(0.328 - 0.134) + (0.215 - 0.21)} = 0.97$$

$$V(S_3 \geq S_5) = 1$$

$$V(S_4 \geq S_1) = 1$$

$$V(S_4 \geq S_2) = \frac{(0.287 - 0.196)}{(0.287 - 0.196) + (0.28 - 0.215)} = 0.58$$

$$V(S_4 \geq S_3) = 1$$

$$V(S_4 \geq S_5) = 1$$

$$V(S_5 \geq S_1) = 1$$

$$V(S_5 \geq S_2) = \frac{(0.252 - 0.196)}{(0.252 - 0.196) + (0.28 - 0.175)} = 0.34$$

$$V(S_5 \geq S_3) = \frac{(0.252 - 0.158)}{(0.252 - 0.158) + (0.21 - 0.175)} = 0.72$$

$$V(S_5 \geq S_4) = \frac{(0.252 - 0.158)}{(0.252 - 0.158) + (0.215 - 0.175)} = 0.74$$

Measuring the weights of indexes in pairwise comparisons matrix

$$\begin{aligned} w(x_1) &= \min\{V(S_1 \leq S_2, S_3, S_4, S_5)\} = \min\{0.35, 0.08, 0.125, 0.36\} = 0.08 \\ w(x_2) &= \min\{V(S_2 \geq S_1, S_3, S_4, S_5)\} = \min\{1, 1, 1, 1\} = 1 \\ w(x_3) &= \min\{V(S_3 \geq S_1, S_2, S_4, S_5)\} = \min\{1, 0.65, 0.97, 1\} = 0.65 \\ w(x_4) &= \min\{V(S_4 \geq S_1, S_2, S_3, S_5)\} = \min\{1, 0.58, 1, 1\} = 0.58 \\ w(x_5) &= \min\{V(S_5 \geq S_1, S_2, S_3, S_4)\} = \min\{1, 0.34, 0.72, 0.74\} = 0.34 \end{aligned}$$

Finally, the non-normalized weight vector of indexes is obtained as follows:

$$w' = [w'(x_1), w'(x_2), w'(x_3), w'(x_4)] = [0.08, 1, 0.65, 0.58, 0.34]$$

Normalizing the weight vector of third step and calculating the weight vector of criteria

$$\sum w'(x_i) = 2.65$$

$$w = [0.05, 0.42, 0.20, 0.14, 0.17]$$

Therefore, the final weight and prioritization of strengths in the field of human resources recruitment from the perspective of one of the respondents and according to FAHP method is as follows:

Table 6: Ranking the strengths in the field of human resources recruitment through FAHP method

Strengths in the field of human resources recruitment	Weight	Priority
Socialization status of company	0.05	5
Proportion of employees' skills and expertise to target job	0.42	1
The recruitment experts' ability to do the specialized tasks	0.21	2
The rate of attention to competence system in selection	0.14	4
Choosing the right person for the right job at the right time	0.18	3

It is shown that the sum of importance coefficients is exactly equivalent to 1 that indicates the total accuracy of calculations. The manual FAHP calculations presented in this section are provided solely to illustrate the computational procedure for one respondent. Final rankings reported in the study were obtained by aggregating the judgments of all 384 respondents using geometric mean aggregation and subsequently analyzed using Super Decision software.

Finally, the output diagram of super decision software for prioritizing the strengths in the field of human resources recruitment in all respondents is as follows:

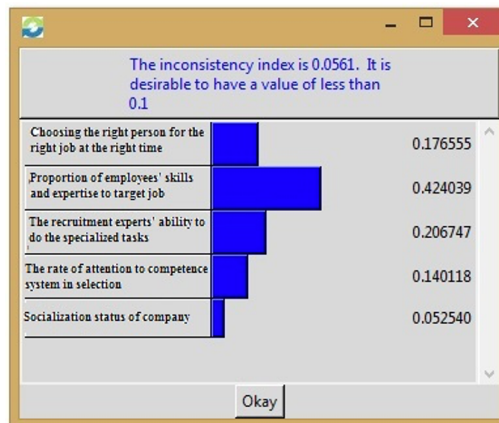


Figure 1: Prioritization of strengths in the field of human resources recruitment

As shown, the proportion of employees' skills and expertise to target job is the first priority, the recruitment experts' ability to do the specialized tasks as the second priority, Choosing the right person for the right job at the right time as the third priority, the rate of attention to competence system in selection as the fourth priority and the socialization status of company is put in the last priority.

3.2 Ranking the strengths in the field of human resources retention by FAHP

The strengths in the field of human resources retention include: Providing the services outside the job description, the construction project employees' satisfaction with received salaries and rewards, employee satisfaction with governing psychological atmosphere, granting the rewards and service compensation according to the performance and capability.

The final weight and priority of strengths in the field of human resources retention resources through the FAHP Method are as follows respectively:

Table 7: Ranking the strengths in the field of human resources retention through FAHP method

Strengths in the field of human resources retention	Weight	Priority
Providing the services outside the job description	0.07	4
The construction project employees' satisfaction with received salaries and rewards	0.50	1
Employee satisfaction with governing psychological atmosphere	0.21	3
granting the rewards and service compensation according to the performance and capability	0.22	2

The output chart of Super Decision Software for final prioritization of strengths in the field of human resources retention is as follows:

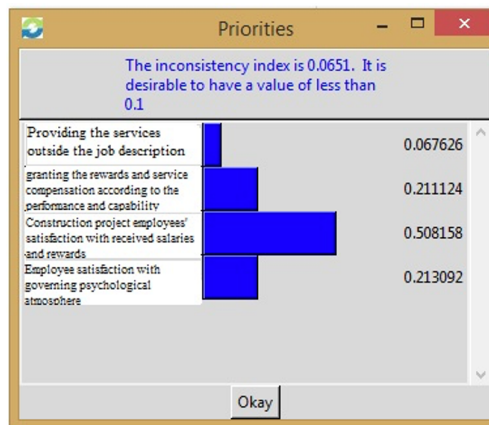


Figure 2: Prioritizing the strengths in the field of human resources retention

As shown, the construction project employees' satisfaction with received salaries and rewards is put in the first priority, and then granting the rewards and service compensation according to the performance and capability, employee satisfaction with governing psychological atmosphere and finally providing the services outside the job description, respectively.

3.3 Ranking the weaknesses in the field of human resources recruitment

The weaknesses in the field of human resources recruitment are as follows: Non-native personnel, the involvement of non-job-related factors (such as gender and marital status) in the employment process, the lack of adequate facilities to recruit elite labor.

Therefore, the final weight and prioritization of weaknesses in the field of human resources recruitment through FAHP method are as follows respectively:

Table 8: Prioritization of weaknesses in the field of human resources recruitment through FAHP method

Weaknesses in the field of human resources recruitment	Weight	Priority
Non-native personnel	0.55	1
Involvement of non-job-related factors (such as gender and marital status) in the employment process	0.24	2
The lack of adequate facilities to recruit elite labor	0.21	3

The output chart of Super Decision Software for final prioritization of weaknesses in the field of human resources recruitment is as follows:

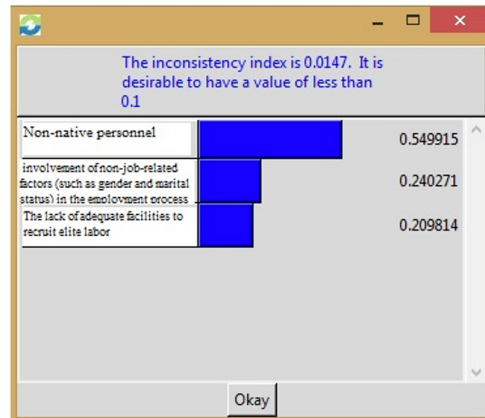


Figure 3: Prioritization of weaknesses in the field of human resources recruitment

As shown, the non-native personnel is put in the first priority and then the involvement of non-job-related factors (such as gender and marital status) in the employment process, and the lack of adequate facilities to recruit elite labor, respectively.

3.4 Ranking weaknesses in the field of human resources retention through FAHP

The weaknesses in the field of human resource retention are as follows: The prolonged operation and completion of projects, the lack of clear boundaries among the employer, consultant and contractor, the lack of management in financial resources sector, and scheduling the projects by observers.

Therefore, the final weight and prioritization of weaknesses in the field of human resources retention through the FAHP are as follows respectively:

Table 9: Ranking the weaknesses in the field of human resource retention through FAHP

Weaknesses in the field of human resources retention	Weight	Priority
Prolonged operation and completion of projects	0.25	2
The lack of clear boundaries among the employer, consultant and contractor	0.19	3
The lack of management in financial resources sector	0.48	1
Scheduling the projects by observer	0.08	4

The output chart of Super Decision Software for final prioritization of weaknesses in the field of human resources retention is as follows:

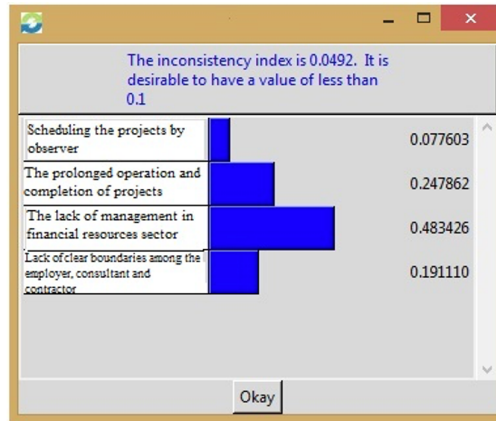


Figure 4: Prioritization of weaknesses in the field of human resources retention

As shown, the lack of management in financial resources sector is put in the first priority and then the prolonged operation and completion of projects, the lack of clear boundaries among the employer, consultant and contractor, and finally scheduling the projects by observer, respectively.

3.5 Ranking the opportunities in the field of human resources recruitment

The opportunities in the field of human resources recruitment are as follow: The number of educated job-seeking labor in the region, the project owners' rate of attention to the labor law, the contractors' experiences to save time, cost and quality, the job seekers' interest in employment.

Therefore, the final weight and prioritization of opportunities in the field of human resources recruitment through FAHP are according to the follows table based on their degrees of importance:

Table 10: Prioritization of opportunities in the field of human resources recruitment through FAHP

Opportunities in the field of human resources recruitment	Weight	Priority
The number of educated job-seeking labor in the region	0.091	4
The contractors' experiences to save time, cost and quality	0.551	1
The job seekers' interest in employment	0.125	3
The project owners' rate of attention to the labor law	0.233	2

The output chart of Super Decision Software for final prioritization of opportunities in the field of human resources retention is as follows:

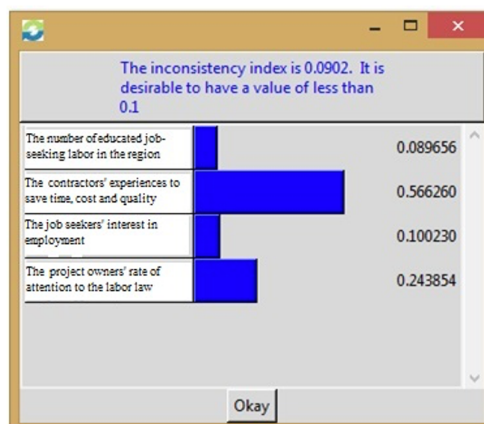


Figure 5: The final prioritization of opportunities in the field of human resources recruitment

As shown, the contractors' experiences to save time, cost and quality is put in the first priority, and then the project owners' rate of attention to the labor law, the job seekers' interest in employment, and finally the number of educated job-seeking labor in the region, respectively.

3.6 Ranking the opportunities in the field of human resources retention through FAHP

Ranking opportunity in the field of human resources retention is as follows: The financial and public credit support, entrepreneurship, the proportion of salary and wage with the staff minimum welfare indexes.

Therefore, the final weight and prioritization of opportunities in the field of human resource retention through FAHP method are according to the following table:

Table 11: Ranking the opportunities in the field of human resources retention through FAHP

Opportunities in the field of human resources retention	Weight	Priority
Financial and public credit support	0.24	3
Entrepreneurship	0.37	1
Proportion of salary and wage with the staff minimum welfare indexes	0.34	2
Providing the health and welfare measures	0.05	4

The output chart of Super Decision Software for final prioritization of opportunities in the field of human resources retention is as follows.

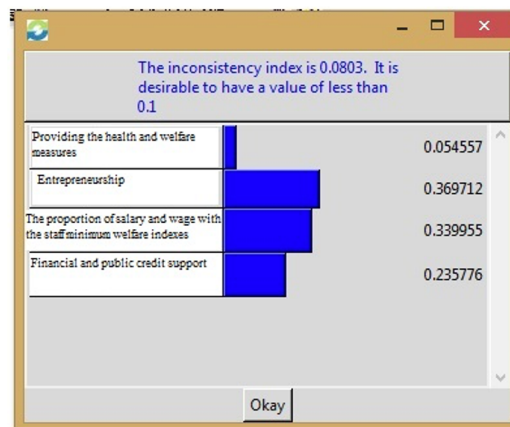


Figure 6: The final prioritization of opportunities in the field of human resources retention

As shown the entrepreneurship is put in the first priority and then the proportion of salary and wage with the staff minimum welfare indexes, financial and public credit support, and finally providing the health and welfare measures.

3.7 Ranking the threats in the field of human resources recruitment through FAHP

It includes the contractors' unwillingness to implement the projects in deprived areas, the lack of proportional organizational expertise to job applicants' expertise, failure to utilize the updated technologies in employment.

Therefore, the final weight and prioritization of threats in the field of human resources recruitment through the FAHP method are according to the following table:

Table 12: Prioritization of threats in the field of human resources recruitment through FAHP

Threats in the field of human resources recruitment	Weight	Priority
The contractors' unwillingness to implement the projects in deprived areas	0.217	2
the lack of proportional organizational expertise to job applicants' expertise	0.656	1
Failure to utilize the updated technologies in employment	0.127	3

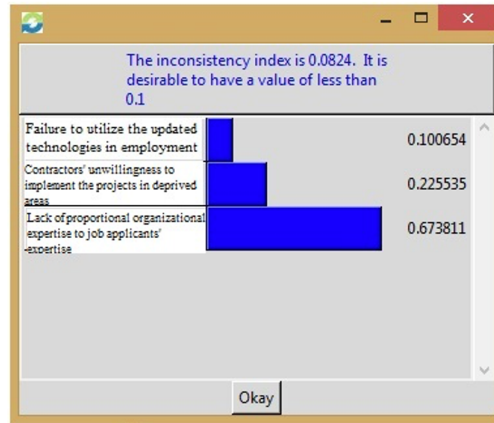


Figure 7: Prioritization of threats in the field of human resources recruitment

The chart output of Super Decision Software for final prioritization of threats in the field of human resources recruitment is as follows:

As shown, the lack of proportional organizational expertise to job applicants' expertise is put in the first priority and then the contractors' unwillingness to implement the projects in deprived areas and finally the failure to utilize the updated technologies in employment.

3.8 Ranking the threats in the field of human resources retention through FAHP

The threats in the field of human resource retention include: The lack of proportional employees' salaries and wage to the costs of living, inflation and effects of long-term construction, the authorities' personal and short-term attitudes towards the construction problems, and inflexible climate of projects.

The final weight and prioritization of threats in the field of human resources retention through FAHP method are according to the following table:

Table 13: Ranking the threats in the field of human resources retention through FAHP

Threats in the field of human resources retention	Weight	Priority
The lack of proportional employees' salaries and wage to the costs of living	0.40	1
Inflation and effects of long-term construction	0.16	3
The authorities' personal and short-term attitudes towards the construction problems	0.07	4
Inflexible climate of projects	0.37	2

The chart output of Super Decision Software for final prioritization of threats in the field of human resources retention is as follows.

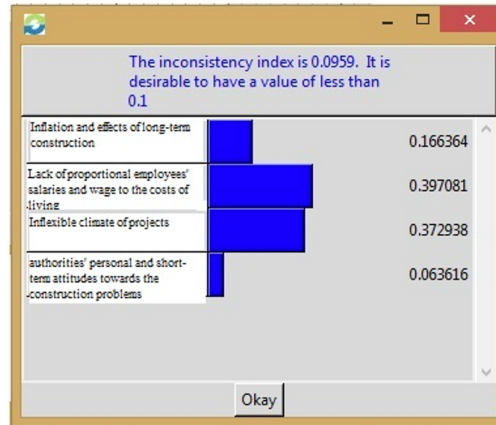


Figure 8: Final prioritization of threats in the field of human resources retention

As shown, the lack of proportional employees' salaries and wage to the costs of living is put in the first priority and then the inflexible climate of projects, inflation and effects of long-term construction, and finally the authorities' personal and short-term attitudes towards the construction problems.

3.9 Sensitivity Analysis

Sensitivity analysis is commonly employed in multi-criteria decision-making studies to evaluate the robustness and stability of ranking results under varying weighting scenarios [13]. A sensitivity analysis was conducted by varying criterion weights by $\pm 10\%$. The ranking order remained unchanged, indicating the robustness of the FAHP results. The sensitivity analysis confirmed that no changes occurred in the ranking order under the examined weighting scenarios, indicating that the proposed FAHP model is robust and stable.

4 Conclusion and Suggestion

4.1 Managerial Implications

The findings indicate that matching employee competencies with job requirements should be the primary recruitment strategy of construction contractors. Furthermore, employee retention can be improved through competitive compensation systems, performance-based rewards, and improved financial management practices.

These findings are consistent with previous studies emphasizing the importance of competency-based recruitment, employee engagement, and performance-based reward systems in improving organizational effectiveness and employee retention [21, 6].

4.2 Conclusion

This study developed an integrated SWOT-FAHP framework for prioritizing factors affecting human resource recruitment and retention among Grade A and Grade B construction contractors. The findings revealed that the proportion between employees' competencies and job requirements represented the most important recruitment strength, while employee satisfaction with salaries and rewards was identified as the most influential retention strength. Among recruitment weaknesses, non-native personnel ranked first, whereas inadequate management of financial resources was identified as the most critical retention weakness.

The findings are broadly aligned with prior research in strategic human resource management and multi-criteria decision-making, which highlights the importance of aligning workforce competencies with organizational objectives and improving employee welfare to achieve sustainable competitive advantage [4, 15].

The results further demonstrated that contractors' experience in managing project time, cost, and quality constituted the most significant recruitment opportunity, while entrepreneurship represented the most important retention opportunity. Regarding threats, the mismatch between organizational requirements and applicants' expertise was identified as the most influential recruitment threat, whereas insufficient salary levels relative to living costs constituted the most important retention threat.

The proposed SWOT–FAHP framework provides a practical decision-support tool for construction contractors and human resource planners by facilitating systematic prioritization of recruitment and retention factors. The findings can assist managers in developing competency-based recruitment systems, improving employee retention policies, and enhancing strategic workforce planning in construction projects.

4.3 Suggestions for future studies

Future research may extend the proposed SWOT–FAHP framework in several directions. First, future studies could incorporate dynamic project-related factors, such as changes in project complexity, economic conditions, and workforce mobility, to evaluate how recruitment and retention priorities evolve over time. Second, researchers may compare the results obtained from the FAHP approach with other multi-criteria decision-making methods, such as Fuzzy TOPSIS, ANP, or DEMATEL, to assess the robustness and consistency of the prioritization results. Finally, the proposed framework could be applied to other categories of construction contractors or different industries to examine the generalizability of the findings across various organizational and project environments.

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