Evaluation of construction companies performance by using stepwise weight assessment ratio analysis

Mohammed Neamah Ahmed1, Ali Hashim Yas2, Ihab Gheni Hussein3

1 Civil Engineering Department, College of Engineering, Kerbala University, Kerbala, Iraq.
2,3 College of Engineering, Kerbala University, Kerbala, Iraq.

ABSTRACT

The extent to which the facility and the construction process meet and/or surpass a client's expectations is critical for client satisfaction. As a result, company evaluation is a well-established procedure in project management in the construction industry to ensure projects are performed in compliance with the contract documents and applicable laws and regulations. The purpose of this study is to present and debate certain criteria for evaluating the Iraqi construction sector companies’ performance based on Stepwise Weight Assessment Ratio Analysis (SWARA) to assess company responsibility and performance in support of future projects. The evaluation criteria of construction companies are studied in this paper. The criteria have been categorized into main groups: (a) organization and management; (b) time; (c) quality; (d) cost; (e) resource; (f) safety practices. The main criteria have been divided into forty-four sub criteria. The findings of this paper demonstrate that the most important criteria in evaluating the construction companies’ performance is cost, followed by time, quality, organization and management, resources, and lastly safety practices which ranked based on the weight of criteria (35.7%, 24.2%, 16.3%, 11.2%, 7.4%, 5.2% respectively) with the SWARA technique.

Keywords: Construction, Companies, SWARA, Performance Evaluation, Management

Corresponding Author:
Mohammed Neamah Ahmed
Civil Engineering Department
University of Kerbala, Iraq
Email: mohammed.niema@uokerbala.edu.iq

1. Introduction

The construction industry is a vital sector that has a significant impact on a country's economic development and national society. It has the potential to help the country create a large number of job opportunities. The construction industry’s growth is inversely linked to the country's economic growth. [1]. In the management of construction firms, performance measurement is critical. It gives the required data for process control and allows for the setting of difficult yet achievable goals. It is also essential to support the business strategies implementation [2]. As a result, the most important evaluation criteria for the company’s performance in the Iraqi field of construction is studied in this paper. Weight assessment is a significant subject in several MCDM problems. One of the new techniques is the SWARA approach. An expert's perspective on estimates and weight computations is important in this technique. Reference [3] state that, every expert selects the significance of every criterion. All the factors are ranked by each expert in descending order from the first to the last one. The expert makes use of his or her own implicit knowledge, information, and abilities. The most important criterion is ranked first, and the least important criterion is ranked last, according to this procedure. The key advantage of this decision-making process is that important problems are defined in some cases, based on company or country policies, and there is no need for a ranking factor assessment. As a result, SWARA may be effective for some topics where priorities have been established based on previous events. Researchers have investigated and employed SWARA in a variety of domains in the past such as for machine tool selection [4], facility location...
problem [5], architect selection [6], evaluating sustainability indicators of the energy system [7], personnel selection problem [8], evaluating the prominent criteria in high tech industry investment prioritization [9], evaluating the criteria for solar projects [10], project selection [11], [12].

Since there is no systematic study on the criteria for evaluating construction companies in Iraq, therefore this paper aims to fill a research gap by evaluating the performance of Iraqi construction sector enterprises using the SWARA method. The importance of research will be highlighted in this study by analyzing crucial performance evaluation criteria for construction companies. The following is a breakdown of the paper's structure. The data and methods used, as well as the procedural stages, are detailed in the following section. Section 3 demonstrates the results and discussion. Lastly, conclusions are drawn in the last section of this paper.

2. Data and methods

2.1 Identify the main criteria and sub-criteria

To identify the main criteria and sub-criteria for construction companies’ evaluation, for construction companies’ evaluation, the researcher studies the literature review related to the research and extract a number of criteria, and interviews with project managers, group of experts, academics, professionals and engineers in government institutions to find out the criteria from their perspective about evaluation of construction companies.

2.2 Use the focus group discussion (FGD) technique

Used the Focus Group Discussion (FGD) technique with experts and specialists and decision-makers to select the criteria and sub-criteria to be suitable with Iraqi environmental and requirements.

In the table 1, the six Main Criteria (MC) and forty-four Sub-Criteria (SC) for performance evaluation of construction companies captured and selected by theoretical study and field work [13], [14], [15], [16], [17].

Table 1. The criteria for evaluating a company’s performance

| Code  | Main Criteria | Sub-criteria                                                                                                                                                                                                 | Code  | Justifications for selection the criteria                                                                 |
|-------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------------------------------------------------------------------------------------------------|
| OMMC  | Organization and Management | Cooperation/Responsiveness with project staff, client, and representatives Follow chain of authority and comply with directions Actively and cooperatively participate in the settlement of project issues. Promptly resolve any issues after notification Meet expectations on project coordination Carry out activities in a timely manner that does not disrupt other people's work or cause harm to their property. Any issues that arise are quickly resolved. Work with subcontractors to exercise authority, coordinate, and supervise work operations to ensure the timeline and requirements are met. | OMSC1 | The purpose of this criteria is to evaluate to what extent are the company executes the directions. |
|       |               |                                                                                                                                                                                                            | OMSC2 |                                                                                                       |
|       |               |                                                                                                                                                                                                            | OMSC3 |                                                                                                       |
|       |               |                                                                                                                                                                                                            | OMSC4 |                                                                                                       |
|       |               |                                                                                                                                                                                                            | OMSC5 |                                                                                                       |
|       |               |                                                                                                                                                                                                            | OMSC6 |                                                                                                       |
|       |               |                                                                                                                                                                                                            | OMSC7 |                                                                                                       |
|       |               |                                                                                                                                                                                                            | OMSC8 |                                                                                                       |
| TMC   | Time          | Schedule the work and follow it Initial project schedule suitability Observance of the agreed-upon schedule Timeliness and accuracy of schedule updates Adherence to recovery schedule and timely submittal Notification of changes to the schedule in a timely manner | TSC1  | The purpose of this criteria is to evaluate to what extent are the company is experienced and active at scheduling work and arranging construction activities, including starting and finishing the project on time and meeting important |
|       |               |                                                                                                                                                                                                            | TSC2  |                                                                                                       |
|       |               |                                                                                                                                                                                                            | TSC3  |                                                                                                       |
|       |               |                                                                                                                                                                                                            | TSC4  |                                                                                                       |
|       |               |                                                                                                                                                                                                            | TSC5  |                                                                                                       |
|       |               |                                                                                                                                                                                                            | TSC6  |                                                                                                       |
| Code | Main Criteria | Sub-criteria | Code | Justifications for selection the criteria |
|------|---------------|--------------|------|------------------------------------------|
| QMC  | Quality       | Meet the contract requirements | QSC1 | The purpose of this criterion is to see how well the organization meets deadlines for delivering required documentation and reports. |
|      |               | Provide an effective inspection and quality control procedures | QSC2 | This incorporates, but is not limited to, delivery tickets, certification of supplies, invoices, progress schedules, shop drawings, contractor staking, material samples, requests for extensions of time, and contractor QA/QC plans and documentation. |
|      |               | Workmanship quality | QSC3 | |
|      |               | Work Quality of Subcontractors | QSC4 | |
|      |               | Plan and specification adherence | QSC5 | |
|      |               | QA/QC Plan Adequacy | QSC6 | |
|      |               | Implementation of the QA/QC Plan Adequacy | QSC7 | |
|      |               | QA/QC Documentation Adequacy of Materials | QSC8 | |
|      |               | Timely correction of deficient work | QSC9 | |
|      |               | QSC10 | |
|      |               | QSC10 | |
| CMC  | Cost          | Follow the contract's labor standards/wage-rate requirements. | CSC1 | The object of this criterion is to see how well the company adheres to all applicable rates of wage, employment laws, and regulations, as well as submit correct certified payrolls and pay all subcontractors on time. |
|      |               | Laws and regulations compliance and early payment. | CSC2 | |
|      |               | Accuracy of payrolls and other required documentation. | CSC3 | |
|      |               | Identify changes as were needed, not at the end of the task or project | CSC4 | |
|      |               | Avoiding and minimizing change orders | CSC5 | |
|      |               | Documentation of the change order | CSC6 | |
|      |               | Pricing of the change order | CSC7 | |
|      |               | Timely performs change order work | CSC8 | |
| RMC  | Resources     | Enough equipment to finish the job on time. | RSC1 | This criterion is used to determine whether the company has appropriate and appropriate equipment to maintain the project on track. Is the equipment capable of meeting the parameters and producing a high-quality product? |
|      |               | Personnel who are both competent and sufficient to accomplish the assignment on time. | RSC2 | |
|      |               | All of the equipment complies with or exceeds the specifications. | RSC3 | |
|      |               | Adjust resources in response to demands of the project delivery schedule | RSC4 | |
|      |               | Trained and Skilled Workforce | RSC5 | |
| SMC  | Safety Practices | Take the initiative to ensure the safety and health of the employees | SSC1 | This criterion is used to determine whether the company has good safety practices. Is the company following its safety program and complying with regulatory requirements? |
|      |               | The safety equipment is in perfect working order. | SSC2 | |
|      |               | Follow good safety practices | SSC3 | |
|      |               | Take adequate precautions with any hazardous materials | SSC4 | |
|      |               | Properly report all injuries or damage associated with project | SSC5 | |
|      |               | Conduct the Periodic audits of compliance | SSC6 | |
|      |               | Minimizes job-site accidents | SSC7 | |
2.3 Extract main and sub-criteria weights by used the (SWARA).

It is one of the techniques for determining weight values that play an important role in a decision-making process. The following steps will explain the essential principles of SWARA as well as the technique for determining the relative weights of criteria. [18]:

2.3.1 Ranking the criteria

The importance of each criterion should be prioritized. The experts rank the defined criteria in order of relevance throughout this phase. The final list of criteria is listed from the most important to the least important.

2.3.2 Determine value of (Sj)

Calculate the value of the average value’s (Sj) comparative significance. Determine the relative importance Sj of criterion (j) in respect to criterion (j-1) starting with the second criterion, then repeat for each criterion. The criterion (Cj) is less important than (Cj-1)

\[ S_j \leftrightarrow j + 1 = \sum_{k=1}^{r} C_j \leftrightarrow j + 1 / r \quad (1) \]

\( S_j = \) Significance of the average value
\( J=2,3,… \)
\( C_j = \) Current criteria more important than criteria
\( h= \) No. of experts

2.3.3. Determine value of (Kj)

The value of (Kj) find by calculate the coefficient (Kj) as follows:

\[ K_j = \begin{cases} 1 & j=1 \\ \frac{S_j + 1}{j > 1} \end{cases} \quad (2) \]

\( K_j = \) Coefficient of criteria
\( J=2,3,… \)
\( S_j+1 = \) Significance of the average value

2.3.4. Determine value of (qj)

Re-calculated weight qj as follows:

\[ q_j = \begin{cases} 1 & j=1 \\ \frac{q_j - 1}{K_j} \end{cases} \quad (3) \]

\( q_j = \) Re-calculated weight
\( K_j = \) Coefficient of criteria
\( q_{j-1} = \) The previous re-calculated weight

2.3.5. Calculate the weight of criteria

\[ W_j = \frac{q_j}{\sum_{k=1}^{m} q_j} \quad (4) \]

Wj: denotes the relative weight of criteria.

3. Results and discussions

The main criteria include Organization and Management, as well as time, cost, quality, resource, and safety. are deemed the essential criteria that are utilized in evaluating the company’s performance in Iraq. Everyone main
criteria were broken down into sub-criteria. To evaluate the weights of criteria, the SWARA technique was applied to determine the main and sub criteria weights.

### 3.1. Ranking the main and sub criteria

The first stage is the one that all the eight experts rank criteria on their opinion, then a new (final) ranking is obtained by averaging the criteria rankings, which is shown in Figure 1, 2,3,4,5,6, and 7. The main criteria are listed in descending order by experts in Table 1. Through using the interval rating (1–5) Likert scale, where 5 denoted Very High, 4 High, 3 Medium, 2 Low, and 1 Very Low, each expert determines their preferred level of ratings for each single specified criterion.

![Figure 1. Main criteria ranking](image)

Figure 1. Main criteria ranking

Experts have ranked the main criteria. Obtained rank of criteria indicate that the cost criteria are the first rank, while second criteria rank is time. quality has third rank, organization and management criteria was fourth rank, while the safety and resource have a fifth and sixth rank respectively. Figure 2, 3,4,5,6 and 7 illustrate how experts ranked the sub-criteria.

![Figure 2. Organization and management sub-criteria ranking](image)

Figure 2. Organization and management sub-criteria ranking
Figure 3. Time sub-criteria ranking

Figure 4. Quality sub-criteria ranking

Figure 5. Cost sub-criteria ranking
The results of sub-criteria ranking showed that, in the organization and management criteria, promptly resolve any issues after notification (OMSC4) is most important. In time criteria, the adequacy of initial project schedule (TSC2) is most important. In quality criteria, the compliance with plans and specifications (QSC5) is most important. In cost criteria, the practices change order avoidance and minimization (CSC5) is most important. In resource criteria, the Adjust resources in response to demands of the project delivery schedule (RSC4) is most important. In safety criteria, the Minimizes job-site accidents (SSC7) is most important.

### 3.2. Determine comparative significance (Sj) and weights (Wj) for main criteria

The second stage is similar to the first stage. Again, the criteria importance order was obtained as in the first stage form, decision makers made their own pair wise comparisons, but instead of taking the average of the weight values at the end of the SWARA Method, the process was continued by taking the average of the pairwise comparisons (sj) by application equation 1. The process and results are presented in Table 2.

| Experts | TMC↔CMC | QMC↔TMC | OMMC↔QMC | RMC↔OMMC | SMC↔RMC |
|---------|---------|---------|----------|-----------|---------|
| 1       | 0.5     | 0.5     | 0.3      | 0.6       | 0.2     |
| 2       | 0.4     | 0.4     | 0.5      | 0.5       | 0.5     |
| 3       | 0.5     | 0.4     | 0.6      | 0.4       | 0.4     |
| 4       | 0.4     | 0.6     | 0.5      | 0.6       | 0.3     |
After completing the \((S_j)\) comparison between the primary criteria using equation 1, the next step is to use the equations 2, 3, and 4 to calculate the primary criteria weights. Table (3) shows the main criteria weighting by using the SWARA.

### Table 3. Main criterion weights

| M. C | Sj ↔ j+1 | K_j = S_j + 1 | q_j = q_j - 1 / k_j | W_j = q_j / \(\sum q_j\) |
|------|-----------|---------------|---------------------|---------------------|
| CMC  | ---       | 1.0           | 1.0                 | 35.7                |
| TMC  | 0.475     | 1.475         | 0.678               | 24.2                |
| QMC  | 0.488     | 1.488         | 0.456               | 16.3                |
| OMMC | 0.463     | 1.463         | 0.312               | 11.2                |
| RMC  | 0.500     | 1.500         | 0.208               | 7.4                 |
| SMC  | 0.425     | 1.425         | 0.146               | 5.2                 |

\(\sum = 2.800\) \(\sum = 100\)

#### 3.3. Calculate sub criteria significance (S_j) and weights (W_j)

This stage is similar to the stage in section 3.2. Again, the sub-criteria importance order was obtained from decision makers making their own pair wise comparisons. Table 4 shows relative importance assessment for organization and management sub-criteria.

### Table 4. Relative importance assessment for organization and management sub-criteria

| Experts | O&M Sub criteria relative importance |
|---------|--------------------------------------|
|         | OMSC3 ↔ OMSC4 | OMSC1 ↔ OMSC3 | OMMC6 ↔ OMMC1 | OMSC2 ↔ OMMC6 | OMSC5 ↔ OMSC2 | OMSC7 ↔ OMSC5 | OMSC8 ↔ OMSC7 |
| 1       | 0.4            | 0.4            | 0.7            | 0.4            | 0.3            | 0.7            | 0.3            |
| 2       | 0.4            | 0.5            | 0.7            | 0.5            | 0.4            | 0.4            | 0.4            |
| 3       | 0.4            | 0.6            | 0.7            | 0.5            | 0.6            | 0.4            | 0.5            |
| 4       | 0.5            | 0.4            | 0.5            | 0.5            | 0.5            | 0.5            | 0.5            |
| 5       | 0.5            | 0.4            | 0.6            | 0.5            | 0.3            | 0.6            | 0.4            |
| 6       | 0.5            | 0.5            | 0.7            | 0.5            | 0.7            | 0.4            | 0.5            |
| 7       | 0.6            | 0.5            | 0.5            | 0.5            | 0.4            | 0.5            | 0.6            |
| 8       | 0.5            | 0.6            | 0.3            | 0.5            | 0.7            | 0.3            | 0.5            |
| Av. value | 0.475         | 0.488         | 0.588         | 0.488         | 0.488         | 0.475         | 0.475         |

The calculation of the organization and management sub-criteria weights shown in table 5.
Table 5. Weights of organization and management sub-criteria

| M. C   | Sj↔ j+1 | Kj = Sj + 1 | qj= qj-1/ kj | Wj= qj/ ∑ qj |
|--------|---------|-------------|--------------|-------------|
| OMSC4  | ---     | 1.0         | 1.0          | 34.6        |
| OMSC3  | 0.475   | 1.475       | 0.678        | 23.4        |
| OMSC1  | 0.488   | 1.488       | 0.456        | 15.8        |
| OMSC6  | 0.588   | 1.588       | 0.287        | 9.9         |
| OMSC2  | 0.488   | 1.488       | 0.193        | 6.7         |
| OMSC5  | 0.488   | 1.488       | 0.130        | 4.5         |
| OMSC7  | 0.475   | 1.475       | 0.088        | 3.0         |
| OMSC8  | 0.475   | 1.475       | 0.060        | 2.1         |
|        |         |             |              | ∑= 2.892    |
|        |         |             |              | ∑= 100      |

Table 6 show relative importance assessment for time sub-criteria.

Table 6. Relative importance assessment for time sub-criteria

| Experts | TSC1↔TSC2 | TSC3↔TSC1 | TSC4↔TSC3 | TSC5↔TSC4 | TSC6↔TSC5 |
|---------|-----------|-----------|-----------|-----------|-----------|
| 1       | 0.4       | 0.5       | 0.4       | 0.5       | 0.6       |
| 2       | 0.5       | 0.5       | 0.4       | 0.3       | 0.6       |
| 3       | 0.6       | 0.4       | 0.5       | 0.5       | 0.6       |
| 4       | 0.5       | 0.6       | 0.5       | 0.3       | 0.4       |
| 5       | 0.4       | 0.3       | 0.6       | 0.5       | 0.5       |
| 6       | 0.5       | 0.4       | 0.7       | 0.5       | 0.4       |
| 7       | 0.5       | 0.5       | 0.3       | 0.6       | 0.6       |
| 8       | 0.4       | 0.6       | 0.4       | 0.7       | 0.3       |
| Av. value | 0.475   | 0.475     | 0.475     | 0.488     | 0.5       |

The calculation of the time sub-criteria weights shown in table 7.

Table 7. Weights of time sub-criteria

| M. C   | Sj↔ j+1 | Kj = Sj + 1 | qj= qj-1/ kj | Wj= qj/ ∑ qj |
|--------|---------|-------------|--------------|-------------|
| TSC2   | ---     | 1.0         | 1.0          | 35.7        |
| TSC1   | 0.475   | 1.475       | 0.678        | 24.2        |
| TSC3   | 0.475   | 1.475       | 0.460        | 16.4        |
| TSC4   | 0.475   | 1.475       | 0.312        | 11.2        |
| TSC5   | 0.488   | 1.488       | 0.210        | 7.5         |
| TSC6   | 0.500   | 1.500       | 0.140        | 5.0         |
|        |         |             |              | ∑= 2.8      |
|        |         |             |              | ∑= 100      |
Table 8 show relative importance assessment for quality sub-criteria.

| Exp. | QSC2 ↔ QSC5 | QSC1 ↔ QSC2 | QSC10 ↔ QSC1 | QSC3 ↔ QSC10 | QSC4 ↔ QSC3 | QSC7 ↔ QSC4 | QSC6 ↔ QSC7 | QSC8 ↔ QSC6 | QSC9 ↔ QSC8 |
|------|-------------|-------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 1    | 0.4         | 0.6         | 0.5          | 0.3         | 0.5         | 0.6         | 0.4         | 0.6         | 0.6         |
| 2    | 0.5         | 0.6         | 0.5          | 0.5         | 0.6         | 0.4         | 0.5         | 0.6         | 0.5         |
| 3    | 0.5         | 0.4         | 0.5          | 0.5         | 0.6         | 0.5         | 0.7         | 0.5         | 0.5         |
| 4    | 0.6         | 0.5         | 0.4          | 0.4         | 0.7         | 0.5         | 0.5         | 0.4         |
| 5    | 0.4         | 0.6         | 0.5          | 0.4         | 0.4         | 0.5         | 0.5         | 0.4         |
| 6    | 0.5         | 0.5         | 0.3          | 0.6         | 0.5         | 0.6         | 0.3         | 0.5         |
| 7    | 0.5         | 0.3         | 0.7          | 0.4         | 0.6         | 0.3         | 0.5         | 0.5         |
| 8    | 0.5         | 0.4         | 0.5          | 0.6         | 0.5         | 0.3         | 0.6         | 0.4         |
| Av. value | 0.488 | 0.488 | 0.488 | 0.488 | 0.488 | 0.538 | 0.500 | 0.488 |

The calculation of the quality sub-criteria weights shown in table 9.

| M.C | Sj ↔ sj+1 | Kj = Sj + 1 | qj = qj-1/ kj | Wj = qj/ ∑ qj |
|-----|-----------|-------------|---------------|--------------|
| QSC5 | ---       | 1.0         | 1.0           | 33.5         |
| QSC2 | 0.488     | 1.488       | 0.672         | 22.5         |
| QSC1 | 0.488     | 1.488       | 0.452         | 15.0         |
| QSC10| 0.488     | 1.488       | 0.304         | 10.3         |
| QSC3 | 0.488     | 1.488       | 0.204         | 6.9          |
| QSC4 | 0.488     | 1.488       | 0.137         | 4.5          |
| QSC7 | 0.488     | 1.488       | 0.092         | 3.0          |
| QSC6 | 0.538     | 1.538       | 0.060         | 2.0          |
| QSC8 | 0.500     | 1.500       | 0.04          | 1.4          |
| QSC9 | 0.488     | 1.488       | 0.027         | 0.09         |
| ∑ = 2.961 |             |             |               |              |
| ∑ = 100 |             |             |               |              |

Table 10 show relative importance assessment for cost sub-criteria.

| Experts | CSC3 ↔ CSC5 | CSC2 ↔ CSC3 | CSC1 ↔ CSC2 | CSC6 ↔ CSC1 | CSC7 ↔ CSC6 | CSC4 ↔ CSC7 | CSC8 ↔ CSC4 |
|---------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 1       | 0.5         | 0.4         | 0.4         | 0.3         | 0.5         | 0.3         | 0.6         |
| 2       | 0.5         | 0.5         | 0.7         | 0.4         | 0.6         | 0.5         | 0.3         |
| 3       | 0.5         | 0.4         | 0.3         | 0.7         | 0.4         | 0.7         | 0.4         |
| 4       | 0.5         | 0.5         | 0.4         | 0.5         | 0.7         | 0.5         | 0.3         |
| 5       | 0.5         | 0.4         | 0.6         | 0.3         | 0.5         | 0.4         | 0.6         |
| 6       | 0.4         | 0.6         | 0.3         | 0.5         | 0.4         | 0.6         | 0.5         |
| 7       | 0.5         | 0.5         | 0.4         | 0.4         | 0.4         | 0.4         | 0.7         |
| 8       | 0.5         | 0.5         | 0.6         | 0.5         | 0.6         | 0.4         | 0.5         |
| Av. value | 0.488 | 0.475 | 0.463 | 0.450 | 0.513 | 0.475 | 0.488 |
The calculation of the cost sub-criteria weights shown in table 11.

Table 11. Weights of cost sub-criteria

| M. C | Sj↔ j+1 | Kj = Sj + 1 | qj=qj-1/ kj | Wj= qj/ ∑ qj |
|------|--------|------------|-------------|-------------|
| CSC5 | ---    | 1.0        | 1.0         | 33.8        |
| CSC3 | 0.488  | 1.488      | 0.672       | 22.7        |
| CSC2 | 0.475  | 1.475      | 0.456       | 15.5        |
| CSC1 | 0.463  | 1.463      | 0.312       | 10.5        |
| CSC6 | 0.450  | 1.450      | 0.215       | 7.3         |
| CSC7 | 0.513  | 1.513      | 0.142       | 4.8         |
| CSC4 | 0.475  | 1.475      | 0.096       | 3.2         |
| CSC8 | 0.488  | 1.488      | 0.065       | 2.2         |

∑= 2.958 ∑= 100

Table 12 show relative importance assessment for resource sub-criteria.

Table 12. Relative importance assessment for resource sub-criteria

| Experts | RSC1 ↔ RSC4 | RSC2 ↔ RSC1 | RSC3 ↔ RSC2 | RSC5 ↔ RSC3 |
|---------|-------------|-------------|-------------|-------------|
| 1       | 0.5         | 0.5         | 0.3         | 0.7         |
| 2       | 0.4         | 0.5         | 0.5         | 0.5         |
| 3       | 0.5         | 0.4         | 0.6         | 0.3         |
| 4       | 0.4         | 0.6         | 0.4         | 0.5         |
| 5       | 0.4         | 0.3         | 0.6         | 0.4         |
| 6       | 0.4         | 0.5         | 0.7         | 0.5         |
| 7       | 0.5         | 0.5         | 0.4         | 0.5         |
| 8       | 0.7         | 0.4         | 0.5         | 0.3         |
| Av.value| 0.475       | 0.463       | 0.500       | 0.463       |

The calculation of the resource sub-criteria weights shown in table 13.

Table 13. Weights of resource sub-criteria

| M. C | Sj↔ j+1 | Kj = Sj + 1 | qj=qj-1/ kj | Wj= qj/ ∑ qj |
|------|--------|------------|-------------|-------------|
| RSC4 | ---    | 1.0        | 1.0         | 37.6        |
| RSC1 | 0.475  | 1.475      | 0.678       | 25.5        |
| RSC2 | 0.463  | 1.463      | 0.463       | 17.4        |
| RSC3 | 0.500  | 1.500      | 0.309       | 11.6        |
| RSC5 | 0.463  | 1.463      | 0.211       | 7.9         |

∑= 2.661 ∑= 100
Table 14 show relative importance assessment for safety sub-criteria.

Table 14. Relative importance assessment for safety sub-criteria

| Experts | SSC1↔SSC7 | SSC4↔SSC1 | SSC2↔SSC4 | SSC6↔SSC2 | SSC3↔SSC6 | SSC5↔SSC3 |
|---------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1       | 0.4       | 0.6       | 0.2       | 0.6       | 0.6       | 0.4       |
| 2       | 0.5       | 0.5       | 0.5       | 0.6       | 0.5       | 0.2       |
| 3       | 0.5       | 0.3       | 0.5       | 0.6       | 0.5       | 0.4       |
| 4       | 0.4       | 0.4       | 0.6       | 0.4       | 0.6       | 0.5       |
| 5       | 0.7       | 0.4       | 0.7       | 0.3       | 0.5       | 0.6       |
| 6       | 0.5       | 0.4       | 0.6       | 0.3       | 0.4       | 0.7       |
| 7       | 0.3       | 0.6       | 0.5       | 0.5       | 0.4       | 0.5       |
| 8       | 0.4       | 0.7       | 0.3       | 0.6       | 0.3       | 0.7       |
| Av. value | 0.463 | 0.488 | 0.488 | 0.488 | 0.475 | 0.475 |

Table 15 shows how the weights of the safety sub-criteria were calculated.

Table 15. Weights of safety sub-criteria

| M.C | Sj↔ j+1 | Kj = Sj + 1 | qj=qj-1/ kj | Wj=qj/ Σ qj |
|-----|---------|-------------|-------------|-------------|
| SSC7 | ---     | 1.0         | 1.0         | 34.5        |
| SSC1 | 0.463   | 1.463       | 0.684       | 23.6        |
| SSC4 | 0.488   | 1.488       | 0.460       | 15.8        |
| SSC2 | 0.488   | 1.488       | 0.309       | 10.7        |
| SSC6 | 0.488   | 1.488       | 0.208       | 7.2         |
| SSC3 |         |             | 0.141       | 4.9         |
| SSC5 | 0.475   | 1.475       | 0.096       | 3.3         |

Σ = 2.898  Σ = 100

3.4. Final weights of main criteria and sub criteria

Final results of weights for main criteria and sub-criteria by using the SWARA technique illustrated by Table 16.
| Main Criteria       | Weight | Sub-criteria                                                                 | Weight |
|--------------------|--------|-----------------------------------------------------------------------------|--------|
| **Cost**           | 35.7   | Avoiding and minimizing change orders                                        | 33.8   |
|                    |        | Accuracy of payrolls and other required documentation                        | 22.7   |
|                    |        | Laws and regulations compliance and early payment                            | 15.5   |
|                    |        | Follow the contract's Labor Standards/Wage-Rate requirements                  | 10.5   |
|                    |        | Documentation of the change order                                            | 7.3    |
|                    |        | pricing of the change order                                                  | 4.8    |
|                    |        | Identify changes as were needed, not at the end of the task or project       | 3.2    |
|                    |        | Timely performs change order work                                            | 2.2    |
| **Time**           | 24.2   | Initial project schedule suitability                                         | 35.7   |
|                    |        | Schedule the work and follow it                                              | 24.2   |
|                    |        | Observance of the agreed-upon schedule                                       | 16.4   |
|                    |        | Timeliness and accuracy of schedule updates                                  | 11.2   |
|                    |        | Adherence to recovery schedule and timely submittal                          | 7.5    |
|                    |        | Notification of changes to the schedule in a timely manner                   | 5.0    |
| **Quality**        | 16.3   | Plan and specification adherence                                             | 33.5   |
|                    |        | Provide an effective inspection and quality control procedures               | 22.5   |
|                    |        | Meet the contract requirements                                               | 15.0   |
|                    |        | Timely correction of deficient work                                          | 10.3   |
|                    |        | Workmanship quality                                                          | 6.9    |
|                    |        | Work Quality of Subcontractors                                               | 4.5    |
|                    |        | Implementation of the QA/QC Plan                                             | 3.0    |
|                    |        | QA/QC Plan Adequacy                                                          | 2.0    |
|                    |        | QA/QC Documentation                                                          | 1.4    |
|                    |        | Adequacy of Materials                                                         | 0.9    |
| **Organization and Management** | 11.2 | Promptly resolve any issues after notification                               | 34.6   |
|                    |        | Participate in the settlement of project issues                              | 23.4   |
|                    |        | Cooperation/Responsiveness with project staff, client and representatives     | 15.8   |
|                    |        | Carry out activities in a timely manner that does not disrupt other people's work or cause harm to their property. | 9.9    |
|                    |        | Follow chain of authority and comply with directions                         | 6.7    |
|                    |        | Actively and cooperatively meet expectations on project coordination          | 4.5    |
|                    |        | Any issues that arise are quickly resolved.                                  | 3.0    |
|                    |        | Work with subcontractors to exercise authority, coordinate, and supervise work operations to ensure the timeline and requirements are met | 2.1 |
| **Resources**      | 7.4    | Adjust resources in response to demands of the project delivery schedule      | 37.6   |
|                    |        | Enough equipment to finish the job on time.                                 | 25.5   |
|                    |        | Personnel who are both competent and sufficient to accomplish the assignment on time. | 17.4 |
|                    |        | All of the equipment complies with or exceeds the specifications.            | 11.6   |
|                    |        | Trained and Skilled Workforce                                                | 7.9    |
| **Safety Practices**| 5.2   | Minimizes job-site accidents                                                  | 34.5   |
|                    |        | Take the initiative to ensure the health and safety of the employees         | 23.6   |
|                    |        | Take adequate precautions with any hazardous materials                       | 15.8   |
|                    |        | The safety equipment is in perfect working order.                            | 10.7   |
|                    |        | Conduct the Periodic audits of compliance                                    | 7.2    |
|                    |        | Follow good safety practices                                                 | 4.9    |
|                    |        | Properly report all injuries or damage associated with project               | 3.3    |
4. Conclusions
This study presented the SWARA technique to prioritize performance evaluation criteria. The SWARA tool play a significant impact in the making of a decision and to compute the final weighted values of performance criteria. This study identified six main criteria and forty-four sub criteria that directly influence the success of construction firms, and they could be utilized by practitioners in the Iraqi construction business to better assess the company's performance. As the Iraqi construction market grows, the conclusions of this study will aid international corporations in understanding the success criteria by which Iraqi construction firms are measured. The findings of this study can help guide the process of evaluating the performance of construction firms. The findings of this study demonstrate that the most important criteria in evaluating the construction companies' performance is cost, followed by time, quality, organization and management, resources, and lastly safety practices. The worth of this paper is to assist in determining the performance of companies in construction sector as well as the relative importance of decision criteria in measuring the performance of Iraqi construction sector companies using the SWARA technique.

References
[1] L. W. Siew, L. K. Fai, and L. W. Hoe, “Performance Evaluation of Construction Companies in Malaysia with Entropy–VIKOR Model,” Engineering Journal, vol. 25, no. 1, pp. 297–305, Jan. 2021.
[2] H.-B. Kim and Y.-S. Kim, “Performance indices for quantitative measurement of R&D results in private construction companies,” KSCE Journal of Civil Engineering, vol. 19, no. 4, pp. 814–830, Mar. 2015.
[3] V. Keršulienė, E. K. Zavadskas, and Z. Turskis, “SELECTION OF RATIONAL DISPUTE RESOLUTION METHOD BY APPLYING NEW STEP-WISE WEIGHT ASSESSMENT RATIO ANALYSIS (SWARA),” Journal of Business Economics and Management, vol. 11, no. 2, pp. 243–258, Jun. 2010.
[4] E. K. Zavadskas, M. Hasan Aghdaie, and S. Hashemkhani Zolfani, “Decision making in machine tool selection: An integrated approach with SWARA and COPRAS-G methods,” Engineering Economics, vol. 24, no. 1, Feb. 2013.
[5] S. Hashemkhani Zolfani, M. H. Aghdaie, A. Derakhti, E. K. Zavadskas, and M. H. Morshed Varzandeh, “Decision making on business issues with foresight perspective; an application of new hybrid MCDM model in shopping mall locating,” Expert Systems with Applications, vol. 40, no. 17, pp. 7111–7121, Dec. 2013.
[6] V. Keršulienė and Z. Turskis, “INTEGRATED FUZZY MULTIPLE CRITERIA DECISION MAKING MODEL FOR ARCHITECT SELECTION / INTEGRUOTAS NERAIŠKUSIS DAUGIATIKSLIS SPRENĐIMŲ PRIĖMIMO MODELIS ARCHITEKTUI ATRINKTI,” Technological and Economic Development of Economy, vol. 17, no. 4, pp. 645–666, Jan. 2012.
[7] S. H. Zolfani and J. Saparauskas, “New Application of SWARA Method in Prioritizing Sustainability Assessment Indicators of Energy System,” Engineering Economics, vol. 24, no. 5, Jan. 2014.
[8] D. Karabasevic, D. Stanujkic, S. Urosevic, and M. Maksimovic, “An approach to personnel selection based on Swara and Waspas methods,” Bizinfo Blaze, vol. 7, no. 1, pp. 1–11, 2016.
[9] S. H. Zolfani and M. Bahrami, “INVESTMENT PRIORITIZING IN HIGH TECH INDUSTRIES BASED ON SWARA-COPRAS APPROACH,” Technological and Economic Development of Economy, vol. 20, no. 3, pp. 534–533, Oct. 2014.
[10] M. Vafaeeipour, S. Hashemkhani Zolfani, M. H. Morshed Varzandeh, A. Derakhti, and M. Keshavarz Eshkalag, “Assessment of regions priority for implementation of solar projects in Iran: New application of a hybrid multi-criteria decision making approach,” Energy Conversion and Management, vol. 86, pp. 653–663, Oct. 2014.
[11] S. Hashemkhani Zolfani, J. Salimi, R. Maknoon, and S. Kildienė, “Technology Foresight about R&D Projects Selection: application of SWARA method at the policy making level,” Engineering Economics, vol. 26, no. 5, Dec. 2015.
[12] Ö. EROĞLU and C. GENCER, “Classification on SWARA Method and an Application with SMAA-2,” *Journal of Polytechnic*, May 2021.

[13] H. Yan, H. Elzarka, C. Gao, F. Zhang, and W. Tang, “Critical Success Criteria for Programs in China: Construction Companies’ Perspectives,” *Journal of Management in Engineering*, vol. 35, no. 1, p. 04018048, Jan. 2019.

[14] H. A. E. M. Ali, I. A. Al-Sulaihi, and K. S. Al-Gahtani, “Indicators for measuring performance of building construction companies in Kingdom of Saudi Arabia,” *Journal of King Saud University - Engineering Sciences*, vol. 25, no. 2, pp. 125–134, Jul. 2013.

[15] A. S. Tofan and H. K. Breesam, “Identify the Appropriate Key Performance Indicators for Evaluating the Performance of Construction Companies in Iraq,” *International Journal of Engineering & Technology*, vol. 7, no. 4, p. 459, Nov. 2018.

[16] L. Kong and H. Luo, “An Effective Method In Safety Performance Evaluation For Construction Companies,” *Proceedings of the 2018 7th International Conference on Energy and Environmental Protection (ICEEP)*, 2018.

[17] M. B., Neerajkumar, D. Sharma, and B. K. Kashiyani, “A Review of Factors Affecting Contractor Performance in Construction Work,” *International Journal of Advanced Research in Engineering, Science & Management*, 2015.

[18] D. Karabasevic, D. Stanujkic, and S. Urosevic, “The MCDM Model for Personnel Selection Based on SWARA and ARAS Methods,” *Management - Journal for theory and practice of management*, vol. 20, no. 77, pp. 43–52, Dec. 2015.