Safety management in private construction project in Iraq

Hatim A. Rashid [1], Omar Akrm Al-juboori [2], Ahmed Mohammed Raoof Mahjoob[3*]
[1] Al-Nahrain University, College of Engineering, Department of Civil Engineering
[2] University of Baghdad, College of Science, Reconstruction and Projects Unite
[3] University of Baghdad, College of Engineering, Civil Engineering Department

ABSTRACT

The construction industry considers one of the most dynamic industries due to the unique features such as the change in the project site and condition. These features make the application of specifications and codes more difficult. Occupational Safety requirements in project is also difficult to be implemented and monitored due to the unique features of this industry. The aim of the study is to propose a new method that will determine the performance and management of the occupational safety in the construction site, in order to increase the safety at work in the private construction sector in Iraq. Another purpose of this evaluation is to establish a fundamental point that can be graded according to the safety index for the Iraqi construction industry. The information has been collected through a checklist and a questionnaire; the study focused on data collection paradigm and framework based on a fuzzy logic approach, which is especially able to evaluate the efficiency and monitoring of management defects of private contractors in the fields of occupational safety management. The results show a high security management performance in the private construction sector in Iraq, and the survey results show that there is a great deficiency in training on job security, also study found out that the top three elements of occupational safety management in Iraq are: First Aid-medical needs, Safety committees, Hazard prevention and control.

Keywords: Safety management, Iraq Construction Industry, qualitative approach, Occupational safety index, Fuzzy logic

Corresponding Author:
Ahmed Mohammed Raoof Mahjoob
University of Baghdad, College of Engineering, Civil engineering department, Baghdad, Iraq
E-mail: ahmed.mahjoob@coeng.uobaghdad.edu.Iq

1. Introduction

Currently, both in Iraq and in developed countries, private civil construction continues to standout as one of the most problematic sectors with regard to accidents at work [1]. In Iraq, the sector is the fourth largest generator of fatal accidents in terms of frequency and the second in terms of the coefficient per hundred workers [2]. Furthermore, Iraqi private construction projects segment does not yet act as a pressure factor, since the exclusive use of state insurance (which imposes an equal rate for all companies) is predominant, contrary to what occurs in the countries mentioned, in which insurance is controlled by the private sector and calculated based on indicators that reflect the real age of each company [3]. Although the economic and social costs of work accidents are high, were 13.5% of accidents in private construction companies are related to an occupational safety issue [4]. However, few companies are largely not trying to avoid them through systematic approaches; there is no sufficient experience available to support new business arrangement types [5], limiting themselves to complying with legislation [6]. Nevertheless, Iraq standards have a restricted scope, focusing mainly on the implementation of measures related to physical security installations (guardrails or landings, for example), and failing to require broader preventive measures aimed at eliminating and reducing risks in its origins [7]. The goal of this research is to propose a new approach that will evaluate first: the overall safety performance of construction by using the performance of safety management at work, and second: the performance of the construction site application in the assessment to improve the safety at work in buildings. The research is focused on a data acquisition model and development methodology based on a fuzzy logic approach, particularly capable of assessing the performance of private contractors in the field of workplace safety management and on-site safety performance and reporting of management deficiencies. The aim of this assessment is to create a basic point that can be classified according to the safety index developed for the construction industry in Iraq.

2. Research methodology

2.1 Development of checklist and survey to be applied in the field

The results established in literature (Awss, 2019) demonstrate the need for a safety management assessment and benchmarking tool that can assist contractors and the government in improving safety at work [8]. This research data was collected through questionnaires adopted, with permission, from the ILO/WHO Committee on Occupational Health, 1995. The questionnaire was closed and categorized in two sub-sections. The questionnaire forms distributed to people with construction site experience. The questionnaire has been carefully designed using statistical techniques [Questionnaire of the ICOH OHS Survey in 2015) [9], The questionnaire was written in Arabic, in addition to the English language, to help the people involved in interpreting their projects so that they could share their views confidentially. In the current survey, a mixed method approach is followed. Structured interviews (Through personal and telephone based on the designed questioner) and personally interact the workers at construction working site were implemented.

As a first step for data collection, a checklist was developed; the checklist is to evaluate field work safety. Information has been received from the field with a standard checklist that adopted from a report by Han, et al. (2007) [10]. This comprehensive workplace health and safety checklist reveals shortcomings in implementation in the Iraq construction sector. The study relay on a site-related evaluation framework uses a straightforward approach, not nuanced risk assessment. Reliability and simplicity was used in this evaluation. This checklist contains elements that are deemed relevant in terms of workplace safety and also comply with the International Labor Organization (ILO) regulations and protection legislation in Iraq [11]. Furthermore, the checklist was applied on-site by the authors in order to get reliable and objective results in every construction.

The next step for data collection was the questionnaire survey section; the questionnaire is to evaluate safety management performance. The questionnaire was developed considering the occupational safety management criteria in different management systems included in the survey are as follows: Occupational Safety Programs, Safety and Health Responsibilities, Employee Participation for the Task, Compliance for Work, Hazard Prevention, Risk Prevention and Control/ Mitigation, Internal Audits, Emergency Response Plans, First Aid / Medical Needs, Safety and Health Accident Investigation, Reporting and Analysis, Training and Safety Meetings, Occupational Safety Boards and Contractor / Subcontractor Relationship.

It was necessary to refer the questionnaire to a variety of adjudicators who are working on building sites during the development process until they circulated the questionnaire copies to the participants. The purpose of this step was to assess their apparent honesty and to respond to their suggestions so that the questionnaire could be successful. The adjudicators here had to follow various criteria, including scientifically, professional and academic specifications. The adjudicators information illustrated in Table 1.

Table 1. Details of adjudicators

(1) Academic Degree

Category	B.Sc.	M.Sc.	Ph.D.
Percentage	80	10	10

(2) Industrial Experience

Category	6-10 years	11-15 years	16-20 years	21 years or above
Percentage per freq.	10	30	40	20

(3) Distribution by Job Title

Category	Occupational Safety Advisor	Director of Safety Office	Department Director	Safety Engineer	Safety Supervisor
Percentage	10	10	20	30	30

Consequently, some elements are slightly updated after the questionnaire was addressed by the adjudicators while others were fully adjusted. A final questionnaire was created following this. The respondents were requested to rate their agreement against the identified occupational safety management criteria according to a 5-point Likert scale (1=least important and 5=most important). The questionnaire consists of two sections as follows:

1. Respondents' general information: The segment was structured to gather the general characteristics of participants as well as their educational level, age, experience, and profession. Profile of the respondents given as follows:

- Number of people in every sector.
- The respondents were members of Site Engineer / Adviser / Manager / Project Provider / skilled workers / Labor.
- Qualification for education: graduate / primary / secondary / bachelor / master / Doctorates.
- Experience at job.
- Number of individuals involved.

2. Safety in projects information: This section has been used to assess safety conditions in the respective projects. Therefore, the segment analyzed the opinions of respondents on safety structures working in Iraqi programs. This section includes three sub-sections of the questionnaire.

The study targeted large-scale construction companies in Baghdad, and was carried out with occupational safety management officers and occupational safety experts. The questionnaire was sent to 57 private construction companies located in Baghdad Governorate, Iraq. Among those, 10 companies were contacted by phone initially to determine whether they would participate in the research study. Finally, a total of 10 worksites that agreed to participate were carried out. Statistical analysis was conducted and important information was used in results and recommendations. In our study, the projects were selected with similar qualities. The following criteria have been considered for project selection:

• Projects must be building construction.
• Each project should have more than 50 workers and occupational safety management.
• The building must be at the first-floor level.
• Occupational safety specialist must be found.
• The project should have more than one subcontractor.

The size of participating companies varies in terms of the number of employees. The total number of employees working in the structures visited was more than 4000 employees; of thus, seven construction companies have more than 200 workers. The titles of the companies are kept confidential due to the commercial status of the companies. All companies' representatives who fill out the questionnaire for their own companies are in a managerial position or a job security specialist as appear in table 2.

3. Data analysis

A total of 190 questionnaires form were distributed to the participants. At the end, 82 completed questionnaires were successfully collected signifying a response rate of 43.15%. The data collected from the questionnaire survey were analyzed using the Statistical Package for Social Sciences (SPSS) software version 20. As shown in Figure 1 to Figure 3, over 74% of the respondents had a bachelor's degree. 35.36% hold Engineer/ Safety Engineer positions. Also, approximately over one-third had 21 or above years of construction experience.

Table 2, Details of respondents

(1) respondents by academic degree			
Category	B.Sc.	M.Sc.	Ph.D.
Percentage	74.39	10.97	14.64

(2) Construction experience				
Category	6-10 years	11-15 years	16-20 years	21 years or above
Percentage per freq.	19.52	19.51	25.60	35.37

(3) Distribution of all respondents by job title					
Category	Advisor	Director	Engineer/ Safety Engineer	Safety Supervisor	Contractor
Percentage	13.42	12.20	35.36	24.39	14.63

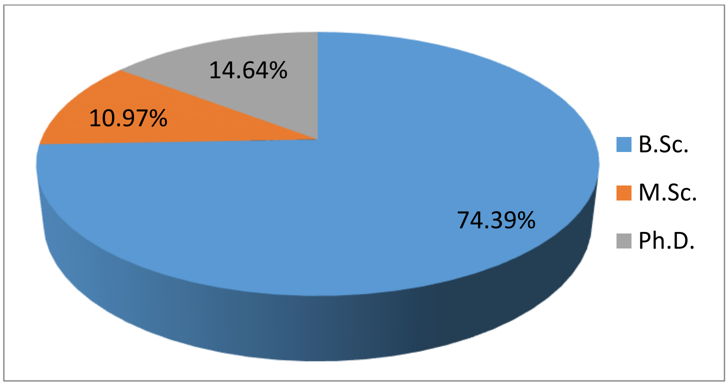


Figure 1. Respondents details by academic degree

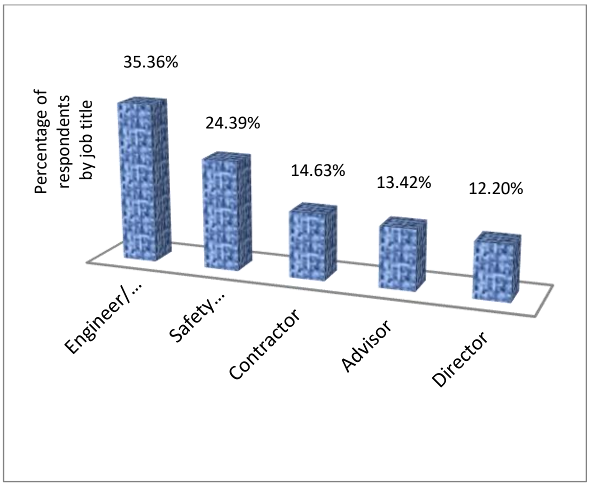


Figure 2. Respondents details by job title

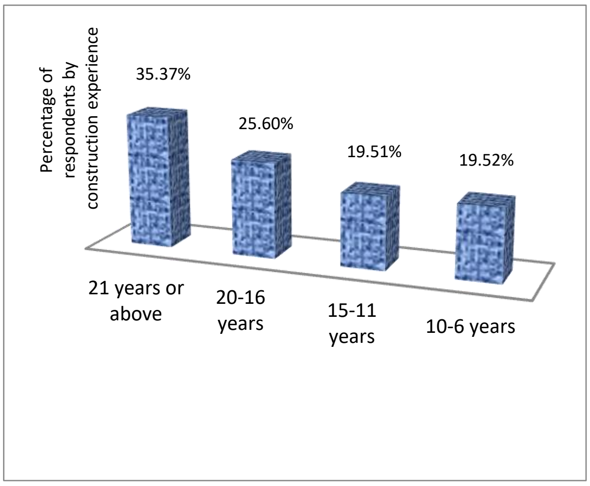


Figure 3. Respondents details by industrial experience

3.1 Safety performance index

To evaluate the information received from the checklist, Safety Performance Index SPI was used. SPI defined as measures reflecting the operational conditions and workplace safety of the private construction sector that influence the safety performance Gitelman, et al (2014) [12]. SPI can be calculated as: The total number of yeses divided by the sum of yes and no in each part and the result is found.

$$\text{Safety Performance Index (SPI)} = \left(\frac{\sum \text{No.of 'Yes'}}{\text{No.of Applicable Items}}\right) \quad \text{Eq.(1)}$$

For measuring SPI, the list implemented by (Gitelman, et al) is used, as shown in Table 3.

Table 3. Checklist classification

Score (%)	Condition
0 to 59 %	Weak
60 to 69%	Medium
70 to 79%	Good
80 to 89%	Very good
90 to 100%	Excellent

As seen in Table 4, the overall safety performance index of 10 construction companies is 72.6%, which means 7.26 out of 10 points. Thus, SPI is obtained as 7.26. Although it's generally shows a high security management performance for the companies participating in the study. On the other hand, the high variance indicates that this performance cannot be fully reflected on the field and there are application errors. This results from case such as Fire [13], is in compliance with injuries caused by an accident at work in Iraq. Contrary to other departments, fire is not the main cause of injuries (ranks second in the lowest safety level 55.6%), due to the specific situation. Fire rarely occurs in buildings, and this often leaves time for reaction and perception for these workers. Unlike fire, other types of accidents occur suddenly.

Falling from height (50.9%) is the first among accident types. Many workers die every year in the construction industry from falls. Protection and scaffolding application deficiencies constitute a significant part of the fall.

Although the fall risk is included in occupational safety programs, it has been observed that the workers do not use adequate fall prevention systems and there are not enough handrails to prevent falling from height. That is why the program of occupational safety management remains in the documents. This fact forms the background of falling type accidents. Excavation also has one of the lowest safety levels in the survey. Excavation works were found to be poor in terms of occupational safety with 69.4 %. Most of the injuries are in the form of drowning of individuals as a result of soil subsidence. Therefore, an adequate shoring system should be applied; buttresses or trench boxes and excavation guards should be placed on the edges of the excavations.

Table 4. Checklist results

Ranking	Safety grade	Safety performance index over 100	Grading
1st	7. Formwork Works	96	Excellent
2nd	11. Health and Comfort	87.2	Very good
3rd	9. Layout	83.2	Very good
4th	4. Crane and Lifting Tools	75	Good
5 th	5.Hand Tools	74.1	Good
6 th	6. Electricity	70.4	Good
7 th	8.Personal Protection	70.4	Good
8 th	3. Excavation	69.4	Mediocre
9 th	1. Piers	67.3	Mediocre
10 th	10. Fire	55.6	Weak
11 th	2. Falling from Height	50.9	Weak
General Performance		**72.6**	**Good**

Average Safety Score	Variance Value	SD
72.6	152.69	10.34

3.2 Safety management assessment

As explained in previous sections, for an effective management of health and safety programs, management job security should encourage prevent accident, inspection, investigation and safety performance with health and safety meetings that conduct inspections at all levels. In this study, an occupational safety management index (SMI) [14] was developed, that reflects the intensity of the level of occupational safety management activities. The developed index was then used to identify shortcomings in safety management activities to compare with the construction company overall safety performance. SMI indicates the occupational safety management efficiency of the construction in question. SMI estimation requires a detailed job security study. Safety management index (SMI) [15] is using the following equation:

$$\text{Safety Management Index (SMI)} = \left(\frac{\sum \text{Likart Scale Points}}{\text{No.of Applicable Items}}\right) \times 2 \quad \text{Eq. (2)}$$

The results conducted with the basic statistical analysis and the completed questionnaire is specified in this study.

Table 5 shows a detailed breakdown of the average ranking of safety management activities. Construction firms SMI's vary between 4.76 and 3.42 and the variance varies around 0.73. The top five elements of occupational safety management are: First Aid-medical needs (mean value = 4.76), Safety committees (mean value = 4.48), Hazard prevention and control / reduction (mean value = 4.41), Job Safety responsibility and accountability, (mean value = 4.38) and accident investigation, reporting and analysis (mean value = 4.34).

Furthermore, the five under-performance elements of occupational safety management that related to the staff are: Emergency Response Plans (3.42), Contractor / Subcontractor (3.49), Internal Audits (3.75), Compliance to Task (3.78), Training and Occupational Safety Meetings (3.85). Moreover, Safety management 13 elements are linearly associated with SPI. Findings show that unlike the results reported in other studies, there is no very strong positive linear relationship between occupational safety management performance (SMI) and On-site safety performance (SPI). The correlation coefficient was found to be 0.658, with the Pearson's r −value of 0.01 significance. These results show that observing real situations on the spot with a checklist changes traditional results. Although the companies participating in the study generally (8.25 out of 10) show high safety management performance, it did not fully reflect on the occupational safety performance in the field. These findings show that the occupational safety management systems of companies are not working properly. It is clear that these management activities cannot be imposed as part of all workers and the construction site. This explains the low safety performance for the contractor / subcontractor relationship, training and safety management.

Table 5. Ranking of safety management activities

Ranking	Occupational safety management items	mean value
1st	First Aid-Medical Needs	4.76
2nd	Safety Committees	4.48
3rd	Hazard Prevention and Control / Reduction	4.41
4th	Job Safety Responsibility and Accountability	4.38
5 th	Accident Investigation, Reporting and Analysis	4.34
6 th	Occupational Safety Programs	4.20
7 th	Safety and Health Responsibilities	3.92
8 th	Risk Prevention and Monitoring of Threats	3.81
9 th	Compliance to Task	3.78
10 th	Training and Occupational Safety Meetings	3.85
11 th	Internal Audits	3.75
12 th	Contractor / Subcontractor Relationship	3.49
13 th	Emergency Response Plans	3.42

3.3 Factor analysis of occupational safety management staff

With factor analysis, variables are grouped and easily manipulated [16]. When the primary analysis was run with all variables of 13 components, it was found higher than 1.00, indicating the same number of factors in the first survey structure. This reveals the reliability of the questionnaire. Factor analysis requires various tests for suitability for use. As a first step, the determinant of the *R* matrix should be more than 0.00001. This value for these data in the study is 0.0000227 and is greater than 0.00001 and KMO and Bartlett's test results given in Table 6.

Table 6. KMO and bartlett's test [17]

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.854
Bartlett's Test of Sphericity Approx. Chi-Square	127.437

The first factor seems to be related to job security management commitment, the second factor to the relationship between field and worker control, and the third factor to the occupational safety regulations **Table 7**. According to the factor analysis, the factor of field and worker control was found to be lower than the other components, and this explains why the construction firms' low on-site safety performance (SPI) was found (Table 6).

Table 7. Factor analysis

Dimension	Eigen value	% of Variance	Cumulative % of Varianc	Interpreted Component	Sub-Elements	Factor Loading
1	7.501	52.07	58.09	Management commitment	Accident Investigation, Reporting and Analysis	0.793
					Occupational Safety Programs	0.773
					Job Safety Responsibility and Accountability	0.678
					Training and Occupational Safety Meetings	0.667
					Hazard Prevention and Control / Reduction	0.604
					Emergency Response Plans	0.583
2	1.049	8.071	66.01	Site and worker control	Risk Prevention and Monitoring of Threats	0.825
					Contractor / Sub-contractor Relationship	0.790
					Safety and Health Responsibilities	0.728
					Internal Audits	0.647
					Compliance to Task	0.601
3	0.971	7.041	72.886	Safety-Arrangement	Safety Committees	0.862
					First Aid-Medical Needs	0.736

3.4 Occupational **safety performance evaluation model** (OSPI)

In this section, fuzzy logic principles [18], models, and applicability in the current research discussed Figure 4.

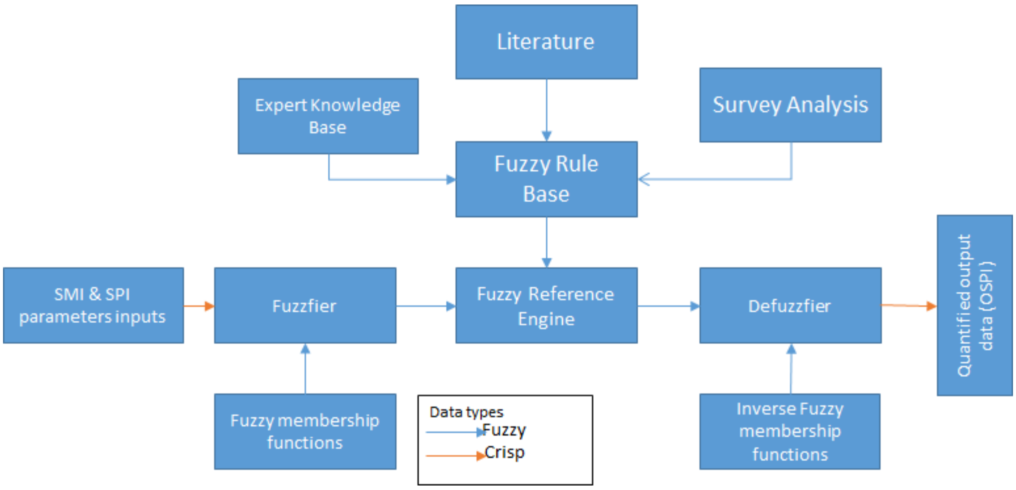
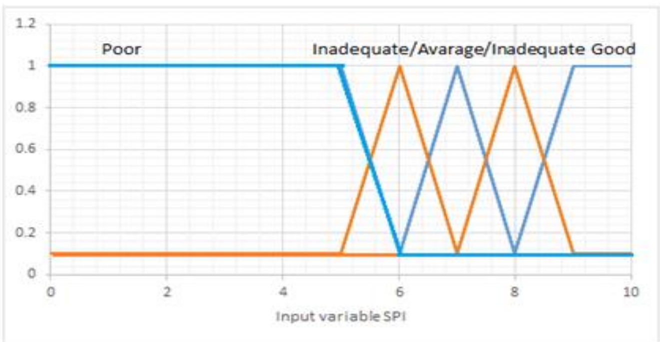


Figure 4. Fuzzy logic system of the model in the current work

The construction site and safety management performance are integrated Table 8, and this integration determines the overall safety performance of the construction. With this systematic approach, expert opinion and current occupational safety level can be combined within the framework of fuzzy logic to give an overall safety index. As mentioned above, 5 levels can be used for linguistic variables SMI, SPI and OSPI (Figure 5 to Figure7). Output estimation is one or a combination of the following:

• Poor Security
• Mediocre Security
• Average Security
• Adequate Security
• High Security

The literature presented by (Abas, et al 2020) [19] shows that linguistic variables are commonly used at levels 4-7.



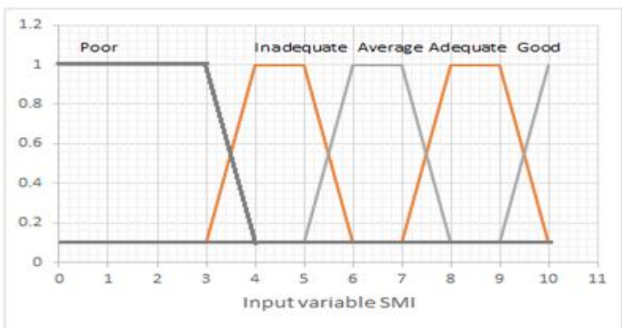


Figure 5. SPI membership function Figure 6. SMI membership function

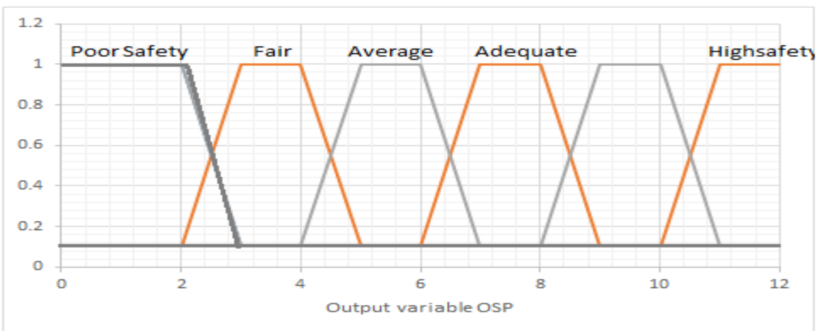


Figure 7. OSPI membership function

On the fuzzy rule base, all the rules are combined and evaluated using Mamdani indirect methods [20]. The categories of rules used in this study are as given in Table 9.

3.5 Sample assessment

To make the assessment criteria clear, a detailed example is shown below. This example shows how fuzzy logic membership functions work as shown in Figure 8 and figure 9. In this way, OSPI is determined [21]. Assuming that after applying the checklist and the questionnaire, the SPI and SMI results are found to be 7.56 and 7.87. First, numerical values are taken to determine the degree of belonging to fuzzy membership functions. Entry SPI = 7.56 gives membership values of 0.76 and 0.363, and these are "sufficient" and "average", fuzzy set values, respectively. SMI = 7.87 will be respectively 0.044 "average" and 0.97 "sufficient". The fuzzy VE model from the created rule (category) library is used to apply the necessary rules. The four rules that affect the evaluation process are given in Table 10. A single output value is reached with the central average calculation method. The relation between the inputs and outputs were established based on construction experts' opinions. These relations were used to build the rules of the fuzzy interfere system. Below are few examples of the IF-THEN rules used in the model:

1) Rule 1: if the SMI is low, and SPI is low, then the OSPI has a low influence level.
2) Rule 1: if the SMI is low, and SPI is moderate, then the OSPI has a low influence level.
3) Rule 1: if the SMI is moderate, and SPI is moderate, then the OSPI has a moderate influence level.

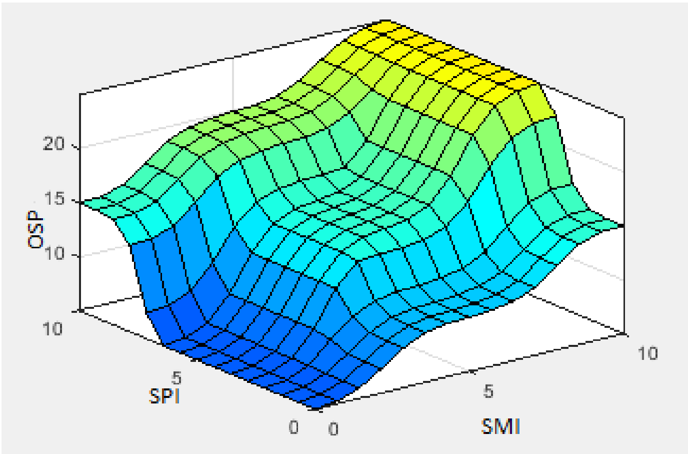


Figure 8. Fuzzy logic relationship of variables developed in MATLAB surface view

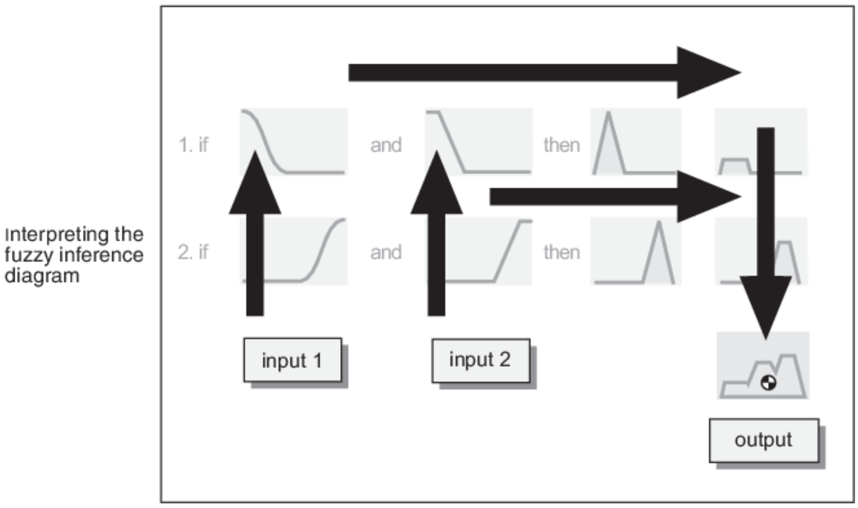


Figure 9. Interpretation of fuzzy logic interaction diagram

Table 8. Safety management assessment results

Company	CT-Mean	RPM-Mean	EI-Mean	OSP-Mean	JSR-Mean	HP-Mean	SH-Mean	ERP-Mean	FA-Mean	AI-Mean	TOS-Mean	SC-Mean	CR-Mean	SMI	SPI
1st	2.35	3.06	3.97	3.57	2.16	3.06	3.24	3.36	4.22	4.37	4.17	4.32	4.13	4.28	4.09
2nd	3.62	3.80	3.99	3.59	3.33	3.84	4.03	3.63	3.36	4.11	3.99	3.59	3.33	4.07	3.95
3rd	4.25	4.17	4.08	3.67	3.91	4.21	4.12	3.71	3.95	4.50	4.08	3.67	3.91	4.46	4.04
4th	4.06	4.26	4.48	4.03	3.74	4.31	4.52	4.07	3.77	4.61	4.48	4.03	3.73	4.56	4.43
5th	4.91	5.01	5.11	4.60	4.52	5.06	5.16	4.64	4.56	5.41	5.11	4.60	4.52	5.36	5.06
6th	4.56	4.79	5.03	4.52	4.20	4.84	5.08	4.57	4.24	5.17	5.03	4.52	4.19	5.12	4.98
7th	4.61	4.56	4.52	4.07	4.24	4.61	4.56	4.11	4.28	4.93	4.52	4.07	4.24	4.88	4.47
8th	3.24	3.73	4.28	3.86	2.98	3.76	4.33	3.89	3.01	4.03	4.28	3.86	2.98	3.99	4.24
9th	2.64	2.77	2.91	3.06	2.43	3.88	2.94	3.09	2.45	4.15	2.91	3.06	2.43	4.11	2.88
10th	3.58	5.37	5.42	4.88	3.29	5.42	5.48	4.93	3.33	5.80	5.42	4.88	3.29	5.75	5.37
Mean	3.78	4.15	4.38	3.99	3.48	4.30	4.35	4.00	3.72	4.71	4.40	4.06	3.68	4.66	4.35
Variance	0.60	0.57	0.42	0.25	0.51	0.41	0.54	0.28	0.36	0.30	0.41	0.24	0.35	0.29	0.40
SD	0.81	0.79	0.68	0.53	0.75	0.67	0.77	0.56	0.63	0.57	0.67	0.52	0.62	0.57	0.67

Table 9. Application of the categories

Category	SMI Membership Function	SPI Membership Function	Fuzzy Logic (AND) operator
Category1	0.044	0.363	0.044 Average
Category2	0.044	0.737	0.044 Average
Category3	0.97	0.363	0.363 Average
Category4	0.97	0.737	0.737 Adequate

Finally, Table 8 output summarizes the elements of Safety Management Evaluation (SME), SMI, SPI, OSPI and the 3 lowest performance elements that need improvement and need to be corrected.

Table 10. General safety management evaluation results of companies

Company	SMI	SPI	Fuzzy logic OSPI	Under/Over perform	Term Corresponding to OSPI
1st	7.86	5.75	4.21	UNDER PERFORM	20% Average Safety; 80% Fair Safety
2nd	8.39	6.01	5.62	UNDER PERFORM	100 % Average Safety
3rd	7.74	5.96	4.74	OVER PERFORM	74% Average Safety;26% Fair Safety
4th	9.61	9.77	9.22	OVER PERFORM	100 % Average Safety
5th	8.04	7.44	3.93	UNDER PERFORM	61% Average Safety;39% Fair Safety
6th	8.43	7.05	5.62	UNDER PERFORM	100 % Average Safety
7th	8.94	7.04	6.24	UNDER PERFORM	100 % Average Safety
8th	9.02	6.51	4.08	UNDER PERFORM	96% Average Safety;04% Fair Safety
9th	9.33	5.25	5.64	UNDER PERFORM	100 % Average Safety
10th	8.16	6.14	6.8	OVER PERFORM	100 % Average Safety

4. Results and discussion

The practical work presented in this paper should be seen in relation to the sample size. More reliable outputs are obtained with a larger sample than the generally accepted statistical principle [22]. Due to the real observations on the spot as stated below, the study sheds light on a number of important issues and guides. The implementation of the proposed method can reveal the overall safety performance of the construction safety management elements and factors, so here each company decides to focus resources where it is important to improvement.

The findings of this study confirm the role of occupational safety and safety management. It is concluded from the collected data that occupational safety management is effective in improving the general construction work safety and working environment [23]. Another important finding of this study is that there is not a high positive linear relationship between the occupational safety management index and 13 basic components and job site application safety performance.

A factor analysis technique Table 6 was applied and occupational safety management elements were divided into three basic groups. According to the factor analysis, the factor of field and worker control was found to be lower than the other components, and this explains the reason for the low safety performance (SPI) of construction companies at the construction site. These findings strengthen the thesis that SMI and SPI should be considered as two different variables that make up OSPI. Without the SMI and SPI integration and unless management activities are filtered down for all workers in the field, overall job security is not effective. The OSPI was developed for Iraq of 10 construction companies that make up 33 percent of the project (5.90) than were found to be higher. Five underperformance staff of occupational safety management, Emergency Response Plans (3.42),

Contractor / Subcontractor (3.49), Internal Audits (3.75), Compliance to Task (3.78) (Table 3), Training and Occupational Safety Meetings (3.85). The lack of emergency action planning on construction sites was identified as an important area. Emergency response plans are rarely integrated at sites with more than one contractor. Emergency response scenarios should span the entire construction site, and employees should be trained in their roles for each scenario. The subcontractor-contractor relationship was found to be the second lowest factor. Considering the fact that the constructions in our country are based on subcontractors, it is understood that subcontractors play an important role in ensuring occupational safety in buildings. It has been found that a subcontractor evaluation program that monitors safety performance is required for these subcontractors. Comprehensive site safety and health self-regulation is an important element. According to the survey results, it is understood that internal audit should be done more frequently.
The survey results also show that there is a great deficiency in training on job security. Most workers do not have a detailed training. As a result, these workers sometimes fail in some jobs they do with their own experiences. Construction companies should provide detailed and periodic occupational safety training to reduce and eliminate future accidents. The study also showed that the most injuries in construction sites occur to construction workers more than other specialties such as carpenters, blacksmiths and others, because the construction process includes, I am aware of many details according to many decisions, and the construction worker is at risk of injury if he fails to meet the requirements of safety and personal protection.

5. Conclusions

This work tried to identify, through the use of qualitative techniques of data collection and treatment, the perceptions of workers and management in relation to safety at work on a construction site. The perceptions revealed several problems in the management of occupational safety in the company, which are probably common, or even more serious, in most companies in the sector. The results of the study also contributed to the identification of research potentials in the area. The SME tool also points out areas that need improvement, and helps construction firms in assessing safety performance and management staff. Thanks to the developed program, the most important safety management deficiencies that affect the construction work safety performance can be identified. The Safety Management Evaluator (SME) can be a very important tool in improving job security. Those who will use this method should have basic knowledge about management concepts and processes. SME should not be seen as a way to directly report job security deficiencies, but as an auxiliary tool to improve safety management and overall safety performance.

Recommendations

- Labor and worker-related bodies, such as the Department of Labor and Social Security must set the standards and laws that guarantee the worker's life and entitlements, provide conditions of protection and public safety while doing their work, and provide supervisory agencies to track and validate the need for contractors and employers to provide security
- The questionnaire process found that there was no provision in the contract stipulating the need to include safety measures and protect workers from risks. Therefore, it is appropriate to include a paragraph in the contracting contract provisions that the contractor is obliged to include the necessary measures for the protection of the sites' land.
- Training programs must be given for employees in the workplace, particularly young people who often lack an informant, in order to familiarize them with the work they do on the site and the risks they can face in the event of safety concerns.

- Focus on providing a special safety section in contracting firms, enabling their workplace supervisory position, and setting plans to prevent and minimise risks and providing a healthy atmosphere for two employees to improve their work efficiency.

References

[1] Dr. Wadhah Amer Hatem, 2017. Evaluation of Safety Systems in Iraqi Construction Projects, International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 21 pp. 11714-11726.

[2] Shibani, Dr Abdussalam, 2016. Risk management in construction projects in iraq: contractors' perspective. International Journal of Engineering Research 4(3),May 2016,

[3] Choudhry, Rafiq & Fang, Dongping & Ahmed, Syed, 2008. Safety Management in Construction: Best Practices in Hong Kong. Journal of Professional Issues in Engineering Education and Practice - J PROF ISSUE ENG EDUC PRACT. 134. 10.1061/(ASCE)1052-3928(2008)134:1(20).

[4] Al- juboori, Omar Akrm, 2004. Studying and Analyzing Actual Safety Situation of Construction Factories in Iraq, MSc. thesis- Department of Civil Engineering / University of Al- Mustansiriya, pp. 86.

[5] Zimmermann, J. ; Aljuboori, Omar A., 2013. The challenges of governing public private partnership in Iraq infrastructure projects. Creative Construction Conference, Budapest, Hungary 2013, pp. 910-922.

[6] Hopkins, A., 2007. Beyond compliance monitoring: new strategies for safety regulators. Law & Policy, 29(2): p. 210-225.

[7] Zhou, Z., Y.M. Goh, and Q. Li, 2015. Overview and analysis of safety management studies in the construction industry. Safety science, 72: p. 337-350

[8] Mahmoud, Awss, 2019. Evaluating the Effectiveness of Occupational Health and Safety Management System of Construction Companies in Iraq (Al-Rasheed State Contracting Construction Company as a case study). Journal of Engineering and Development, Vol. 13, No. 2, 182-198

[9] Jorma Rantanen, Suvi Lehtinen, Antonio Valenti, Sergio Iavicoli,Occupational health services for all A global survey on OHS in selected countries of ICOH members,page No 8, annexure 4.ISBN 978-889-434-692-3 (pdf) Web: icohweb.org/site/multimedia/pubblicazioni/ICOH%20global%20survey%20OHS%20for%20all.pdf

[10] Han, Byoung-Soo & Park, Chan-Sik & Hong, Sung-Ho., 2007. Occupational Health and Safety Risk Assessment Checklist for Preventing Accidents During Building Design Phase. Korean Journal of Construction Engineering and Management. 8(2), pp.68-74.

[11] https://www.ilo.org/safework/countries/arab-states/iraq/lang--en/index.htm

[12] Gitelman, Victoria & Vis, Martijn & Weijermars, Wendy & Hakkert, Shalom.,2014. Development of Road Safety Performance Indicators for the European Countries. Advances in Social Sciences Research Journal. 1, pp. 138-158. 10.14738/assrj.14.302.

[13] Krishen, Anjala & Kachroo, Pushkin & Agarwal, Shaurya & Sastry, Shankar & Wilson, Masha, 2015. Safety Culture from an Interdisciplinary Perspective: Conceptualizing a Hierarchical Feedback-based Transportation Framework. Transportation Journal. 54. 516-534. 10.5325/transportationj.54.4.0516.

[14] Khodeir, Laila & Salaheldine, Youhansen, 2018. The Impact of Integrating Occupational Safety and Health into the Pre-Construction Phase of Projects: A Literature Review. 3, pp. 177-186.

[15] Wali, Khalil & Saber, Nazik, 2019. Appraisal of Risk Factors which Influence the Construction of the School Buildings in Northern Iraq. Tikrit Journal of Engineering Sciences. 26, pp. 1-8. 10.25130/tjes.26.2.01.
[16] Hatem, Zaid & Abdul Hamid, Abdul Rahim & Abba, Nuhu, 2019. Factors that Leads to Poor Welfare Facilities Implementation at Construction Sites in Iraq. 10.13140/RG.2.2.35911.65448.
[17] Wen, Xuezhou & Quacoe, Daniel & Quacoe, Dinah & Appiah, Kingsley & Danso, Bertha, 2019. Analysis on Bioeconomy’s Contribution to GDP: Evidence from Japan. Sustainability. 11. 712. 10.3390/su11030712.
[18] Huang, Dao-Zheng & Hu, Hao & Li, Yi-Zhou, 2012. Application of Fuzzy Logic to Safety Risk Assessment of China's Maritime Passages. Transportation Research Record: Journal of the Transportation Research Board. 2273, pp.112-120. 10.3141/2273-14.
[19] Abas, Nor & Yusuf, N & Suhaini, Nurul & Kariya, Norfarahayu & Mohammad, Hairuddin & Hasmori, Muhammad, (2020). Factors Affecting Safety Performance of Construction Projects: A Literature Review. IOP Conference Series: Materials Science and Engineering. 713. 012036. 10.1088/1757-899X/713/1/012036.
[20] Rezaei, Mohammad, 2018. Indirect measurement of the elastic modulus of intact rocks using the Mamdani fuzzy inference system. Measurement. 129, pp. 319-331. 10.1016/j.measurement.2018.07.047.
[21] Dhas, J. & Satheesh, M., 2012. Multiple objective optimization of submerged arc welding process parameters using grey based fuzzy logic. Advances in Production Engineering & Management. 7, pp. 5-16. 10.14743/apem2012.1.126.
[22] Biau, D. J., Kernéis, S., & Porcher, R., 2008. Statistics in brief: the importance of sample size in the planning and interpretation of medical research. *Clinical orthopaedics and related research*, *466*(9), 2282–2288. https://doi.org/10.1007/s11999-008-0346-9
[23] Wachter JK, Yorio PL., 2014. A system of safety management practices and worker engagement for reducing and preventing accidents: an empirical and theoretical investigation. Accid Anal Prev. 2014 Jul;68:117-30. doi: 10.1016/j.aap.2013.07.029. Epub 2013 Aug 7. PMID: 23993683.