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Occupational safety basics understanding in oil and gas industry: An evaluation

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ABSTRACT

In project management, risk is a surprise that might be resulted in a good, or bad, impact on a project. However, people tend to consider it a threat. This study is an evaluation work to the understanding of the risk management and safety culture of the construction sector in oil and gas industry in Iraq. A survey questionnaire was prepared, tested, distributed to a sample of engineers, from several engineering specialties, who are working on different levels in the mentioned sector. A high percent of the respondents are safety engineers, and some have a higher university degree, e.g. MS an Ph.D. The collected data then analyzed using different statistical approaches. The results show that there is a good understanding of the safety in general among engineers. However, risk management and planning tools are not understood effectively among the respondents. Moreover, having a higher degree or specializing in different majors have no impact on perceptional understanding of the safety and risk. This study is one of the first steps in studying the occupational safety in Iraq construction and oil and gas industries. Since Iraq is considered for rebuilding after different wars, international firms are in need to understand how safety is managed and to what level it is applied. From this perspective, this study is one of studies that help achieving the firms' goal regarding safety.

Keywords: risk management, safety, Wilcoxon test, BBS

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1. Introduction

Safety planning plays an important role in mitigating and preventing the events that may lead to different losses in money, time, and ultimately human lives. The task of safety planning may not be achieved effectively unless a safety program is adopted and enforced. It is difficult to apply a safety program without knowing what the understanding of the project personnel of the safety and risk is. Moreover, how do engineers and middle management perceive risks and evaluate the training courses that an organization provides. Furthermore, in developing countries different steps should be taken to set up suitable safety plans that fit the general culture in these countries, and this research eases this goal. Construction is a hazardous industry and identifying a hazard causes can help in initiating appropriate plans to reduce the impact of these hazards [1]. Those who are in the first line facing the safety issues or planning for safety are of the best sources to evaluate safety and risk levels [2]. Linking the construction work to another heavy industry like oil and gas industry makes it even harder to deal with the safety and risk concerns. The high number of safety problems in construction, either standing alone or as a part of another industry, comes from the fact that a construction project is complex which relates to the uniqueness of the construction industry projects. In fact, uncertainties and safety issues are encountered in various stages of any project [3]. On the other hand, oil and gas industry is the main supplier of the energy around the globe and safety issues in a like industry might be disastrous. From that sense, it is important to invest different resources to understand the safety and risk realty, particularly in those countries produce oil and gas like Iraq.

Risk management is the main approach that is adopted to identify, assess, and avoid risks on any project. So, those who are entitled to lead project personnel in safety planning, enforcing, managing procedures should be knowledgeable about the subject. After identifying risks, assessing them should be conducted. Risk assessment focuses on explaining the uncertainties and the impact results from them. Crucial factors that shape the uncertainty are of the core of the risk management process [4]. This trend was examined in different studies, see for example [5] – [7]. Moreover, Safety and risk regulations, in addition to other factors, are essential in creating a safer environment. Industries like oil and gas are extremely in need to regulations related to safety and risk [8] that is because they might be disastrous in terms of accidents outputs. Employees in oil and gas industry, specifically in construction sector, have to have a safety culture. Moreover, a safety climate should be common to provide a safer workplace. It is good to mention that there is not clear agreement on the meanings of the safety climate and safety culture among different authors and organizations; for more discussion about these terms refer to [9].

In oil and gas industry, documents show that the numbers are unsatisfactory in terms of safety records [10]. Safer workplace enhances not only the productivity, and other aspects related to the production, but also sets a better reputation to the firms that conduct the work. The major elements in oil and gas industry that need to be protected are human lives, environment, resources, and reputation [11]. Historically, there were different catastrophic accidents that led to safety issues and all of this happened because low level of risk assessment strategies [12].

In Iraq, it is known that there are scarce studies regarding safety in general, and safety and risk in construction sector in oil and gas industry particularly. Actually, the subject is of high significance not just because of the importance of human lives but also that this industry is the main source of the government funding. This study aims to evaluate the familiarity of the engineering personnel at construction sector in oil and gas industry with the safety and risk rules and requirements. From this aim, the safety level could be examined which will lead ultimately to realize the safety realty in Iraq. Investigating the engineers' perception related to the mentioned evaluation is guiding to the second objective. That other objective is examining the idea that the engineers' major and degree affect his/her perception regarding the safety evaluation.

1.1 Research significance

safety and health wellbeing are considered particularly important aspects in all work sectors as the human deals with different machines and situations. Some of these situations are complex and risky by nature. From this point of view, every organization should have a specific safety program that is planned carefully to satisfy its needs of protecting people. Safety programs should be developed continuously to increase safety level in the organization which in turn reduces accidents, increases production, cuts off worker compensations for safety issues, etc. Accordingly, the significance of this research for developing countries becomes clearer. In developing countries, the suitable safety rules might not set and the understanding of the idea of safety could not be clear. This idea can be assured by lesser safety research studies and scarce law acts regarding safety in governmental documents.

1.2 Research objectives

The study objective is to evaluate the risk management framework through the processes of examining, identifying, analyzing, and evaluating risks. This main objective will be concluded from five minor objectives. Those five minor objectives are: knowing information about risk management tools, evaluating of the training courses, understanding the engineer's role regarding safety, recognizing administrative controls, and assessing of the behavior-based safety (BBS). The primary research questions for the study are as follows:

1. Is there any perception, negative or positive, regarding safety and risk in construction sector in oil and gas industry?
2. Does the major of an engineer respondent play any role in the mentioned perception in question 1?
   Answering this question is by examining this hypothesis:
   H1: Responses differ depending on the respondent' major.
3. Does the degree of an engineer respondent play any role in the mentioned perception?
   Answering this question is by examining this hypothesis:
   H1: Responses differ depending on the respondent' degree.

2. Methodology

To evaluate the general understanding of safety by engineers who work in construction sector in oil and gas industry in Iraq, a questionnaire was carefully prepared and distributed. There are two approaches when examining safety: one is theoretical, and the other is practical. The theoretical approach might be investigated by conducting this study and the other may be measured by looking at the recorded safety cases, in oil and gas industry particularly. In this study, the theoretical approach will be studied using responses to a questionnaire distributed to engineers with different levels of experience and different engineering majors. Those engineers are working on constructing new facilities related to oil and gas industry. Before distributing the survey questionnaire, it was evaluated by a group of experts in construction safety planning. It was planned when preparing for the questionnaire so that the answers to its questions be analyzed quantitatively; that is why the questions were prepared in most cases as Likert scale ratings. By leaving a note in each question that asks if the respondent has another insight to state, the respondents have given the opportunity to add more thoughts. Likert scale was used to quantify the responses by utilizing five ratings: Strongly agree (SA), agree (A), Neutral (N), Disagree (D), and Strongly disagree (SD). To ease the quantification of these ratings, later in the analysis process, numbers from one to five were coded instead of the original ratings as 1, 2, 3, 4, and 5, respectively.

The survey was divided into five areas each of which is measuring an approach in the intended evaluating process. Firstly, is regarding familiarity of the respondents with risk evaluation processes. SOWT, risk assessment matrix, and accidents recording have used to measure the safety and risk knowledge among the respondent engineers. SWOT is used to manage organizational plans strategically [13] where the risk matrix is an assessment measure to the risks and is used specifically in oil and gas industry [14]. Secondly, is about the quality of the training courses provided by their organizations. The questions were focused on the training courses related to safety basics. Thirdly, is regarding the level of understanding of the role and commitment of engineers to safety in work. In another word, how committed is the engineer to the safety planning and enforcement. Fourthly, is about the knowledge of hierarchy controls and their applications in the work. This group of questions is related to the administrative control on the jobsites. Finally, is how effective the Behavior-based safety (BBS). BBS focuses mostly on establishing consciousness regarding safety and health wellbeing in an organization [15]. Each of these areas is emphasized by four questions, which makes all questions are 20, excluding the biographical questions. Biographical questions were limited to the experience years, study degrees, and engineering majors.

Convenience sample was adopted in this study. In construction related sector(s) it is hard to apply randomness in surveying construction personnel [16-18]. Out of 200 distributed surveys, 50 were considered for further analysis as they filled completely. A mixed approach to analyze collected data was adopted; that is descriptive and inferential statistics. Moreover, descriptive statistics was used to show the results using simple measures such as mean and standard deviation, and graphics. While to understand the role of the major and college degree in shaping the response of a respondent, inferential statistics was applied.

3. Results and discussion

As it was mentioned above, there were 50 valid surveys out of the distributed ones in this study for engineers from different majors and college degrees. Table 1 below shows the distribution of the participants degree, specialization, and experience years. From the table, the sample is of engineers, where some of them are with higher degrees. Additionally, having mostly all the respondents with more than five years of experience gives a supportive thought about their evaluation to the nature of safety and risks in their organizations. However, the experience may not be used to infer the scoring trend of the respondents as the table shows that there is only one respondent with less than 5 years of experience.

Table 1. The participants degree, major, and experience years.

Degree	Major	Experience, years
PhD = 5	Civil Eng. = 26	> 5 = 49
MS = 5	Chemical Eng. = 13	< 5 = 1
BS = 40	Electrical Eng. = 4	
	Mechanical Eng. = 3	
	Other = 4	

An important note that should be stated is that the respondents cover a good range of different engineering majors (specializations), as shown in the table 1 above. To answer the study questions, the results and discussion section was divided into two subsections: one regarding question one and the other is related to questions two and three. The analysis is explained below with emphasizing each area of the five mentioned areas of the survey questions. It is important to indicate that the agreement ratings (SA & A) were summed to ease the analysis and to emphasize the agreement against the disagreement; the same was applied to the ratings (SD & D); this was applied in analyzing questions 2 and 3.

3.1. Question 1 Analysis

3.1.1 The knowledge of the risk management

By calculating the response percentages per each question in the first area (risk analysis management), there is a high percent of respondents being neutral regarding SOWT analysis, 50%. While those who have a strongly agreement and an agreement rating are 4% and 46%, respectively. This trend indicates that respondents do not have a good knowledge about one of the important risks evaluating and planning techniques. Regarding the risk matrices, most respondents (76%) have a good understanding about its role, which indicates a positive notion. On the other hand, there is an agreement from the respondents that the data recording regarding safety should be kept (100%), which also shows a supportive insight. The final item in this first area, is the removing of the hazards. A higher percent (92%) agreed that this should be conducted whenever a hazard is identified, which reflects a good sense of risk prevention. To ease following of the total results about the first area, the responses of all questions were summed in terms of the five ratings. Referring to the figure 1 below, it is obvious that the majority have enough theoretical knowledge about the risk management requirements. However, there are some gaps in this kind of knowledge.

Figure 1. Risk management knowledge

3.1.2 The goodness of the safety training courses

In terms of safety trainings, 90% of the respondents assured that their firms offer related courses frequently for all employees. This percent reflects a good impression that the oil and gas companies in Iraq are paying a reasonable attention to keep their employees safe. Regarding the contents of these trainings, high percent of the respondents (71%) believe that the contents are good enough to provide safety basics. However, there is a clear sound that some are not agreed with this result or they are neutral about it (6%). Being neutral may not mean that respondents refuse the agreement, yet it could mean they are not sure about it. The safety benefits that the respondents get from the training could be questionable to some extent. Actually, there is 34% of the respondents either neutral or not agreed with the statement that they graduate with enough safety knowledge. In general, the trainings are beneficial, and most people agreed on that (66%). Figure 2 shows the general sense regarding all the four questions of this area.

Figure 2. Safety training courses

3.1.3 Engineer's role and commitment towards safety

The commitment of an engineer to safety motivates others to follow the safety rules and procedures to prevent and/or mitigate the safety issues on jobsites. This statement is supported by 71% of the respondents. While engineer's ignorance of safety rules does not affect his/her officiality is disagreed by the majority of respondents (92%) and the remaining percent of the respondents was neutral. Ninety-four percent of respondents believe that the engineer should learn more about safety requirements personally. This is a good point to be mentioned as it establishes a safety culture that is needed in developing countries work environment. Figure 3 summarizes the results of the third area, engineer's commitment to safety procedures.

Figure 3. Engineer's commitment to safety rules

3.1.4 Knowledge of administrative controls and their applications

The Safety signages are an effective way to reduce accidents, is a statement that most engineers agreed on (72%). Moreover, the respondents agreed (100%) on that a list of hazardous substances used in the workplace is kept and readily available to everyone. Furthermore, the agreement on the wiring should have groundings was (96%) and the checklist could be a helpful factor to avoid some risks that may lead to safety issues was (78%). Figure 4 shows the results of the area of hierarchy controls knowledge among engineers.

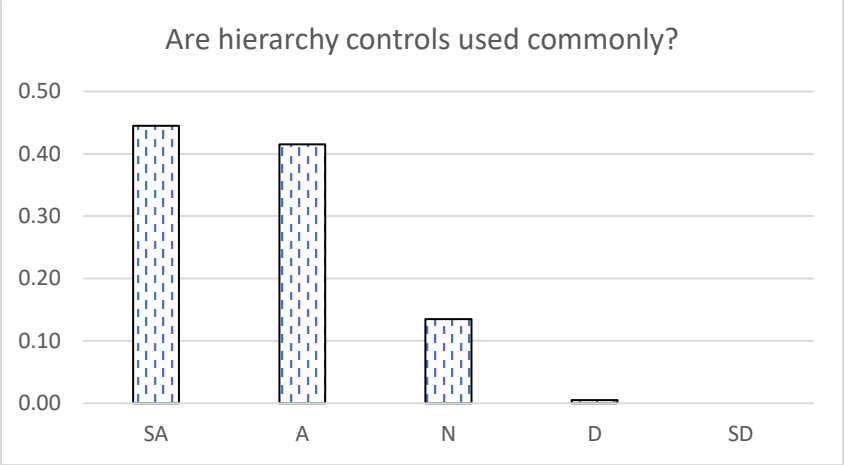

Figure 4. Hierarchy controls knowledge

3.1.5 Behavior-based safety

All the respondents (100%) disagreed that the safety is not a priority to the higher management and 38% disagreed that changing the safety behavior does not require a change in work style. Finally, high percentages of the respondents, 84% and 100%, agreed that some behaviors are more difficult than others because they are linked to the community habits and also behavioral safety awareness affects the safety level, respectively. Figure 5 explains the results of the BBS area of the questionnaire.

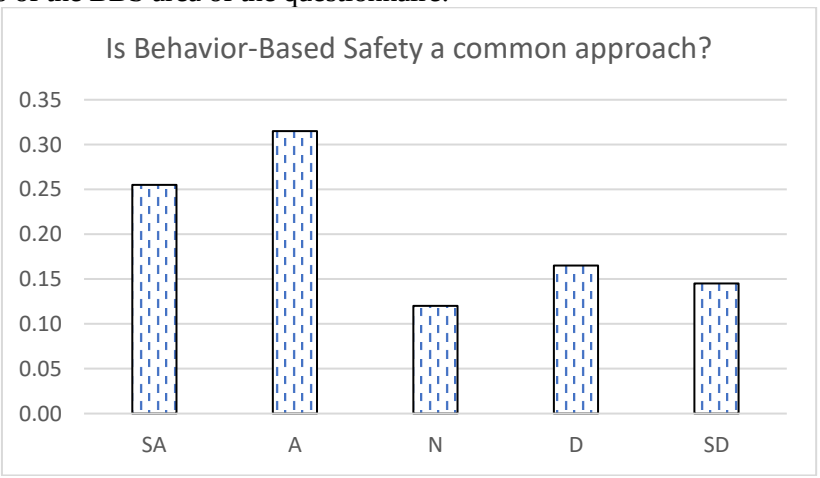

Figure 5. Behavior-Based Safety

3.2 Questions 2 & 3 Analysis

In the second and third questions of this research, authors investigated the association between the response and the degree of the respondent, e.g. holding a higher degree after BSc or not. Since the data is built on a Likert scale rating, a nonparametric statistical tool should be used. Since the data is related because they come from same respondents, Wilcoxon Signed Rank test is used. The alternative hypothesis was that there is an impact of the degree on the response that drives it towards a specific trend. To ease the process and to not repeat it for each question responses privately, the responses of the four questions of each of the five areas were gathered and tested. Moreover, each area of the questions has the same subject to measure. From that, it is now an investigation to the area in terms of the presence of the association or not.

From the Wilcoxon test , using R platform, the calculated p-values of the five areas are (A_1 = 0.09201, A_2 = 0.9955, A_3 = 0.1784, A_4 = 0.8711, A_5 = 0.0164), where A_1 refers to area 1 and so on, as it was explained in methodology section. From these values, it could be concluded that the alternative hypothesis that the respondents impacted by the degree level is rejected (at 5% significance level) for all the areas except A_4 where the null hypothesis is rejected. By examining the data, it is obvious that the average of the higher degree engineers is bigger than that for BSc engineers. The reason might be that the engineers with master or PhD have

more knowledge about the BBS and that is why they assign greater ratings trusting and/or recommending it. On the other hand, the major of the respondents was also investigated in case it influences the scoring tendency. The alternative hypothesis (H1) was that the scoring tendency is driven by the major of a respondent. Wilcoxon test was used to examine this hypothesis for all of the five areas and the following p-values were recorded (A_1= 0.2248, A_2 = 0.5118, A_3 = 0.7307, A_4= 0.2478, A_5= 0.2125). It is obvious that the null hypothesis is accepted for all the five areas. So, there is no association between the scoring and the major of the respondent (at 5% significance level). Depending on the results of Wilcoxon Signed Rank test, the populations are identical in terms of the responses tendency excluding the BBS rating in degree related question.

4. Conclusions

This study was conducted to set a start point regarding safety and health in Iraqi construction sector, in oil and gas industry. This goal was planned to be investigated depending on several objectives regarding risk management, safety training, engineer commitment to safety, BBS, and importance of administrative controls. After revealing the goal results, it was planned to understand if the safety and risk understanding is impacted by degree and major. The results show that there is an acceptable level of understanding of safety and risk among engineers in Iraqi construction sector. Moreover, all the mentioned minor objectives were reasonable in terms of suitability with the general trend globally. That is, safety training is useful and important, engineers should be committed to safety on jobsites, BBS and administrative controls are beneficial and understood. There is only one issue that is not common in Iraqi safety and risk planning and this is the risk management tools familiarity. That is, engineers are not familiar with some strategic tools regarding safety and risk. Finally, major and degree are not associated with engineers' risk conceptualization. From this study, one can think that the safety in Iraq, specifically in oil and gas industry, is acceptable to somewhat and there are some areas that need more work to enhance safety and risk planning and enforcing. Furthermore, the research shows a gap in the understanding and practice of the risk assessment tool between management and operation, especially in the behavioral effects

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