

Developing and Implementing an Auditing Tool For Assessing Health and Safety in Oil Industry Projects

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Abstract. Developing a tool for assessing health and safety in construction projects assists project managers to control the project status related to safety, as well as help them to improve it. This research aims to discover significant factors in assessing health and safety performance of oil industry projects. For this purpose, the primary factors were distinguished based on literature review and a questionnaire were distributed among experts to rank them all. Through this framework, the weight factors were defined so that managerial factors got top scores and finally a case study was regarded to implement this new auditing tool.

Keywords: Health and safety performance, health and safety factors, auditing tool.

1. Introduction

Construction projects, especially oil industry projects, are dangerous due to congested environment and risky nature of these projects. Accidents such as falling or injuries rates are much higher in construction industry in comparison with other industries [1, 2]. Hence, safety is always one of the concerns of project managers of this type of projects. The importance of this concept in construction is so critical that satisfactory safety performance is an important criterion in selecting construction contractors [3, 4].

In addition, some earlier studies have mentioned safety performance as a key indicator in measuring project performance or success [5, 6, 7, 8]. Cheung et al. [9] indicates health and safety as one of the categories in measuring construction project performance and focuses on factors like statistics, procedures, training, and inspection in this area. Hence, developing a tool to assess health and safety performance of the project in different phases of project lifecycle and on a regular basis is essential. Such an auditing tool enables project managers to evaluate the safety level of under construction projects and focuses on most important poor areas to attain higher performance.

The main objective of this research is to develop an auditing tool for assessing health and safety performance of oil industry projects. To achieve this purpose, firstly, influential factors have been identified through investigating standards and previous researches, revising efforts of oil companies on safety issue, and studying similar auditing tools. Secondly, to make it more precise, identified factors have been screened through a quantitative questionnaire to indicate the most important ones. Finally, AHP method has been applied to assign weights to the key factors. Acquired tool has been implemented in a case study project.

It should be mentioned that the proposed tool does not audit health and safety status of completed projects in their operation phase, and is limited to under construction projects. Also, it does not suggest formulas for measuring safety factors.

2. Literature review

2.1. Health and safety factors in projects

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In several studies health and safety has been considered as an important factor that affects the performance of construction projects [9, 10]. In some studies, health and safety factors have been classified in various categories. Enshassi et al. [10] divided health and safety to sub factors regarding application of health and safety factors in organization, safety of Project location, report of accidents rate and assurance rate of project.

Furthermore, some other studies have focused on those health and safety factors which affect construction contractors' performance. OSHA recordable incidence rates and Experience Modification Rating (EMR) have been introduced as two most dominant methods in assessing contractors in terms of safety performance [11, 12]. Indices that have been applied in these methods, are representatives of the number of injuries, lost time, and the money has been paid to staff for accidents compensation. Ng et al. [12] also introduces Score Card for safety performance evaluation. Developed by Hong Kong government, this method consists of different elements regarding maintenance, information, training and supervision. Safety performance evaluation (SPE) framework of Ng et al. [12] divides safety factors in project and organization level and assigns weights to them in order to find the total safety score of contractor. At project level, the proposed framework consists of project management committee, hazard management, information, training and promotion, implementation, recording, reporting and investigation, and emergency procedures as main factors. Categorizing factors to project and organization level, also has been followed by Sawacha et al. [2]. This researcher has indicated historical, economical, psychological, technical, procedural, organizational and work environment issues as project level factors.

Organizational safety policy, training, safety meetings, safety equipment, inspection, safety incentives and penalties, workers' attitude towards safety, and labour turnover rates have been mentioned as most crucial factors that drives safety performance in prior researches [11].

2.2. Health and safety in oil companies

Investigating safety approaches of some remarkable oil companies revealed that such companies observe safety as one of their major concerns, and have a systematic manner toward safety management.

For instance, promoting Health, Safety and Environment (HSE) performance level has been perceived as one of the capital objectives of National Iranian Oil Company (NIOC) [13]. It includes defined strategies such as organizing HSE management system, enhancing HSE knowledge level and effective staff participation in HSE practices. Similarly, industrial safety has been mentioned as the top priority for Total Company [14] and contributed to apply safety management system along with annual performance review in all units.

Additionally, Chevron and BP Corporations both conduct safety performance audit and utilize rewarding system for safe operations [15, 16]. BP is also equipped with safety training and capability development plan with respect to process safety. Regarding workplace conditions, Chevron implements a system to acquire an injury-free workplace. Furthermore, recognition the environmental and health risks together with mitigation of main ones are other safety functions of this Company.

2.3. Health and safety auditing tools

Based on the nature of the activities which has been performed in an organization or in a project, there are various types of auditing tools related to health and safety. Beside acts, regulations and standards, some companies also have designed auditing tools for measuring their compliance with health and safety issue.

For instance, according to points 57 up to 71 of Iran's fourth five- year development plan [17], all requirements to follow health and safety regulations should be considered in workplaces.

In Canada also criminal offence related to safety of workplaces has been legitimated [18]. According to this act, any non-compliance activity can causes irreversible damages to the organizations and makes serious problems for both the individuals and organizations. This amendment has provided some steps to identify and prioritize hazards, and try to eliminate them through control, communication and evaluation.

Furthermore, in some companies specific methodologies have been applied for auditing safety statues. For instance, NIOC follows the principles of quality management system in implementing HSE requirement with emphasis on leadership and policy, planning and implementing, meeting the requirements and control.

International Association of Oil and Gas Producers (OGP) [19], is another example of companies which has provided a safety check list. The company focuses on some main areas such as demonstration of management commitment, organizational and operational requirements, training, engineering and operation standards, operating and safety procedures, emergency and incident response, audit and inspections, motivation and communication, as well as contractors.

3. Research Methodology

3.1. Data Collection

To meet the aim of the survey, first step is to identify significant factors in assessing oil-projects' health & safety performance. Stated required items were collected through conducting a comprehensive literature review, investigating safety features mentioned in international standards and finally studying current applicable safety tools in workplaces. Exploring all declared sources, 62 primary items associated with project safety performance were identified.

Acquired factors then were categorized under five main groups namely physical, chemical, personnel, informational, and managerial. In order to gain substantial factors in each category and to reach less number of factors to be weighted by pair-wise comparison in next step, elimination of less significant items were observed through distributing questionnaire. In fact, questionnaires were given to respondents who were involved in safety issues of oil projects in Iran. Due to limited access to available experts on this issue, by means of random selected method, totally 80 questionnaires were distributed among participants via email.

3.2. Data analysis

Participants were requested to assign a number to each factor based on a five-point Likert scale (ranging from Very high (5) to Very low (1)) to identify "how much that factor is prominent in assessing safety performance of oil projects". Next, according to Ng et al. [12] mean rank method was selected for ranking initial items. Calculated mean score contributed to acquire top 30 factors (elements with average value ≤ 3.5 were omitted). Afterwards, to prioritize items and determine the weights, remained elements were given to HSE managers to be ranked by Analytical hierarchy process (AHP) method. Weights of categories and factors as well as inconsistency rate have been measured by Expert Choice Software to confirm the validity of opinions.

4. Findings

Totally 41 participants responded the sent out questionnaires, representing the 51 % rate of response. Majority of participants were male (70%) and 61% of them had between five to ten years experience.

Analyzing collected data by calculating average weighted response shows that four most important factors are: 1- Identification and consideration of all workplace hazards/risk (in chemical category with the mean of 4.34), 2- Emergency equipment (in physical category with the mean of 4.17), 3- Labour health and safety training (in Personnel category with the mean of 4.17) and 5-Hazards/risk assessment and Control (in chemical category with the mean of 4).

In addition, data reveals that "Stakeholders point of view", "Number of third party claims due to negligence", and "General information documents such as brochures, catalogues and annual reports" (with means of 2.73, 2.76 and 2.9 respectively) are less important factors in evaluating health and safety performance in oil projects regarding respondents' point of view.

Data shows that "Emergency equipment", "Fall Protection" and "Check equipment before using" (with means of 4.17, 3.93 and 3.88 respectively) are most important factors in physical category. Top three factors in assessing safety performance of oil industry projects in other categories are: "Labour health and safety training", "Providing Personal Protective Equipment", and "First aid facilities" in personnel category, "Identification and consideration of all workplace hazards / risk", "Hazards / risk assessment and Control" and "Prioritized hazards / risk" in chemical category, "Project safety risk management plan", "Interest, commitment and attitudes of top management" and "Awareness of safety and emergency plan" in managerial

category and "Inspection and safety audit", " Provide operation instructions and safety information" and " Lesson learned from accidents" in informational category.

To determine the weights of key components and also prioritizing the remained factors under each category, opinions of six health and safety managers with average of 10 years experience were applied through AHP method. Utilizing expert choice software declared that inconsistency rates gained from respondents were reliable (0.0093 which is less than 0.1).

The highest obtained score refers to managerial category with 50% weight. The second and third significant categories were informational and personnel factors. These findings are consistent with prior studies [20]. Moreover, AHP results demonstrate the weights of factors in each category. Top three weights of each category have been demonstrated in Table 1.

Table1: Top health and safety factors

Category	Weight of category	Factor	Weight of factor
Managerial	50%	Interest, commitment and attitudes of top management	34%
		Setting safety standards and measurable targets by management	15%
		Considering safety as part of contractors selection procedure	14%
Informational	20%	Provide operation instructions and safety information	42%
		Inspection and safety audit	27%
		Lesson learned from accidents	17%
Personnel	17%	Labor health and safety training	26%
		Providing Personal Protective Equipment	19%
		Permit to work	13%
Physical	7%	Check equipment before using	21%
		Emergency equipment	21%
		Select work equipment regarding working conditions	19%
Chemical	6%	Identification & consideration of all work place hazards/risks	34%
		Prioritized hazards / risk	22%
		Hazards / risk assessment and Control	20%

5. Applying the tool: Case study

After developing the auditing tool based on defined main safety factors and their weights in previous step, the tool has been implemented in one of the construction projects of National Iranian Oil Refining and Distribution Company (NIORDC) which is under construction phase. The objective of this project is to construct a plant to produce a new high quality gasoline product.

A team consists of three experts involved in safety issues of mentioned project, were responsible to assess and define current status of each defined safety factor in the project and assign grade to them. The grading marks varies from zero (if the factor is not applicable for the project) to five (excellent deployment which demonstrates activities related to the factor are deployed systematically, monitored and improved).

Table 2, shows the final results after grading all factors and calculating values of the factors in each category (Value = Grade × Weight of each factor). Data illustrates that in general the health and safety performance of selected project is satisfactory. As the managerial category has gained the highest weight in comparison with other categories, the project manager of mentioned project should focuses on that as an area of improvement. Based on scores, providing and implementing an emergency plan beside project safety risk management plan is suggested as a critical action for improving health and safety performance.

Table 2: Final results of case study project

Category	Weight of category	Value	Score (Value × Weight of category)
Physical	7%	3.29	0.2303
Chemical	6%	3.89	0.2334
Personnel	17%	3.67	0.623
Informational	20%	3.83	0.766
Managerial	50%	3.36	1.68
TOTAL VALUE	100%		3.5327

6. Conclusion

There is no doubt that health and safety issues are one of the critical aspects in projects especially in oil industry. This research proposed an auditing tool for assessing health and safety performance of a project through investigating most important factors. Collected data from experts involved in oil industry projects revealed that managerial factors regarding health and safety are the most significant factors which project managers should pay more attention to, by preparing and deploying effective plans. Informational factors are at the second level of importance. Proposed auditing tool would be beneficial for setting safety target, defining the current status and areas need to be improved, as well as bench marking purposes.

7. References

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