Critical success factors influencing construction safety program implementation in developing countries

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Abstract. The construction industry has always been considered as one of the most hazardous industries globally. The condition is worse in developing countries due to poor implementation of safety management. To overcome this problem, there is a need to focus on improving the implementation of safety programs. This paper aims to identify the factors that have the potential to influence the implementation of safety programs in construction projects in developing countries. An extensive review of literature found 21 critical success factors. Sixteen semi-structured interviews with experts in the Iraqi construction industry was conducted to gain in-depth insight and understanding of these factors. The interviewees confirmed the relevance of the success factors and emphasized on the importance of several factors, including management commitment, safety training, the enforcement of safety rules and regulations, and stakeholder collaboration. Technology is a new factor identified by the interviewees. The findings can be used in the Iraqi construction industries and in developing countries to support the implementation of safety programs.

Keywords: safety management; safety program; construction projects, developing countries, Iraq

1. Introduction
The construction industry is notoriously known as one of the most hazardous industries in the world. This fact clearly shows the importance of safety program implementation in the construction industry [1]. Accidents are undesirable outcomes in construction projects and have a series of negative consequences. They incur additional direct costs, such as medical costs and damages, and indirect costs, such as delays and interruptions, poor reputation, and low worker morale [2, 3]. The condition in developing countries is even worse because of the lack of safety regulations and poor enforcement of regulations [4-7].
The unique characteristics of the construction industry, such as being labour intensive, dynamics, and exposed to weather conditions, also contribute to the poor safety performance of the industry [10,11]. In such a hazardous work environment, safety program is a proactive method to promote safety on construction sites [8]. Top management has a very important role to play in implementing this safety program because they are the ones who allocate resources to ensure the success of the program [4, 9, 13]. The implementation of an effective safety program can eventually lead to the development of positive safety culture [12].

The aim of this research is to identify the critical success factors to implement safety programs in the construction industry. A comprehensive literature review was conducted to identify these factors, while semi structured interviews were used with construction industry practitioners to verify the critical success factors in the context of developing countries.

2. Critical success factors of construction safety program implementation

Oregon Occupational Safety and Health Division [14] defined safety and health program as what people do to control injuries and illnesses at their workplace. According to Anton [15], safety program is the control of the working environment, equipment, processes, and the workers for the purpose of reducing accidental injuries and losses in the workplace. Rowlinson [16] explained that a safety program in the construction industry is a method to stop unsuitable behaviour that leads to an accident, to detect and report the issues, and to report the accident.

Critical success factors (CSFs) are areas in which results, if they are satisfactory, will ensure success within and of the organization [17]. In the context of safety, CSFs include events, resources, and actions that are required to implement a safety program effectively [18]. Based on previous studies, 21 factors have been identified as substantial to safety program implementation, particularly in developing countries. Table 1 summarised these factors.

| Factor | Description | Sources |
|--------|-------------|---------|
| Personal attitude | Attitude is the ability for certain people to react positively or negatively to objects or conditions and is typically established via experience. A safety program can be implemented effectively if the attitudes of the employees toward safety are strengthened | 19, 20 |
| Personal motivation | To ensure laudably safety performance, all workers on site should be motivated to do their safety responsibilities. | 21-23 |
| Safety meeting | Regular safety meetings must be organized to evaluate safety records to improve safety performance. | 24 |
| Efficient enforcement system | An efficient enforcement scheme should be established by the management to ensure workers follow safety rules and regulations. | 25-28 |
| Suitable Supervision | Effective supervision promotes a safe work environment by ensuring that safety rules and regulations are followed. Supervisors can recommend solutions for safety problems by collaborating with, and listening to, workers. | 28, 29 |
| Training | Adequate safety training improves the employees’ safety knowledge and skills, and develops positive safety behaviours and attitudes. | 8, 20, 30, 31 |
| Equipment and maintenance | Appropriate equipment and its regular maintenance are a way to create a safe work environment | 8, 31 |
| Personal efficiency | It is important to have the right person on the right job to have a successful safety program. to capitalise on his or her ability to identify safety risks and take the right decisions. | 8, 20, 32 |
| Program assessment | After implementing a safety program, periodic evaluations should be done to determine its success in meeting objectives and goals. Shortcomings can be identified by the evaluations. | 33-35 |
Good communication | There should be a clear line of communication between all levels of staff in the project. Workers should be able to report unsafe acts and conditions. | 28, 35, 36  
Allocation of authority and responsibility | Everyone should be accountable to safety. | 15, 35, 36  
Adequate resources | Resources for safety programs are varied, including time, money, staff, information, and safe work methods. | 33, 35, 37-39  
Management Support | In safety program implementation, management plays a very important role. Management should allocate sufficient resources, establish a safety policy, participate in safety meetings, and demonstrate safety commitment through various ways. | 16, 34, 35, 39, 40  
Teamwork | Safety program succeeds when all levels of staff are engaged and recognise that preventing accident is everyone's responsibility. This involves teamwork and cooperation in planning, organising, and controlling various aspects of safety in the workplace. | 41-43  
Clear and realistic goals | Safety goals should be established. The goals should provide clear guidance for all staff to reach the desired results. Safety performance is also measured based on the achievement of these goals. | 25, 35, 44  
Continued participation of employees | Employee involvement is very important for successful safety program. Employees should be engaged and have a chance to participate in implementing safety program. | 35, 45-48  
Safety committee | A committee comprises supervisors, managers and workers is needed to address perform safety activities and address safety issues. | 18, 35, 49-51  
Site inspection system | The aim of safety inspection is to assess the site periodically to identify safety issues and breach of safety regulations and policies. | 13, 18, 51, 53, 54  
Hazard Identification | The aim is to check all construction practices and materials to identify possible hazards which can cause accidents or injuries. | 2, 18, 50, 55  
Pre task planning for safety | This is a meeting (toolbox talk) conducted shortly before the work begins to recognize the potential hazards of the task. | 12, 52, 56  
Safety policies | Having a high quality of safety policies and regulations improves management and workforce attitudes toward safety performance. | 4, 13, 49, 54, 57, 58  
Technology | Technology can be used to enhancesafety in many different ways. | Added by interviewees  

3. Qualitative Method
Semi-structured interview was the qualitative method selected for this research to obtain the insight of experts. The interviews focused on verifying the relevance of the 21 factors identified from the literature review in the context of the Iraqi construction industry. Furthermore, the interviews sought to identify other CSFs which have not been included in the research and barriers to the implementation of safety programs. The interview questions were sent to the interview participants before the interviews, allowing them to consider the questions thoughtfully. To ensure privacy, the names of the participants and their corresponding construction organizations have been coded [60-64]. Each interview lasted around 60 minutes.

4. Demographic information
The process of selecting interviewees began by contacting some private and public construction companies to request their support in identifying pertinent interviewees. Sixteen interviews were conducted with experts and professionals in the Iraqi construction industry. As shown in table 2, all the interviewees had an ample of experience in the construction industry, ranging from eight to 40 years. Their positions were also varied, including site engineer, consultant, project manager, senior manager, and director. They worked in the public sector or private sector or as independent consultants, while the main functions of the organizations cover all the key players in the industry, client, consultant, and contractor, ensuring rich data from different perspectives.
### Table 2: Demographic profile of the interviewees

| No | Position         | Education | Experience (Years) | Sector         | Organization function |
|----|------------------|-----------|--------------------|----------------|------------------------|
| 1  | Director         | BSc       | 30                 | Private sector | Contractor             |
| 2  | Project manager  | PhD       | 28                 | Government     | Client/Developer       |
| 3  | Site engineer    | MSc       | 20                 | Government     | Contractor             |
| 4  | Senior manager   | BSc       | 24                 | Private sector | Client/Developer       |
| 5  | Consultant       | PhD       | 40                 | Independent    | Consultant             |
| 6  | Senior manager   | PhD       | 30                 | Independent    | Consultant             |
| 7  | Project manager  | PhD       | 35                 | Independent    | Consultant             |
| 8  | Site engineer    | MSc       | 15                 | Government     | Client/Developer       |
| 9  | Director         | PhD       | 28                 | Independent    | Consultant             |
| 10 | Site engineer    | MSc       | 12                 | Independent    | Consultant             |
| 11 | Site engineer    | BSc       | 8                  | Private sector | Consultant             |
| 12 | Director         | MSc       | 25                 | Independent    | Consultant             |
| 13 | Project manager  | PhD       | 22                 | Private sector | Contractor             |
| 14 | Senior manager   | MSc       | 15                 | Private sector | Contractor             |
| 15 | Site engineer    | BSc       | 10                 | Government     | Client/Developer       |
| 16 | Consultant       | MSc       | 25                 | Independent    | Consultant             |

5. **Interview results**

Each interview was transcribed, and any additional notes observed during the interview were recorded immediately after the interview. This information was then coded and organized in a separate folder to enable the thematic analysis of interview contents. When conducting the thematic analysis, each transcript was reviewed repeatedly to narrow down and organize the main themes that become the main findings of the research. The interviewees were requested to indicate their opinions whether or not they considered the factors relevant in the Iraqi construction industry and to propose new factors which have not been included on the list. Based on the interview results, some factors were modified and a few ones were added. The validated factors will be used in the second phase of the research, which will focus on establishing the relationships between the success factors and the implementation of safety programs.

The interviewees confirmed the relevance of the majority of the factors identified. Some factors were mentioned more frequently than the others (safety policies, management support, training, adequate resources, and suitable supervision), indicating their relative importance. It is interesting to notice that those who worked in the private sector tended to consider cost, i.e., a safety resource, as a critical success factor.

All the interviewees acknowledged the importance of safety and its influence on productivity, worker morale, the achievement of the project objectives and the reputation of the company. They agreed that the implementation of safety programs is an important step to improve safety in the construction industry in Iraq. In order to implement safety programs successfully, there are several
success factors considered particularly important by the interviewees. First, safety policy and regulations should be the foundation of safety management. The lack of safety regulation is seen as a barrier to implementing programs. The interview suggested that safety rules and regulations as defined in international safety standards, such as those established by the U.S. Occupational safety and health Administration (OSHA), are adopted in Iraq. Currently, safety is also not included in contracts, thus, giving no incentive to contractors and other stakeholders to focus on safety in the projects.

Second, management commitment is another crucial factor because they have the power and authority to allocate resources to implement safety program. Their commitment is the starting point of developing safety culture in the company and they need to actively communicate with those at the lower management levels to demonstrate their safety commitment. These results align with Aksorn and Hadikusumo [18], who found that management support and adequate resources provided by the top management are the most influential factors in safety program implementation. In addition, continuous communication and regular safety meetings influence teamwork and improve the team’s ability to take corrective actions and improve overall safety performance [4].

Third, safety training is another factor that was mentioned frequently by the interviewees. It is obvious that safety training is needed to improve safety knowledge and skills of project personnel. This training is also needed to make personnel aware of the hazards and risks before performing any work.

Fourth, a strong collaboration between stakeholders is a way to ensure that safety becomes a priority in construction projects. Key stakeholders should work together and be committed to safety so that safety programs can be implemented successfully. In this case, safety should be a thing that is implemented in isolation because a construction project involves multiple stakeholders that can influence its success.

In addition, the interviewees suggested technology as a new factor that can affect the implementation of safety programs. Examples of technologies that can be used for this purpose are Building Information Modeling (BIM), four-dimensional computer Design (4D CAD), and using sensor and wearable devices for monitoring workers’ physiology and locations.

6. Conclusion
The aim of this study is to identify the critical success factors that influencing safety program implementation in developing countries. Interviews conducted with industry practitioners in the Iraqi construction industry. The interviewees confirmed the relevance of 21 critical success factors and proposed technology as a critical success factors can affecting on safety program.

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