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The Impact of Integrating Occupational Safety and Health into the Pre-Construction Phase of Projects: A Literature Review

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Abstract

Construction is a high-risk industry owning to several accidents that take place in construction sites. Fatalities and workplace injuries are a major issue. Construction managers concentrate on profitability as far as cost, quality, and time are concerned. Unless experts end up mindful of safety-related issues, development tasks can never reach their targets. The main aim of this paper is to review the literature that highlights the result of the implementation of occupational health and safety practices in construction sites. The research examines the impact of the implementation on the number of accidents in construction sites and the precautions that should be taken into consideration starting from the pre-construction stage. Previous research suggested that early introduction of occupational safety & health management systems (OHSMS) and elements within the project implementation is an important asset in decision-making. It aims toward the abatement of occupational hazards in the workplace. The paper explores through a literature review the root causes of construction accidents and factors causing risks in construction sites. The research explains OSHMS, and its effects, and how they can be integrated into the pre-construction stage in projects. The impact of the implementation of occupational health and safety practices at construction sites will be discussed as well. The study concluded that due to implementing OHSMS, there is a significant reduction in accidents. In order to improve security and health, safety measures should be included starting from the preparation of contract documents. It is recommended that the managers of top construction companies commit more to safety and health procedures. There is a need to provide funding for the regulatory body that oversees health and safety in the construction industry.

Keywords

Occupational health and safety management system; Accident; Construction health and safety; Construction sites

1. Introduction

Construction industry is a high risk industry awing to severe accident occurrence in construction sites and accidental deaths or work-related injuries is considered an issue. Construction managers concentrate principally on profitability as far as cost, quality and time, though development tasks can never accomplish their targets unless experts end up noticeably mindful of the safety-related issues (Smith, 1999).

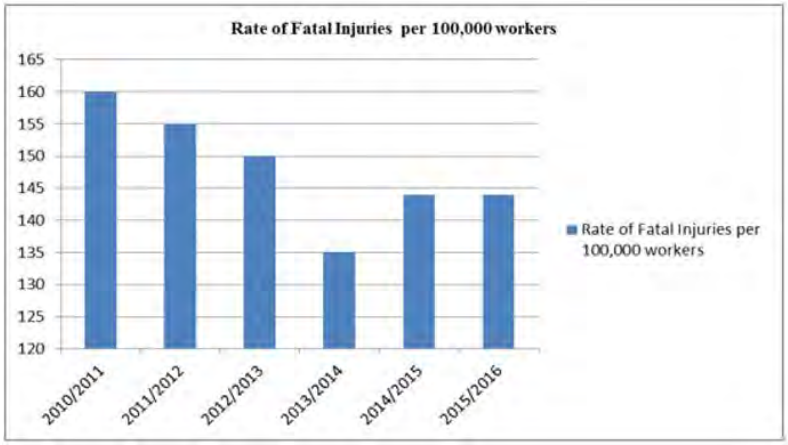

Figure 1. Rate of fatal work-related injuries per 100,000 workers as estimated by Health and Safety Executive (HSE)

As indicated by Health and Safety Executive, the statistics in figure 1 demonstrate the quantity of laborers fatally harmed in 2015/16 is 144, and relates to a rate of deadly damage of 0.46 deaths for every 100,000 labourers. Over the most recent 20-year era there has been a descending pattern in the rate of fatal injury (Workplace fatal injuries in Great Britain 2018, 2018).

Health and Safety are related to ensuring the welfare of the laborers through protection in their separate work environment. Security of laborers is extremely crucial in especially in high risk industries such as the construction industry in light of the fact that the fundamental power behind any site is the laborer. It is discovered that without wellbeing, the dangers and risks at an extremely risky place like construction sites can get individuals harmed, hurt or even executed and appropriately this can cause any development site deferrals and additional consumptions. Health and safety are ensured to both the employees and employers since bosses can't get a decent result if their workers are becoming ill and harmed constantly (Shamsuddin, Ani, Ismail & Ibrahim, 2015).

Occupational Health and Safety Management System can be explained to be part of the whole management framework that encourages the administration of the Occupational Safety and Health dangers related to the business of any organizational structure, planning of the activities and any other practices and processes in order to continually keep the OS&H policy of an association and continual improvement directed towards the abatement of occupational hazards in the workplace, (OSH).

The main objective of the Occupational Health and Safety Management System (OHSMS) to be certified is to empower the awareness of employees in safety through safety work practices, and higher safety standards are promoted in the construction industry, (Teo, Ling & Chong, 2005). It is argued by Smallwood (2002), that accidents are inescapable in the construction industry since the business is known to be naturally unsafe. The high rates of injury are essentially because of deficient or non-presence of OSH administration frameworks (Zolfagharian, Ressang, Irizarry, Nourbakhsh & Zin, 2011).

Health and safety issues are not bound to the construction phase of a project yet happen all through a project. Huge numbers of health and safety problems experienced during construction could be avoided if efforts are made during the project brief and design phases, (Haywood, 2004). (Hare, Cameron & Roy Duff, 2006) and (Saurin & Fermoso, 2004) explored health and safety integrate with preconstruction phase, thus suggested to future researches to develop the whole model for construction project management.

This paper aims to present a literature review on root causes of construction accidents, factors affecting safety in construction sites, what is meant by occupational safety and health management system. The paper then discusses what the pre-construction stage is and effects of implementing occupational safety and health in the inception &feasibility, design &tendering pre-construction stage then implementation of occupational health and safety practices at construction sites will be discussed. Previous research suggested that early introduction of occupational safety & health management systems (OHSMS) and elements within the project implementation, is an important asset in decision-making as it directs towards the abatement of occupational hazards in the workplace.

2. Defining Construction Site Accidents

(Ritter, 2006) explains a 'construction site accident' is any type of accident that happens on a construction site; products fall, people are crushed, buried, burned, electrocuted and fall to their deaths during working hours and the injured party was someone working on that job, (Ritter, 2006). It can be in term of harm to gear and materials and particularly attention is given to injuries, (Hinze & Russell, 1997).

2.1. Root Causes of Construction Site Accidents

There are many different root causes of construction site accidents due to unsafe acts and conditions. Unsafe conditions on site are hazards that can cause injuries, these are: defective tools, unprotected openings, and improper storage of equipment and materials. Unsafe acts on site are hazards caused by actions of people on site, these actions can be categorized in 3 ways: things a person should have done (e.g. inform others about unsafe conditions), things a person should have done differently, and those that a person should have not done at all, (Frederick & Nancy, 2009). However, according to literature, theses can be summed up into eight root causes. According to Table 1, it is shown here that all construction accidents are due to one or more of the eight root causes.

Table 1. RootCauses of Construction Site Accidents, (Frederick & Nancy, 2009)

Root Cause	Description
Absence of legitimate training	An employee was not appropriately prepared in perceiving and staying away from work risks.
Deficient requirement of safety	An employee's supervisor ˜or other individual with safety oversight duties realized that endorsed techniques for staying away from risks were not being taken after, but rather fail to uphold safety standards.
Safe equipment not given	An employer does not give an employee with equipment necessary to decrease risks.
Unsafe strategies or sequencing	The ordinary sequencing of construction tasks does not happen, bringing about a task being more perilous than usual
Unsafe site conditions	The site is intrinsically more perilous than usual construction sites.
Not using given safety equipment	An employee is given appropriate safety equipment yet does not utilize it or does not utilize it legitimately.
Poor attitude toward safety	An employee may have been legitimately trained, but does not appropriately stay away from work risks.
Isolated, sudden deviation from endorsed conduct	A regularly skillful and aware of safety employee abruptly and unforeseeably plays out a perilous demonstration because of exhaustion, distraction, or in like manner.

Out of the eight root causes, the initial five recorded are related to a hazardous condition due to an inadequate management of safety; the last three recorded are related to a perilous act by the harmed party, (Frederick & Nancy, 2009).

This brings us to the main aim of the paper at examining the early introduction of safety management system which is the occupational safety & health management systems (OHSMS) and its elements within the project implementation in the pre-construction stage assuming it, is an important asset in decision-making as it directs towards the abatement of occupational hazards in the workplace.

3. Safety in Construction Sites

Safety is exceptionally crucial in construction industry since it is a high danger industry as the primary power behind any construction site is the laborer. Safety is jeopardized because construction is always a risky task due to work-at heights and other outdoor reasons ,this in addition to workers' attitudes and behaviors (Frederick & Nancy, 2009). Helander (1991) states that construction is substantially more risky than manufacturing and this is partly because of more dangerous working techniques and machines used (Helander, 1991).Research has been done to identify problems for construction safety all over the world. Some research findings from developing countries are gathered and shown in the following table 2.

Table 2. FactorsAffecting Safety in Construction Sites [16-19].

Researches	Factors affecting safety in construction sites
Kartam et al. (Bottani, Monica & Vignali, 2009)	-Disorganized work, -Poor accident record-keeping and reporting -Extensive utilization of foreign workers -Extensive utilization of subcontractors -Absence of safety regulations -The low priority given to safety -The small size of most construction firms, -Competitive tendering, -Severe climatic conditions
Tam et al. (Wilson & Koehn, 2000)	-Top management's poor safety awareness -Absence of training -Project managers' poor consciousness of safety -Reluctance to include assets for safety -Reckless operations
Cheng et al. (International Labor Organization,1988)	-Not giving value to the significance of safety measures actualized at working environments -Not giving adequate safety orientation to new laborers -Not employing all around prepared safety and health staff to execute safety measures
Aksorn and Hadikusumo (Mohamed, 2002)	-Worker contribution -Safety counteractive action and control frameworks -Safety game plan -Management responsibility

It is concluded from the previous studies that many issues are associated with actualizing and implementing safety and health management in construction projects and the majority of the work-related injuries are preventable through safety measures and enhancing safety awareness among industry stakeholders (Baxendale & Jones, 2000).

The following section is concerned with the explanation of what is meant by occupational health and safety management system.

4. Occupational Health and Safety Management System

The occupational health and safety management system (OHSMS); in other words work-related health and safety management system was first prepared by the Health and Safety Executive (HSE) in the United Kingdom (UK) of the Accident Prevention Advisory Unit (APAU) in the UK in 1991. Occupational Health and Safety Management System can be explained to be part of the whole management framework that encourages the administration of the Occupational Safety and Health dangers related to the business of any organizational structure, planning of the

activities and any other practices and processes in order to continually keep the OS&H policy of an association and continual improvement directed towards the abatement of occupational hazards in the workplace (OSHA, 2008).

4.1. Objectives of Occupational Health and Safety Management System

The main objective of the Occupational Health and Safety Management System (OHSMS) to be certified is to empower the awareness of employees in safety through safety work practices, and higher safety standards are promoted in the construction industry, (Teo, Ling & Chong, 2005).It is argued by Smallwood (2002) that accidents are inescapable in the construction industry since the business is known to be naturally unsafe. The high rates of injury are essentially because of deficient or non-presence of OSH administration frameworks (Zolfagharian, Ressang, Irizarry, Nourbakhsh & Zin, 2011).

Bottani, Monica, and Vignali (2009) found through an empirical investigation that companies adopting safety management systems exhibited higher performance for all the topics encompassing company attitude to (Bottani, Monica & Vignali, 2009) through identifying safety goals, giving latest risk data, defining risks and development of training programs to employees.

Wilson (2000) stated that despite the simple concept of the principles behind safety management, it is during the implementation of such a program that construction companies may encounter their most difficult obstacles. It is found that issues such as cooperation from others are vital, yet profoundly ignored, by construction companies which are why seemingly simple problems continue to exist, (Wilson & Koehn, 2000). This will be clarified in the next section as integration of occupational health and safety into construction.

4.2. Implementation of Occupational Health and Safety Management System into Construction Sites

Numerous work-related accidents and injuries are because of a breakdown in the current OSH management system (Zolfagharian, Ressang, Irizarry, Nourbakhsh & Zin, 2011). According to the International Labor Organization (ILO), the contractor has obligations to take measures to protect workers from accidents ;that means the top of the company takes a leadership and responsibility for performing safety management activities either through actual control or nominating another body responsible for overall construction site activities (International Labor Organization,1988). Accordingly, effective safety must be accomplished when there is an appropriate management upon the interaction between technology and individuals.

(Mohamed, 2002) used a questionnaire-based model to assess the safety climate at construction sites, corroborating the significance of management commitment, and laborers' involvement, attitudes, in addition to supportive as well as supervisory conditions, in accomplishing a positive safety work atmosphere (Mohamed, 2002). Makin and Winder 2008 developed a conceptual framework to ensure that an OHSMS brings together the benefits of the three fundamental control procedures for managing working environment risks: safe place, safe individual, and safe frameworks (Makin & Winder, 2008).

Many reasons can be the cause of construction accidents and several shortcomings might take place in phases of in a construction project; planning, design and construction. This is also ascertained by a study made by (Sulaiman& Mahyuddin, 2005). Firstly, in the planning phase, owners pay little attention to safety management and may neglect potential site safety issues. Secondly, in the design phase, designers and architects may disregard all conceivable safety-related design codes or have the capacity to dispense with every single conceivable factor. Finally, in the construction phase, contractors may not be mindful about site dangers or report issues in time, and additionally, laborers may carry out their activity thoughtlessly. Hence, the pre-construction phase is essential. The following part will explain pre-construction, its stages and its integration with occupational health and safety.

4.3. Implementation of Occupational Health and Safety Elements in Pre-construction Phase

Based on Fig.2, Construction Project management is explained in three phases which are; Pre-construction, Construction & Post-construction [23, (Tregenza, 2004) .Pre-construction phase is the first phase, which includes Inception & Feasibility, Design, and Tendering (Singh, 2002).

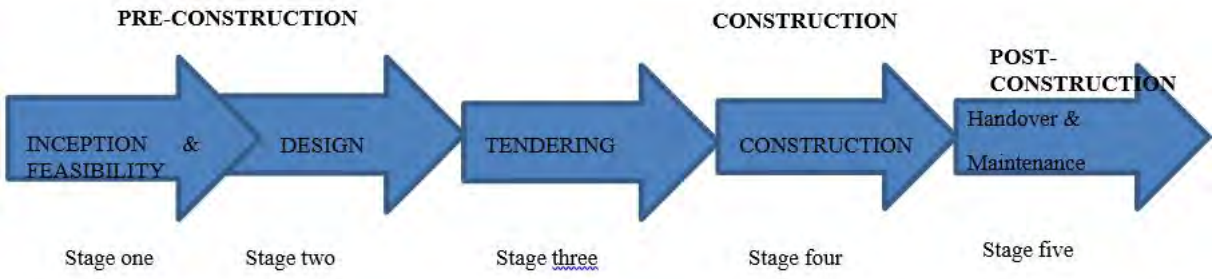

Figure 2. Construction Project Management. Stages (K.S., I. H. S. (2002).

The phases of pre-construction starts with "Inception & Feasibility"; is concerned with the customer's prerequisites and is known as arrangements of the pre-project . It incorporates the project goals as well as, land matter, feasibility study and setting up project association structure. Second phase is "Design"; which contain project brief, calculated and schematic outline improvement, arranging endorsement, enumerating configuration, cost spending planning, and benefit of building, (Hendrickson & Au, 2000). Finally the last phase in Pre-construction is "tendering"; the tender document being an issue and after that being assessed to pick the potential contractor where the objective amid this stage is to obtain an entire and exact comprehension of venture necessities, (College, 2011).

Health and safety issues are not bound to the construction phase of a project yet happen all through a project. Huge numbers of health and safety problems experienced during construction could be avoided if efforts are made during the project brief and design phases (Haywood, 2004). (Hare, Cameron & Roy Duff, 2006), and (Saurin & Fermoso, 2008) explored health and safety integrate with preconstruction phase, thus suggested to future researches to develop the whole model for construction project management. The following table 3 discusses the implementation of occupational health and safety in the three phases Inception & Feasibility, Design, and Tendering.

Table 3. OccupationalHealth and Safety Implementation in Pre-construction phases, author afterextant literature

Pre-construction phases	Occupational Health and Safety Implementation
Inception and feasibility	-Employer is accountable to his employees' safety & health. Employer also has a responsibility for the visitors (OSH). -Project owners can emphatically impact project safety & health performances since they are the person who contribute financing for the project and should be concerned with including OSH during objective identification and project brief, (Huang & Hinze, 2006), and (Sulaiman & Mahyuddin, 2005) -It is also the management's responsibility to alternate attitudes through health and safety awareness of employees (Thye, 2006)

Continued on next page

Table 3 continued

Design	-Half of the work related safety and health issues arise from deficiency in design (Fleming, 2006). -The design professionals who escape the responsibility of integrating health and safety in their design because of the absence of safety training, absence of safety design tools (Gambatese, 1996). -The health and safety factors must be incorporated into the design plan, by doing as such it will make a gradually expanding influence scattering safety and health throughout the industry. -Fundamental concept of prevention through design (PTD); that depends upon excluding safety and health dangers rather than ensuring the safety of the laborers or warning them (Gambatese, 2000). -A design tool has additionally been created to help designers in distinguishing project-specific safety perils and to give best practices to end the risks, (Gambatese & Hinze, 1999).
Tendering	-The first thing that comes in mind upon mentioning elements of safety and health, is how it becomes of legitimate and moral duty (Huang & Hinze, 2003). -Parties that were included with the tendering as contractors need to play their parts in grasping safety and health (Fleming, 2006). -Beginning from the customer, it is an obligation to point out the significance of the safety and health execution of the construction's contractors particularly upon making a choice; contractors should be picked on the contractors' ability in predictive of safe project performance rather than lower tender costs (Levitt, Parker & Samelson, 1981; Fleming, 2006). -It is a problem in the traditional procurement to concentrate on tender cost subsequently limiting the contractual workers to work in a more productive way (Fleming, 2006).

5. Conclusion

This paper presented a literature review on root causes of construction accidents, factors affecting safety in construction sites, what is meant by occupational safety and health management system. The paper then discussed what the pre-construction stage is and effects of implementing occupational safety and health in the inception &feasibility, design &tendering pre-construction stage then implementation of occupational health and safety practices at construction sites will be discussed.

Previous research suggested that early introduction of occupational safety & health management systems (OHSMS) and elements within the project implementation, is an important asset in decision-making as it directs towards the abatement of occupational hazards in the workplace. Despite the contributions and important role construction industry plays in countries' growth, it has dependably been rebuked for the high rates of accidents and fatalities.

Literature review demonstrate that accidents are caused by a broad selection of issues, some of which are hazardous equipment, work site conditions, unique nature of the industry, risky strategy, humans and administration. The reason for accidents in construction industry are basically credited to workers' lack of regard, inability of laborers to obey work techniques, work at high height, operating equipment without safety tools, poor site management, hard work operation, low understanding and skill level of workers, inability to utilize PPE and poor workers attitude about safety. Construction sector is more dangerous than other sectors it is based on the literature findings, which increase the possibility for serious accidents. From the research findings, the aim to review the impact of implementing Occupational Health and Safety practices at construction sites has been stated.

The number of accidents in construction sites could be decreased upon implementing the occupational health and safety into the pre-construction phase. This review enhances the awareness of the role of implementing OHSMS as the main objective of the Occupational Health and Safety Management System (OHSMS) which is certified to promote safety awareness and safe work practices in the construction industry and the responses also show they are aware that OHSMS is effective in prevention of risks and accidents and effective on-site safety and health management.

Finally, health and safety issues are not bound to the construction phase of a project yet happen all through a project. Huge numbers of health and safety problems experienced during construction could be avoided if efforts are made during the project brief and design phases. Researchers investigated the reconciliation of health and safety with the pre-construction phase, thus recommended to future researches to incorporate the factors shown previously with the whole model for construction project management. The occupational health and safety was discussed in the three phases Inception & Feasibility, Design, and Tendering.

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