

Health, Safety and Quality Management Practices in Construction Sector: A Case Study

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Abstract. Construction sector is an important and integral part of infrastructural development. It offers significant effect on national economy of a country. However, the construction industry is recognized to be the most hazardous sector. A harmless work environment in construction sector helps to keep skillful employees or workers on the job by reducing accidents. The consequences of an accident are loss of many lives, loss of healthy and skilled workforces, compensation, and disrupting the production, unwanted cost such as medical costs, and premiums for workers' compensation insurance, liability, property losses working hours and therefore delay in project delivery and morale have created adverse effects on profitability and productivity. This paper examines the status of health, safety and quality management at construction sites in Bangladesh, particularly focusing on Dhaka, the capital city. An attempt was taken to identify the root causes of accidents, the risk prone activities, safety perceptions, attitudes, and behavior of construction workers and management safety practices the factors affecting construction site safety and success indicators of construction projects. Based upon the investigation of the results, this practice has illustrated that the majority of those questioned Bangladeshi construction industries have a very poor degree of risk awareness and do not take health and safety as an essential topic. The suggestions cover three aspects for the implementation of safety practices such as awareness of workers or labors, commitment of top management and the allocation of resources. Finally, this research would reduce the gap of understanding on the aspect of safety practices or studies at construction site in Bangladesh, mainly focusing on Dhaka as well as in other developing countries and can be used as a source of reference in the site safety management.

Keywords: Construction safety, Safety management, quality management, Fatal accident

1. Introduction

Construction is one of the world's biggest and fastest growing industrial sectors. It is an old industry that dated back to the Palaeolithic Age between 40,000 and 12,000 B.C., when humans inhabited in caves or in built structures on level ground. In most industrialized and developing countries, construction industry is one of the most important sector in terms of contribution to economic growth and gross domestic product (GDP) of an economy (Sánchez et al. 2017) and also in terms of impact on the health and safety of the working population. Construction industry is one of the most significant economic activities in the world. Its annual income is about 3000 billion dollars. It accounts for 10 percent of world's total gross domestic product (GDP) (Bawane 2017). The construction industry is both economically and socially important. However, construction industry has a poor reputation of a high accident rate and hazardous activities on site. This reflects by the statistics of high accident rates in recent years in many countries. The construction industry has therefore earned the reputation of being a dangerous or highly hazardous industry because of the disproportionately high incidence of accidents and fatalities that occur on construction sites around the world (Smallwood et al. 2008). This accident causes loss of many lives, health, skilled personnel, compensation, and disrupting the production. It is a consequence of the failure of safety management on construction site. While developed nations have demonstrated commitment to achieving a reduction in accident numbers, the same cannot be said of developing countries (Kheni et al. 2008) like Bangladesh.

Bangladesh is the world's eighth most populous country. Dhaka is the capital and largest city of Bangladesh. It is one of the world's largest cities, with a huge number of population about 18.89 million. It is 4th most densely populated city in the world. In Bangladesh, construction industries are increasing rapidly. Its output is about 10 percent of the total gross domestic product (GDP). In addition, this sector, which employs more than 3 million people, absorbs an important share of the Bangladesh' labour force, according to industry people. This industry in Bangladesh is worth 900 billion Taka or US \$12 billion (BBS 2013). There are more than a thousand companies in Bangladesh who are involved in the construction business (Dewri 2012). Statistics show that Bangladesh will need to construct approximately 4 million new houses annually to meet the future demand of housing in the next twenty years. At present there is a culture of high rise buildings, foot over bridge, building construction and repair of roads, placing of utility services etc. contributes a great deal to improving our quality of life. Unfortunately, it is done in a very careless and unprofessional manner without the safety practices. Therefore, many workers and their families and friends,

involvement in the construction industry leads to the unimaginable pain and suffering associated with an accidental death or serious injury. This is because the safety issues in Bangladesh are grossly neglected especially in the construction sector.

Construction accident as an unexpected occurrence disordering a planned sequence of a construction project which result to loss of production, injury to personnel, damage to plant and equipment (Lucy et al. 1999). According to Health and safety Executive (HSE, 2003), accident is defined as any unintended occurrence that consequences in injury or ill health of people, or damage or loss to property, plant, resources or the environment or a loss of a business. Accident risks in construction industry is much higher than the average occupation risks faced by workers. The death rate of construction industrial workers are two to three times high compared to the workers in other industries or working sectors. On the other hand, the risk of serious injury in construction related job is nearly three times higher than other occupation (Sohail 1999). This is true not only for Bangladesh but also in the rest of the world. Every day about 950 people died and over 720,000 workers get hurt because of occupational accidents (Patel and Jha 2016). According to the International Labor Organization (ILO) at least 60,000 fatal accidents occur each year on construction sites around the world. Construction industrial work is more hazardous than other sector. According to International Labour Organization (ILO), around 60,000 fatal accidents occurred yearly at construction sites in whole world. That means one in six of all fatal work related accidents. One fatal accident is in every 10 minutes (Islam et al. 2015, Lingard 2013). According to Bangladesh Institute of Labour Studies (BILS) report, about 1,196 number of worker is died in construction industries between the year 2005 and 2016. That means approximately 100 deaths occur per year. According to Occupational Safety, Health, and Environment (OSHE), 147 construction workers were killed and according to BILS approximately 100 construction workers were injured in 2016.

Although death rate and injuries in construction industries are higher than the other work places (Leigh and Robbins 2005), there are insufficient cost assessments about fatalities and injuries available. An occupational accident can damage the reputation of a company and have serious legal and financial consequences for the company and its management. According to Rikhardsson and Impgaard (2004), costs associated with each accident can be categorized in three types. Variable costs vary with the number of missed days that the company pays for the lost wages. The second type of cost is a fixed cost. These costs the company for every accident due to administration and communication expenses.

The third one is a disturbance cost that depends on the importance of the injured person's role in the company. According to the International Labour Association (ILO), worldwide appraisals of directly and indirectly about expenses for construction accidents are USD 2.8 trillion, comparable to 4% of the yearly worldwide GDP (Leigh et al. 2014). In 2013, the world's total GNP was Approximately 75592.941 billion USD (World Bank 2013) which means that worldwide the annual cost of work-related injuries and diseases is approximately 3,023,718 million USD (Patel and Jha 2016).

Health and safety are theoretically and practically very different things (Sherratt 2017). According to Alhajeri (2011), Health is the protection of the bodies and minds of people from illness resulting from the materials, processes or procedures used in the workplace. Safety is the protection of people from physical injury. The borderline between health and safety is ill-defined and the two words are normally used together to indicate concern for the physical and mental well-being of the individual at the place of work. Safety is an important issue to ensure uninterrupted work and save lives of workers in any type of industry. Safety and health in construction is a condition in which an employee needs a safe and healthy environment for herself and other people that be affected by its activities. A number of causes influencing safety performance in the construction industry has been identified that include workers' attitudes, construction company size, safety policy, project coordination, economic pressure, management training, and safety culture. The factor affecting safety on construction site includes poor safety awareness of top management, lack of training, poor safety awareness of project managers and reluctance to input resources to safety and reckless operations (Tam et al. 2004). There are three elements to behaving safely; the knowledge, equipment on works, motivation (psychology) on how to operate safely (Marsh et al. 1995). Due to improper or lack of safety practices, different levels of work accidents ranging from minor injuries to fatal accidents have occurred (Solís-carcaño and Arcudia-abad 2014, Fung et al. 2010). Construction safety is largely the responsibility of the owner/developer/contractors and other site professionals. The success of a project depends on the intricate planning and decisions regarding safety measures that are made on site.

Quality and quality systems are topics which have been receiving increasing attention worldwide. The concept of quality management is to ensure efforts to achieve the required level of quality for the product which are well planned and organized. Quality Management may be defined as the optimization of efforts to make sure that the requirements are met efficiently and on the first attempt. Quality management is critically required for a construction company to sustain

in current construction market which is highly challenging and competitive. The effectiveness of quality management in all stages of a construction project has a significant impact on workers' health and safety (Usmen and Vilnitis 2015).

Bakri et al. (2006) suggested that there is a need to look into a new way of improving the image of the construction industry by reducing the hazards at construction sites. He claimed that providing a safe and healthy workplace is one of the most effective strategies for holding down the cost of the construction business. Accidents do not only cause delays in operations and project delivered but also directly and indirectly incur costs. According to Smith and Roth (1991) costs directly associated with occupational injuries and illnesses include medical costs, premiums for workers' compensation insurance, liability, and property losses. According to Singh (2014), during execution at site, these workers are exposed to various risks involved in construction works and other occupational diseases and health hazards which cause injuries and illnesses. As a result, the construction projects get delayed due to loss of working hours and other legal hassles. This ultimately accounts for cost and time overrun. Therefore, it is essential for any construction project to have certain safety guidelines and procedure to be followed for site activities and to create awareness among the workers, site supervisor and engineers. According to Tarrants (1980) and Laufer and Ledbetter (1986) agree that measurement of safety performance is necessary for the reasons such as to locate and identify problem areas, as a basis for trend comparison, to describe the current safety state of an organization, as a basis for evaluating accident prevention programme effectiveness, to assess accident costs, to establish long-term accident control, and as a basis for quantifying probable risk of injury or other loss.

Zhou et al. (2013) reviewed previous studies in the area of innovative technology applications for construction safety management. Laukkanen (1999) conducted a review of occupational health and safety training in the construction sector. Ashley and Bonner (1987) published one of the first studies to focus on political risks in international construction projects. Remawi et al. (2011) examined the relationship between safety management systems and employee's attitudes toward unsafe acts. Pinto et al. (2011) was concerned with traditional management methods related with occupational health and safety areas, and pointed out the major limitations of these methods to deal with construction safety Issues.

2. Safety adoption

The most important factor in a project is company should appoint safety

officers and safety supervisors to control the safety on site. Due to the significance of safety and health at construction site, this company establishes a safety and health committee which consists of all key players who are involved in the project. Personal Protective Equipment (PPE) is the equipment that needed for give a protection to the person from any hazard in workplace. The minimum for personal protection for workers or visitor to a construction site is given below.

Serial No.	Work site safety	The Personal protective equipment's
1	Fall protection	Head protection (safety helmet)
2	Scaffolding	Eye protection (safety glasses)
3	Fire protection	Face protection (Face masks)
4	Safety warning signs and safety awareness signboard.	Hand protection (Hand Gloves)
5	Chemical hazards	Foot protection (safety shoes: boots)
6	Machine and equipment safety	Ear defenders

3. Causes of accident

There are numerous and an enumerable cause of accidents that occurs on site. it is a duty of the site manager or supervisor to identify these causes and ways of eliminating them. Researchers have investigated root causes of accidents on a variety of construction sites (Hinze et al. 1998; Abdelhamid and Everett 2000). Siriwardena et al (2006) points that acts of God or disasters as related to construction are events or actions which causes severe damages to construction products, processes and stakeholders. Various acts of God that cause casualties on construction sites. These are earthquake, rain, flooding, landslides, wind and so on. Some researchers have mentioned structure designers, construction supervisors, and proprietor's role in safety (Huang and Hinze 2006; Wilson and Kohen 2000; Toole 2002). According to Ridley (1986), unsafe acts or unsafe conditions are mainly responsible for serious accidents. He mentioned that almost 99% of the fatal accidents occur because of either insecure acts or insecure conditions or both. According to Toole (2002), there are eight root causes which are mainly responsible for all construction accident. These are lack of appropriate training, insufficient enforcement of safety, safe equipment not provided, insecure methods or sequencing, hazardous site conditions, not using the safety equipment that were provided, and a poor attitude towards safety. According to Ali et al. (2010, general reasons behind the construction accidents are the human element, poor work site management, failure to use personal protective equipment's (PPE) and hazardous equipment used in construction works.

Krishnamurthy (2006) mentioned that the most of the workers or labors are not use Personal Protective Equipment (PPE) properly due to ignorance, negligence, carelessness and over confidence. According to Paringga (2010), instruction and proper training are design to eliminate human error that may cause the accidents and to enable workers or labors to perform a repetitive task with skill. According to Tam et al (2004), causes of accidents are the poor safety awareness from top leaders, lack of proper training, lack of organizational commitment, lack of correct technical guidance, uncontrolled operation, unwillingness to input resources for safety, lack of certified skill labor, unsafe equipment, lack of first aid measures, lack of rigorous enforcement of safety regulation, lack of personal protective equipment (PPE), lack of protection in material transportation and storage, lack of teamwork spirits, shortage of safety management manual, lack of innovative technology and poor information flow. According to Subramani and Lordsonmillar (2014), general types of accident that commonly occur in construction site as observed by the respondents are falling from height, failure of temporary structures, fall of objects, hit by object, electrocution, slippage, caught in between, collapse. On many sites, no training programs for the staff and workers exist; therefore, no orientation for new staff or workers is conducted, hazards are not pointed out, and no safety meetings are held. López et al. (2012) studied the probable causes of accidents with subsequent mitigation actions for Spanish construction industry. Their study found that the maximum rate of accidents (80%) was in the age group (30-39) years working at building construction sites. In addition, sometimes laborers and staff are under the influence of alcohol and drugs. Unfortunately, crew members are not checked for drugs and alcohol before the start of and doing work. Michaud (1995) revealed that consuming any types of drugs or alcohol by workers on their working hour will be dangerous because its disturb the ability of the decision making. Hence, they are not able to act in good way and always lead to wrong decision-making and unsafe working. Minter (2002) stated that drugs and alcohol are the root cause or contributing cause of many accidents on the job every year. Furthermore, from the previous investigation various types of accident with different rate in construction industries were recorded. These are scaffold accidents (McCann and Paine 2002; Yi et al. 2012; Halperin and McCann 2004; Faergemann and Larsen 2000); accidents due to slip, trips and falls (Nadhim et al. 2016 Chen and Jin 2012; Bentley et al. 2006); crane accidents (Neitzel et al. 2001). Ladder accidents (Faergemann and Larsen 2000); electrocution and electrical accidents (Farooqui et al 2008; Crowley & Homce, 2001; Zhao 2015).

4. Management Policy

Management policy or commitment to safety at workplace is very essential to the prevention of accidents. Therefore, it is a need to find a way on how to reduce accidents at construction sites. Many studies for example (Hinze, 2002; Vredenburg, 2002) have shown that health and safety improvements will only be achieved if workers change their behaviors and incentive schemes are implemented to motivate them. To minimize the above causes responsible for the risk factors, the workers as well as supervisor need to be properly trained about proper construction procedures and safety measures and effects of using risky construction equipment's. In this connection, the worker safety must be included in the construction practices by allocating a special budget for this purpose. Wearing clothes that are appropriate to the work and weather condition on site, wearing of hand gloves, wearing of work traction boots at all times on site, wearing of hardhats or helmet at anywhere on site, Provision of eyewear or goggle for welding purposes and so on, Constant inspection and assessment of equipment's, plants, tools and other site materials before use, Organizing effective safety training for all site workers and personnel whether on site or off site, Provision of effective first aid facility and personnel on site, Provision of barriers, signs or reflector around dangerous areas on site. Media sector can play a major role by highlighting the necessity of safety of workers and general public who eventually will be occupant of a building (as owner or individual or corporate level tenants). Necessary temporary facilities and services range from access roads, lay down areas, warehouses, and batch plant, to first aid office, toilet on site, and labor rest area. Construction workers need adequate toilet and washing facilities, a place to warm up and eat their food, and somewhere to store their clothing. The law enforcing authority (RAJUK, PWD, EED, etc.) must strictly inspect structural and human safety conditions during construction processes. Compensation to the deceased and injured workers must be strictly implemented by the law enforcing agencies. It is expected, adoption of these steps can reduce the risks in the construction sector significantly.

5. Common problems at construction site

Workers undertake a risk while at work and the following problem areas are common:

- While excavating in deep trenches (with no proper shoring or bracing), accidents due to cave-ins often occur.
- Concreting is done mainly by laborers, and cements burns due to the unavailability of protective gloves and boots are common.
- Workers fall from heights due to weak scaffolding and the unavailability of

safety belts.

- Workers sustain injuries on the head, fingers, eyes, feet, and face due to absence of personal protection equipment.
- Workers sustain temperature extremes.
- Workers also face electric shock or electrocution.
- There is improper house keeping

Cause for lack of quality in construction

- Inadequate design solutions
- Poor work execution or construction error.
- Inaction error or errors in client's decisions and performance of project managers
- Inadequate materials, products or construction processes
- Inadequate or poor inspection to site conditions
- External factors (adverse weather conditions, force majeure, legal or regulatory amendments, license authorization)

Benefits of a Safety Management System

According to Ahmad (2008), good safety programs would certainly help in reducing injuries at construction sites and also to minimize construction costs, enhance productivity and profitability and more prominently it could protect lives of labors or workers and therefore contribute absolutely to the construction industry and the nation as a whole. According to Loushine et al. (2006), Choudhry et al. (2007), Jazayeri and Dadi (2017) the benefits of a safety management system in the construction industry are:

- Reducing the number of injuries to personnel and operatives in the workplace through the prevention and control of work place hazards.
- Minimizing the risk of major accidents.
- Controlling workplace risks improve employee morale and enhances productivity.
- Minimizing production interruptions and reducing material and equipment damage.
- Reducing the cost of insurance as well as the cost of employee absences.
- Minimizing legal costs of accident litigation, fines, reducing expenditures on emergency supplies.
- Reducing accident investigation time, supervisors' time diverted, clerical efforts, and the loss of expertise and experiences.

6. Major injuries:

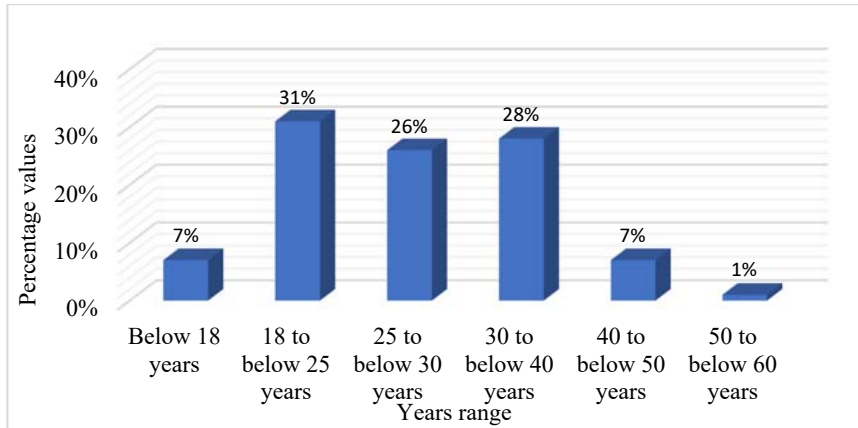


Fig.1. Workers year in construction sector

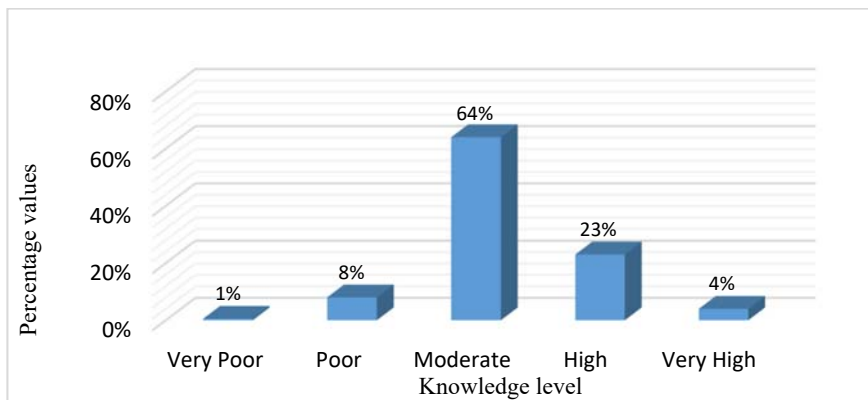


Fig. 2. Knowledge of workers regarding health and safety

According to OSHE survey, a total of 1211 people died and 1418 injured in Bangladesh since 2005 while involved in some type of construction activity. Table 2.5 gives a year wise estimate of the statistics which was provided by OSHE.

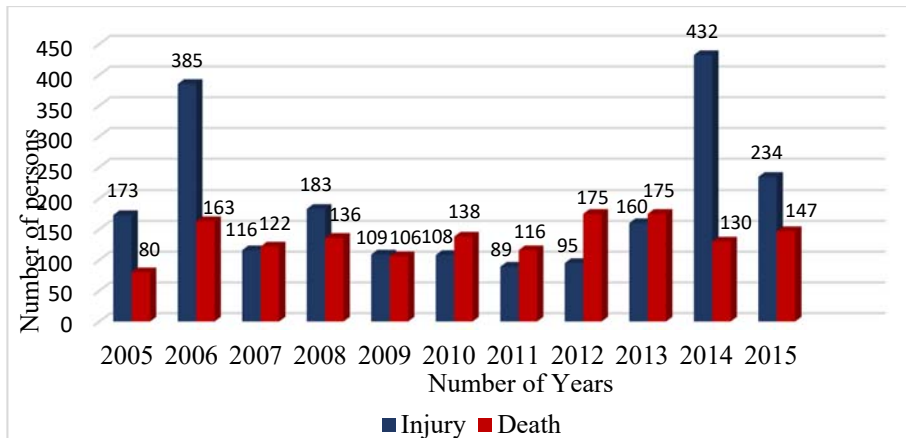


Fig. 3. Fatal accident occurred between the year 2005 and 2015

7. Conclusion

From the investigated results of this research it is almost clear that the health and safety conditions in construction sector in Dhaka, Bangladesh is not good enough. Construction workers or labors lose their life due to occurrence of different unwanted hazards. Falls from heights, failure of temporary structure like scaffolding and ladder or slip, trips and falls from these, electrical shocks and improper crane operations, fall of heavy objects and hit by objects can be marked as the lethal hazards. In addition, construction workers or labors are fall in some other health and safety hazards such as polluted dust and toxic elements. Furthermore, God or disasters as related to construction are events or actions which causes severe damages to construction products, processes and stakeholders. There are several reason have found behind the fatal construction accidents such as worker's illiteracy, lack of proper training regarding health and safety, not using the safety equipment's, ignorance and carelessness and over confidence, consuming drugs or alcohol at work place and so on. There are some major problems are encountered in the safety practices; the problems are ignorance of workers on work procedures, lack of financial allocation for safety management, insufficient enforcement of safety, lack of awareness among workers, and language barrier between supervisors and workers, lack of organizational commitment. Several strategies have been suggested to overcome the problems, such as to provide effective safety training, allocation of special budget for this purpose, full commitment from the top management, provision of barriers, signs or reflector around dangerous areas on site and to provide safety booklets as the strategies to reduce problems in safety practices. The suggestions

cover three aspects for the implementation of safety practices, i.e. awareness of workers, commitment of top management and the allocation of resources. It should be ensured that workers get first aid office, adequate toilet and washing facilities, a place to warm up and eat their food, and somewhere to store their clothing. The law enforcing authority (RAJUK, PWD, EED, etc.) must strictly inspect structural and human safety conditions during construction processes.

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