

Evaluation of Safety Performance Level of Construction Firms In And Around Erode Zone

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Abstract- The construction industry is considered as one of the most hazardous industrial sectors wherein the construction workers are more prone to accidents. Despite recent efforts to improve site safety, construction still accounts for a disproportionate number of occupational-related fatalities. In developed countries there is strict legal enforcement of safety in , the construction industry and also in the implementation of safety management systems which are designed to minimize or eliminate accidents at work places. However, occupational safety in construction industry is very poor in developing countries because lack of safety regulations and standards, low priority of safety, lack of data on safety at construction sites, lack of safety training, lack of safety promotion, and lack of documented and organized safety management systems.

This study deals about the safety performance measurement of various construction firms in and around Erode city. This study also investigates the prevalent safety management practices and perceptions in the construction industry. The study will be conducted in construction sites in and around Erode city through method of questionnaire survey, interview and discussion. The results of the study will reveal the safety level of construction firms in Erode and also the factors which are all the reason for non-safety performance of firms. Furthermore, the study also proposes some recommendations for safer construction.

I. INTRODUCTION

1.1 GENERAL

In recent years the concept of safety culture has attracted considerable attention especially in the dangerous industries, such as the nuclear industry and off-shore oil industry. The construction industry is regarded as a dangerous industry due to two characteristics; decentralization and mobility. The meaning of decentralization is that the employees are

separated by sites. Although regulations and plans are available, they still have to make decision by themselves when facing specific problems. Mobility implies that employees in the construction industry move among the companies, sites, and positions more frequently than those in their traditional industries. Because of these two characteristics, while the promotion of safety management and working condition is achieved in a manner that is used by several industries to consciously improve safety performance, they are inadequate in the construction industry .This is due to decentralization and mobility of the work force. One of the reasons is that in the construction industry, safety performance is more relevant to the human factors. It is especially important for a construction company to improve its safety culture to achieve better safety performance. A positive safety culture means the safety attitude and values of the company are totally accepted by its employees.

In the developed as well as developing part of the world, construction industry is considered to be one of the most significant industries in terms of contributing to GDP and also in terms of its impact on health and safety of the working population. Construction industry is both economically and socially important. However, the construction industry, at the same time, is also recognized to be the most hazardous. Although dramatic improvements have taken place in recent decades, the safety record in the construction industry continues to be one of the poorest. Research shows that the major causes of accidents are related to the unique nature of the industry, human behavior, difficult work site conditions, and poor safety management, which result in unsafe work methods, equipment and procedures. Emphasis in both developing and developed countries needs to be placed on training and the utilization of comprehensive safety programs.

1.2 CONSTRUCTION SAFETY IN DEVELOPED COUNTRIES

In developed countries, recent advancement in

technology, on one hand, has contributed positively to industry productivity, but on the other hand, has created a more challenging and unsafe work environment. Evidently, construction accidents and the associated damage caused to the employees, property, equipment and morale have generated negative effects on the industry profitability and, to some extent, the industry productivity. Responding to this increased safety requirement generated by technology advancement, the industry control environment in developed countries has incorporated safety as an integral part in the regulatory framework. In the U.S.A., for instance, the workers compensation rates are a function of the loss experience of a contractor, and each labor hour is affected through the reflection of those losses in the experience modification rating (EMR). On one hand, a safe contractor can create a substantial competitive advantage through superior safe experience while, on the other hand, an unsafe contractor can be liable to pay huge penalties in terms of insurance. Safety, therefore, and the effects of its absence – accidents – is now a key cost driver for construction firms in such countries. Safe work experience is also becoming a business survival issue for them, as more and more owners are reluctant to permit contractors to bid work without acceptable EMRs. Thus, the most important step in controlling costs for contractors in these countries is to run safe construction projects. Hence the contractors are compelled to implement safety as their business strategy, which has led to recent improvements in global construction safety records.

1.3 CONSTRUCTION SAFETY IN DEVELOPING COUNTRIES

In contrast, developing countries like India have yet to respond to recent technological improvements. Lack of response to technology, however, has not resulted in safer construction sites. In fact, a larger share of construction work being performed by human resources has led to increased number of site accidents. Informal assessments have identified a few major reasons for safety non-performance which include: lack of development of construction sector in the shape of mechanization and industrialization; lack of professional construction management practices which has not only led to unsafe project sites but have also resulted in construction delays, cost overruns, poor productivity and poor product and process quality; inadequate safety provisions laid by the existing regulatory environment which has failed to establish safety as a major industry

objective; insufficient and incentive-less insurance mechanisms which have failed to establish safety as a business survival issue; and unfavorable business environment which has led to adversarial business relationships among stakeholders resulting in controversies, conflicts, claims and litigation and hence diverting the focus away from issues like safety.

Compared to the past, the current decade is witnessing massive infrastructure growth in India. There are numerous infrastructure development projects in progress as well as under planning. All of these projects have the potential to lead the local Industry to gain glory, status and international recognition but only when appropriate efforts are extended to achieve the same. With the stage set for a golden era for development, the challenges are still higher. One of the important areas that require quick and drastic improvement is safety. It is highly essential that all occupational injuries and illnesses should be given due attention. There should be an effort to raise the level of awareness between both employees and employers of the importance of health and safety at worksites.

Prior research done in construction safety indicates the significance of conducting formal assessment exercises for safety management implementation in the construction industry in general. Such assessment exercises are particularly important in benchmarking safety performance as well as formulating safety management policies and strategies appropriate to the particular work environment under study. Consequently, this research aims to delve into the safety performance measurement of local construction firms and hence the overall construction industry of Pakistan based on an investigative site survey.

Traditional measures of safety are after-the-fact measures; namely, that safety is measured after injuries have already occurred. These measures are labeled reactive, trailing, downstream, or lagging indicators because they rely on retrospective data. Focusing on these measures e.g., accident rates and compensation costs often means that the “success of safety is measured by the levels of system failure”. In recent years, there has been a movement away from safety measures purely based on retrospective data or “lagging indicators,” such as accident rates, toward so-called “leading indicators” such as site investigation and measurements of safety climate.

1.4 CONSTRUCTION MANAGEMENT

It is a science which deals with the co-ordination and organization of construction activities like man power, materials, and equipments and finance

so that the project is completed in optimum time and at optimum cost using the best quality materials and techniques maintaining quality. Hence, construction management is a sound site management to effect speed and economy with the optimum utilization of men, materials, machinery and finance.

A construction management involves many kinds of jobs, activities and functions. They are interrelated. A project starts at one specific moment. It requires labor, materials and equipment. The effective handlings of these enable the project to be completed quickly and economically maintaining standards.

A successful completion of a project requires up to date knowledge of construction cost, skills in negotiations, ability in organizational planning, and proficiency in accounting

Procedures, experience of manpower and material management, safety etc., any project need proper planning programming and economic, efficient and quick execution.

The construction industry is statistically one of the most hazardous occupations in this country, and ranks low in safety performance among the industrialized countries of the world. Safety in the construction industry has always been a major issue. Wherever reliable records are available, construction is found to be one of the most dangerous on safety and health criteria. Though much improvement in construction safety has been achieved, the industry still continues to lag behind most other industries with regard to safety. In developing countries, safety rules usually do not exist; if any exist, the regulatory authority is usually very weak in implementing such rules effectively. Further, work hazards at the construction workplace are either not perceived at all, or perceived to be less dangerous than what they actually are.

1.5 DEFINITION OF SAFETY

- Safety has an indefinite number of definition depending upon their subjective evaluation and person using it. Safety is defined in a subjective and relative manner. It is a condition of being safe, freedom from danger or hazards, a keeping of oneself or others safe, especially from danger of accidents or disease.
- A definition that more concretely describes safety is "The surety that the environment that personnel or items are subjected to, is free from inadvertent or unexpected events which may

result in injury to personnel or damage to the items exposed".

1.5.1 Other Definitions

- National Safety Council (NSC) defines safety as "the control recognized hazards to attain an acceptable level of risk".
- A Hazard is defined as an "unsafe condition or activity that, if left controlled can contribute to an accident."
- Risk is a term applied to the individual or combined assessment of "probability of and potential amount of loss".
- National Safety Council (NSC) defines accident as an "occurrence in a sequence of events that produces unintended injury, death, or property damage .Accident refers to the event, not the result of the event".

1.6 WORKPLACE CONSTRUCTION SAFETY

In terms of effectiveness, safe working conditions at construction jobsites are best achieved when the prime or general contractor assumes his rightful leadership role and takes the responsibility to (a)establish, (b)coordinate (c)monitor and (d) generally manage the overall basic safety program content and structure for all parties and persons at his jobsite. Undefined authority among the parties involved related to jobsite safety is not a workable arrangement for such an important matter that literally affects the life and limb of each and every worker on the jobsite.

It is a logical conclusion that the primary or general contractor should assume initial and overall safety responsibility and safety program leadership at his jobsite. He has primary and overall authority and control of his jobsite. He ultimately controls access to the construction site. All persons performing work at his jobsite are either his employees or have been directly or indirectly hired or controlled by him. In addition, the prime or general contractors will, in various degrees, direct, supervise, coordinate, or monitor the progress of the work and perform various inspections to assure that the work complies with provisions of the contract and associated plans and specifications.

For these and other reasons, on a construction jobsite, the prime or general contractor possesses a singular responsibility to conduct specific jobsite safety programming. This programming should establish and provide a workplace free of recognized hazards which

have the potential to cause serious injury to workers, or other individuals, at the jobsite.

When warranted by circumstance, the prime or general contractor may assign certain specific safety activities to others contractors. These contractors will then share a corresponding responsibility for jobsite safety.

These following are some of the workplace construction safety should be followed in the sites by Contractors, Sub-contractors, Engineers, Supervisors, Workers, Visitors and others.

- Child Labour (below 18 years) at site is strictly prohibited
- Smoking is prohibited at work places, except in smoking zones
- All hazards should be properly indicated by signal and barricaded
- All equipments/machineries entering the site should have proper document and should be operated only by the qualified and approved operators
- Always maintain good housekeeping in the work area
- All new workers before starting the work shall be made aware of site safety rules
- Workers required are to be work at height above 2.0m or more height need to wear safety belts
- Nothing to be carried in hands while climbing ladders, both hands must be free while climbing
- Appropriate Personal Protective Equipment (PPE) shall be worn
- Every accident & near miss event must be reported to immediate supervisor and safety patterns
- All workers must take care of themselves and others working around them, take reasonable care for the health and safe themselves and other persons who may be affected by their acts or mission at work
- No person is to operate any mechanical plant or equipment unless they have been trained
- Any new worker coming to the site is made aware of all welfare facilities like toilet, drinking water, first aid room assembly points etc.,

1.7 IMPORTANCE OF SAFETY IN CONSTRUCTION

The construction industry has traditionally been considered as a hazardous occupation, due to the high incidence of occupational injuries and fatal accidents. The number of fatal occupational accidents in construction all over the world is not easy to quantify, as information on this issue is not available for most countries. The construction industry, employing the largest labour force, has accounted for about 11% of all occupational injuries and 20% deaths resulting from occupational accidents. International Labor Organization has estimated that at least 60,000 fatalities occur at construction sites around the world every year. This means that one fatal accident occurs every ten minutes in the sector. Most of these accidents are created due to unsafe behavior and unsafe conditions.

1.8 NEED FOR STUDY

Construction industry in India, according to a survey conducted by the NSSO in 1999-2000, employs a workforce of about 13crores people, but occupational health and safety concerns for the workforce are extremely poor.

While industries dealing in explosives and highly inflammable substances boast little fatalities, the figures in the construction industry are shockingly high. In addition, accidents, injuries, work related diseases such as asbestosis, silicosis and repeated stress conditions have all made construction industry a most hazardous one. Considering most of these go unreported, makes the management of safety much more difficult than any other aspect.

Despite the fact that safety has a direct bearing on productivity and quality, employers relegate personal safety to the back burner and resort to contracting out even large and high profile works.

1.9 RESPONSIBILITY OF SAFETY

There are contracts of many trade involved in a construction project. Hence the main responsibilities for safety and health are upon the principal contractor, but that each employer is responsible for applying measures relating to workers under their own control. The construction industry demands the attention of everyone involved. It requires the government, trade unions, sector's associations, developers, architects, engineers; contractors are required to play their role. All the members involved must work together to create a safe and healthy workplace for all. To avoid the high losses caused by injuries, contractors are required to implement various safety procedures like fall protection, respiratory

protection, confined space entry, competent person and other programs that control the case injuries. If the contractor is successful in preventing these injuries, overhead cost of insurance and hidden costs of accidents are significantly reduced, bringing more profit to the contractor. Hidden cost of an accident is four to ten times the actual costs of the claim and account for items such as employee replacement costs, lose of use, increased costs, damaged products, etc.,

The contractor is already mandated by law to comply with state and national regulations. The owner has to demand that the contractor document and implement the proper safety programs that will protect employees working on the job site. Owners sometimes hesitate and feel that they are interfering with the contractors' way of doing business if the express concerns over safety at a jobsite. In reality, owners have the absolute right to mandate that a good quality safety program be an important part of the selected contractor's culture. The contractor's documents are an effective tool in conveying the owner's safety requirements to the contractor. Poor safety compliance increases the owner's risk and often inflates the final costs of a completed contract, and it is the final costs that need to be considered into this decision making process.

1.10 OBJECTIVES OF STUDY

- To explore the existing safety procedures, regulations, policies and employee values, attitudes and perception about safety climate of the construction companies
- To find safety performance measurement of various construction firms in and around of Erode zone
- To understand the safety problems that occurs in the building construction
- To identify the roots of construction safety problems
- To give suggestion and recommendation to enhance the safety procedures
- To develop a strategy that makes safety an integral part

1.11 SCOPE OF THE STUDY

- This project provides information about various works involved in the construction industry and the safety measures adopted by the companies

- To make the employee aware of the safety norms and procedures of their companies
- In a country like India, safety is all the more important because of lack of social security to the family left behind. Thus, it becomes necessary to consider certain safety measures to prevent accidents

1.12 CONSTRUCTION SAFETY PERFORMANCE SCENARIO IN ERODE

Construction in developing countries, such as India, is more labor intensive than that in the developed areas of the globe, involving 2.5-10 times as many workers per activity. Typically workers tend to be unskilled and migrate in a group, with or without their families, throughout the country in search of employment. In fact, they are usually divided into various factions. Communication problems related to differences in language, religion and culture tend to inhibit safety on the work site.

In Erode, there is a significant difference between large and small contractors. Most large firms do have a safety policy, on paper, but employees in general are not aware of its existence. Nevertheless, a number of major constructors exhibit a concern for safety and have established various safety procedures. They also provide training for workers and maintain safety personnel on the jobsite. For the majority of contractors, however, maximizing profit is the prime concern. Unsafe conditions exist on many sites, both large and small, and labours are subjected to numerous hazards.

On many sites, training programs are not conducted for the engineers, skilled and unskilled labours; therefore, orientation is conducted the engineers, skilled and unskilled labours, hazards are not pointed out, and safety meetings are not held. Employees are required to learn from their own mistakes or experience. In addition, lack of medical facilities, shanty housing, and substandard sanitation tend to exist on remote projects. Workers undertake a risk while at work and the following problem areas are common:

- Excavation of deep trenches (with no proper shoring or bracing), accidents due to cave-ins often occur
- Concreting is done mainly by labours 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
- There is improper housekeeping

Lack of understanding of the job and poor equipment maintenance are also major causes of accidents. Generally injuries are not documented; however, if necessary, a labour might receive first aid or preliminary medical care. In most cases, specialized medical treatment or compensation is unavailable. Workers themselves consider accidents as due to their own negligence, and accept that construction is a dangerous occupation. Nevertheless, major accidents involving the death of a worker may not be documented due to the financial expenses and litigation that could be involved.

Maintenance and inspection schedules often are not followed, and only after a breakdown is equipment repaired. This approach leads to loss of time, idle workers, and project delays. It may also cause damage to property. Breakdown of concrete mixers, vibrators, water pumps, and tractors are common. Electrocution is also a major hazard, due to use of substandard electrical equipment and underground cables. Workers, especially young ones, take chances, and often do not follow safety norms or use personal protective equipment. Also labours and staff are sometimes under the influence of alcohol and drugs. Unfortunately, crew members are not checked for drugs and alcohol before the start of and during work.

Owners and consultants do stress safety before work commences, but as the work progresses their concerns for deadlines becomes a priority and they tend to pay less attention to safety. On large projects, the owners may provide medical facilities at the site, but ultimately safety is the contractors' responsibility. The major injuries faced by contracting firms in Erode on their project sites, in descending order of occurrence, were given as follows:

- Fall injuries
- Struck-by injuries
- Injuries by wastage and raw materials
- Heat stroke
- Head injuries

In the same study, some informal assessments identified a few major reasons for safety non-performance which included: lack of development of construction sector in the shape of mechanization and industrialization; lack of professional construction

management practices, inadequate safety provisions laid by the existing regulatory environment which has failed to establish safety as a major industry objective, insufficient and incentive-less insurance mechanisms which have failed to establish safety as a business survival issue, and unfavorable business environment which has led to adversarial business relationships among stakeholders resulting in controversies, conflicts, claims and litigation and hence diverting the focus away from issues like safety.

1.13 COMPANY IDENTIFICATION

The questionnaire survey is done in the construction company located in and around Erode zone and the companies selected are divided into three categories based on their financial standing

- High level companies
- Middle level companies
- Low level companies

2 METHODOLOGY

2.1 GENERAL

From the literature survey it had been learnt concluded there are many issues about safety in construction industry. Due to time constraint for the project, the descriptive survey method is to be adopted, whereas other methods may take long duration. Several methods for collecting information from the industry were evaluated from various literatures.

2.2 METHODOLOGY ADOPTED

The research methodology consisted of the following steps:

- Literature review to collect base knowledge essential for survey development
- Research design to develop a safety investigation Performa to elicit Information about construction safety performance at different work sites
- Team development and training to prepare resources to undertake the survey on different work sites
- Survey administration i.e. conducting site observation surveys at selected work sites
- Research analysis i.e. assessment of the survey findings to diagnose the safety performance and develop conclusions and recommendations

These steps are explained as follows:

In the first step, literature review was done to find out the scenario in construction safety performance

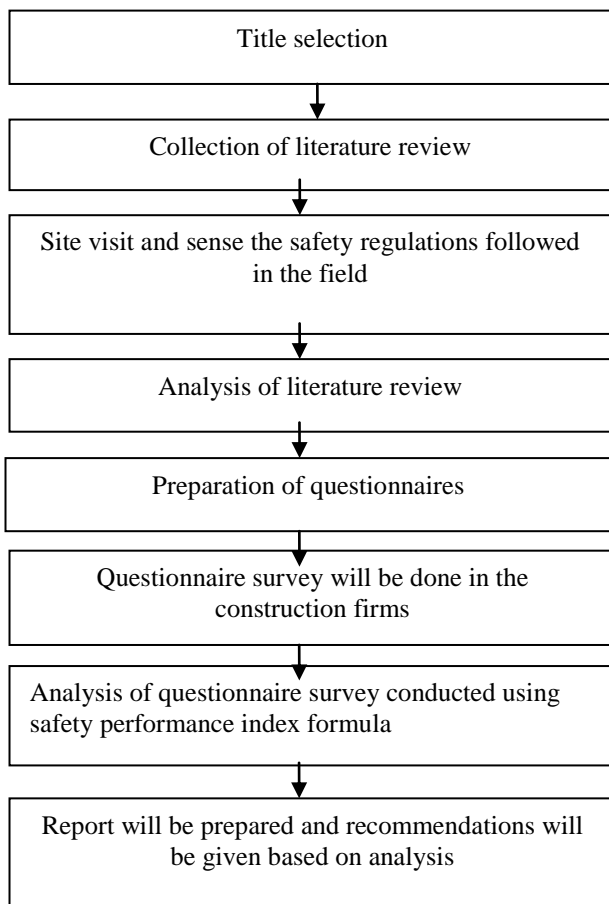
in Erode.

Following the literature review, a safety investigation Performa was developed to elicit information about construction safety performance at different sites. This Performa was divided in five categories covering various aspects of site safety measurement. These divisions included: (1) Personnel safety, (2) Housekeeping, (3) Scaffolding safety, (4) Access to height, (5) Other category

In the next step, site observation surveys will be conducted on sites. As a preference, building construction sites constituting scaffolding operations and working on heights operations were selected. Some snapshots will also been taken as evidence of the observations and also for confirming the validity of the observations.

In the final step, findings based on the observations are then used to analyze the site safety performance of the construction industry. Some conclusions and recommendations will be drawn based on the analysis of the data.

2.3 METHODOLOGY



3.1 GENERAL

A questionnaire was designed to study more about the safety management practices in the construction industry and ways to improve safety performance in construction works. The questionnaires were prepared with reference of literature reviews and field persons like contractors, engineers, project managers and consultant. Because field people are very well known about, what are all the factors affecting the safety majorly.

Table 3.1 Questionnaires

S.No	STATEMENT	SD	D	N	A	SA
Self-protection category						
1.	Workers normally wear safety helmets in site					
2.	Workers normally wear safety shoes in site					
3.	Workers normally wear gloves while handling sharp and hot materials in site					
4.	Workers normally wear goggles when using cutting and welding tools in site					
5.	Workers normally wear ear defenders in noisy condition at site					
6.	Workers normally wear face mask in dusty condition at site					

House-keeping category					
7.	Timbers with nails left in workplace are cleaned daily				
8.	Fall openings are guarded through barricades in site				
9.	Walkways, access routes and staircases are cleaned for debris				
10.	Persons who are cleaning at heights have throwing down objects				
11.	All tools and machinery are properly stored and placed				
12.	Adequate lighting is provided throughout the site				
13.	Stagnant water inside the site is removed daily				
14.	Needed materials are stacked/stored safely				
Scaffolding category					
15.	Scaffolds/ formwork are designed as per the standards always				
16.	Working scaffold platforms are checked for good condition everyday				
17.	Guardrails are good on working scaffold platforms are checked every day				
18.	Scaffold boards are placed correctly is checked everyday				
19.	Personnel working at heights are climbing up or down the outside of scaffolds				
Access to height category					
20.	Overhead power lines are removed before start of project				
21.	Ladders are checked for safety everyday				

22.	Mobile tower scaffolds are checked for safety everyday				
23.	Mobile work platforms are checked for safety everyday				
24.	Equipments used for lifting are maintained properly				
Other general category					
25.	All near-miss incidents and accidents are reported and investigated in site				
26.	About the system of internal safety inspection during construction				
27.	About the safety induction training in site				
28.	About first-aid facilities availability in site				
29.	Whether safety-signs are placed in hazardous place in site?				
30.	About substance abuse testing program on this project				

Where,

SD – Strongly Disagree, D – Disagree, NA/ND – Neither Agree/nor Disagree
A – Agree, SA - Strongly Agree.

4 ANALYSIS OF DATA

4.1 Factor Safety Performance Index:

$$\text{Factor performance Index (FPI)} = \frac{\sum (\text{Factor score} \times \text{No. of sites at a particular score})}{(\text{Total no. of responses for a factor} \times 5)}$$

$$\text{Factor Non-Performance Index (FNPI)} = 1 - \text{FPI}$$

4.2 Safety Performance Category Analysis:

$$\text{Category Performance Index (CPI)} = \frac{\sum \text{FPI (of the factors in the category)}}{\text{No. of Factors in the category}}$$

$$\text{Category Non-Performance Index (CNPI)} = \frac{\sum \text{FNPI (of the factors in the category)}}{\text{No. of Factors in the category}}$$

$$\text{Safety performance Index} = \frac{\sum (\text{Score of Safety non-performance of all factors for a site})}{\text{Maximum Score for a particular site}}$$

$$\text{Safety Non-performance index} = 1 - \text{Safety performance index}$$

Table 4.1 Safety Performance Level Percentage

%SPI	0-20%	> 20% - 40%	> 40% - 60%	> 60% - 80%	>80% - 100%
Safety Performance Level	Extremely Unsafe (US)	Unsafe (US)	Moderately Unsafe (MUS)	Safe (S)	Extremely Safe (ES)

Table 4.2 Likert Scale

STATEMENT	SD	D	N	A	SD
MARKS	1	2	3	4	5

5 CONCLUSION

The expected result of this study will reveal the factors which are the responsible for safety non-performance of construction firms and also the safety level of construction firms in and around Erode zone as furthermore recommendations will also be given to improve the safety level in the sites. This study will also create the safety management awareness to construction firms.

REFERENCES

1. Amr A.G.Hassanein and Ragaa S.Hanna (2008), "Safety Performance in the Egyptian Construction" Journal of Construction Engineering and Management, Vol. 134, No. 6, June 1, ASCE, pp 451-455
2. Bonaventura H.W.Hadikusumo & Kin Dorji (2006), "safety management practices in the Bhutanese construction industry" Journal of Construction in Developing Countries, vol. 11, no. 2, 2006
3. Carlos Razuri, Luis F. Alarcon and Sven Diethelm (2007), "Evaluating The Effectiveness of Safety Management Practices and

4. Kanchana Priyadarshani, Gayani Karunasena and Sajani Jayasuriya (2013) "Construction Safety Management Assessment Framework For Developing Countries: A Case Of Sri Lanka" Journal of Construction in Developing Countries, Penerbit Universiti Sains Malaysia, 2013
5. Mohammad S. El-Mashaleh, Bashar, M. Al-Smadi, Khalied H. Hyari and Shafer M. Rababeh (2010) "Safety Management In The Jordanian Construction Industry" Jordan Journal of Civil Engineering, Volume 4, No.1, 2010
6. Rizwan U.Farooqui, Farrukh Arif, S.F.A. Rafeeqi, "Safety Performance In Construction Industry Of Pakistan" First International Conference on Construction In Developing Countries (ICCIDC-I)
7. Somik Ghosh, Suchismita Bhattacharjee, "Safety Improvement Approaches In Construction Industry: A Review And Future Directions" 47th ASC Annual International Conference Proceedings