CHAPTER I

INTRODUCTION

1.1 AN OVERVIEW OF SAFETY IN CONSTRUCTION INDUSTRY

The construction industry plays a vital role in social and economic development of all countries. The importance and role of the construction industry in the economy of a country has been confirmed by several studies, including Coble and Haupt (1999). In profit driven business, it is common for construction stakeholder; owner, contractor, sub-contractor or even supplier to concentrate exclusively on completing projects to meet the requirement of quality standard with more focus on completing the projects on time and allocated cost. Safety is usually treated as a secondary matter. The lack of motivation in fostering a safety culture has resulted in a poor safety record particularly in construction industries.

According to Davies and Tomasin (1996), there are number of reasons why accident records within the construction industry compare poorly with those of the manufacturing industry. There is normally a controlled working environment, with little change in the work procedure and equipment over long periods; additionally, the labour force usually remains constant in manufacturing industry. So the labour force in the factory environment will have good knowledge on the hazards and precautionary steps to be taken for mitigating the hazards in the working environment. However, the case is quite different in the construction industry as the working environment is constantly changing and labour force is also migrating in nature.
Dangers to health and safety exist within the construction industry because of its fragmented nature, the uncertain and technically complex nature of construction work, the uncontrollable environment in which production takes place, the employment practices, and the financial and time pressure imposed upon project participants (King and Hudson 1985).

The construction industry is a mixture of different organizations, which directly and indirectly influence the construction process. The construction industry comprises many organisations including property developers, architects, engineers, quantity surveyors, accountants, lawyers, management contractors, engineering contractors, civil engineering contractors, labourers, sub-contractors and specialist trades. The same complexity can be found with construction workplaces. Within the workplace construction processes involve such as working at height, manual handling, exposure to hazardous materials, demolition, frame erection, lifting operations, scaffolding and ground works, as well as the varying jobsite personnel and the regular changing of worksites.

Rowlinson and Lingard (1996) have attributed the prototype nature of construction projects, the transient nature of work, low education level of the workforce and high levels of sub-contracting, as major contributing factors to poor safety records within the construction industry worldwide.

Information of the construction accidents is not standardized and the data on accidents are not reported by many countries in the world. The developing countries do not have the accurate information about the accidents, due to the irregular recording or lack of knowledge about recording or reporting the accidents. The accident reports in many countries are published annually, but the information is not standardized. Global estimates
of accidents help to compare different regions and countries to each other to improve safety. In 1998, the global estimate was conducted in 175 countries. Here, the average number of non-fatal accidents was 264 million and there were 3,50,000 fatal occupational accidents (includes industrial sector and construction sector) Pavi Hmlainen et al (2006).

The difference between accident rates in developed and developing countries is remarkable. The developing countries make zero accident policy for their construction of infrastructure and goal. Industrialization in developing countries brings the new situations to the construction industry. In the developing countries, the construction industry cannot identify the hazards (Larsson 2000).

The ILO (International Labour Organization) collects and publishes the global accident rates and figures that these are based upon the notification systems and national recording. In addition to fatal accidents, it also estimates the non-fatal accidents in the construction industry.

The statistics of labour insurance records in fatal injuries of Indian industry (i.e., occupational injuries) are shown in below Table 1.1.

**Table 1.1  Labor insurance records of reported fatal injuries**

*(Fatal injuries per 100,000 employees)*

<table>
<thead>
<tr>
<th>Year</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total men and women</td>
<td>51.0</td>
<td>77.9</td>
<td>87.8</td>
<td>82.5</td>
<td>89.3</td>
<td>133.4</td>
<td>98.3</td>
<td>116.8</td>
</tr>
</tbody>
</table>

Source: Laborsta, 2012

The statistics of labour insurance records in non-fatal injuries of Indian industry (i.e., occupational injuries) are shown in below Table 1.2.
Table 1.2  
Labour insurance records of reported non-fatal injuries  
(Non-fatal injuries per 100,000 employees) 

<table>
<thead>
<tr>
<th>Year</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total men and women</td>
<td>233</td>
<td>342</td>
<td>307</td>
<td>300</td>
<td>392</td>
<td>325</td>
<td>277</td>
<td>325</td>
</tr>
</tbody>
</table>

Source: Laborsta, 2012

The Table 1.1 and 1.2 shows Indian occupational injuries (fatal and non fatal). From the Table 1.1 and 1.2, it is clearly seen that the occupational injuries is increasing.

The overall fatal accident statistics in developed countries of construction industry are shown in the Table 1.3.

Table 1.3  
Labour records of different countries total fatal accidents in construction site

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Country / Year</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>United States</td>
<td>1131</td>
<td>1234</td>
<td>1192</td>
<td>1239</td>
<td>1204</td>
<td>975</td>
</tr>
<tr>
<td>2</td>
<td>United Kingdom</td>
<td>55</td>
<td>58</td>
<td>46</td>
<td>58</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>3</td>
<td>Japan</td>
<td>548</td>
<td>594</td>
<td>497</td>
<td>508</td>
<td>461</td>
<td>430</td>
</tr>
<tr>
<td>4</td>
<td>Germany</td>
<td>178</td>
<td>137</td>
<td>138</td>
<td>154</td>
<td>152</td>
<td>127</td>
</tr>
<tr>
<td>5</td>
<td>Italy</td>
<td>279</td>
<td>243</td>
<td>239</td>
<td>274</td>
<td>219</td>
<td>189</td>
</tr>
<tr>
<td>6</td>
<td>Singapore</td>
<td>31</td>
<td>24</td>
<td>22</td>
<td>24</td>
<td>24</td>
<td>25</td>
</tr>
</tbody>
</table>

Source: Laborsta, 2012

The Table 1.3 shows fatal accidents in different countries. Thus from the data it is inferred that accidents in construction industry are relatively larger in number.

In order to reduce the number of accidents subsequently, reducing the numbers of injuries to the workers and damage to the equipments,
Governments worldwide have maintained an ongoing commitment towards establishing a working environment free of injury and disease. This commitment is reflected by establishing performance based workplace and health and safety legislation which sets generalized performance objectives and provides a system of clearly stated responsibilities to encourage greater self regulation for the construction industry (Mohamed 1999).

Some countries totally depend on government in controlling safety at worksite. The practice of safety in construction in the United States of America (USA) is regulated by governmental agencies such as the Occupational Safety and Health Administration (OSHA), which provides strict rules and regulations to enforce safety and health standards on job site (Jannadi and Assaf 1998). The practice of safety in Kuwait is regulated by two government agencies, Kuwait Municipality (KM) and the Ministry of Public Work (MPW) in addition to the High Committee for Safety and Security at the state level (Kartam and Bouz 1996). The Ministry of Construction takes the overall responsibility in overseeing the construction industry in China, in which the roles include implementing the new strategies and policies such as preparing development programs, regulating construction markets and construction institutions and monitoring construction safety (Tam et al 2004).

Countries such as the United Kingdom, Singapore and Hong Kong have adopted a self regulatory approach to safety, whereby proprietors (including contractors) are required to develop, implement and maintain safety management system (Ng et al 2005). In Singapore, the construction site safety legislation is governed by the requirements stipulated under the Factories Act (Chapter 104) and the Factories (Building Operations and Work of Engineering Construction) regulation requires all occupiers of construction
worksites, which have contract values of S$10 million or more to implement a safety management system specified under the 1999 code of practice for safety management system for construction worksites (Teo et al 2005). In Finland, occupational safety is the responsibility of the employer, while the occupational safety and health laws are enforced by the Labour Inspection Service, an organization of the state (Yränheikki and Savolainen 2000).

In India, Building and other Construction Workers (Regulations of Employment and Condition of Service) Act was enforced on 1st March 1996. Based on this legislation, the State and Central Governments were expected to notify rules. Central government has also notified central rules in November 1998. Only few states have framed the rules but other states are yet to form the rules. Thus notification and enforcement of rules is still lacking in India. However, compared to other countries with respect to the accident rate there is a precious little authentic data available. During the period 2004-2008 there were 79 fatal accident and 45 major accidents reported to the central sector in India (Indiastat 2010). No agency, till date, has been assigned the responsibility to compile such records, and no voluntary efforts have been made in this regard. However, as per survey conducted by International Labour Organisation (ILO), 165 per 1,000 workers get injured during construction activities (Construction Industry Development Council (CIDC) 2003). High rate of injury are primarily due to inadequate or non existence of a safety management system. Therefore, this present research analyses in detail the factors affecting safety in construction sites and proposes solutions for an effective safety management in construction industry.
1.2 CONSTRUCTION INDUSTRY’S SAFETY IN DEVELOPING COUNTRIES

Construction sectors undoubtedly play an important role in the national economy. Construction industry is considered as a key industry because its growth will stimulate the growth of other industries or sectors (Wells 1986).

The construction sector in India faces the following challenges and risks in construction industry.

- No real safety culture.
- Enforcement agency with respect to construction safety yet to be identified.
- Many owners and contractors do not support safety.
- High manual labor content and worker density.
- Workforces are illiterate, poor, unskilled, migrant from rural background.
- Several distinct languages.
- Minimal use of construction equipment.
- Unsystematic working.
- High turnover due to temporary employment varying from days to month.
- Lack of proper training and difficulties in wearing personal protective equipments.
- Exploitation of workers by contractors and sub-contractors.
- Young untrained labourers attempting to do the job without following safety procedures.

In the construction industry, it is generally believed that the industry is a good source of employment at various levels of skills, from a general labour to semi-skilled, skilled and specialist workforce. Unlike the
developed countries, the developing countries do not have well established consulting and contracting companies. Many of the construction and building works are done in an informal manner.

Between developed and developing countries, main differences are found in developed countries, such as existence of legislation and its effective implementation and well aware of hazards in the working environment by vigorous training programme. In developing countries like India, legislation is there, still enforcement agencies have to be identified and a few state governments have to frame the Building and Other Construction Workers (BOCW) rules. Workers turnover is more and migrant in nature. Awareness about the hazards is less, compared to developed countries.

In developing countries, other major impact on this sector is lack of research and development on construction safety. So this had motivated the researcher to address these issues and to reduce the accidents rate. A framework on safety system at construction site in India is needed to address all the above issues. Therefore, this present research will address the above challenges and risks faced by Indian construction industry.

1.3 PROBLEM IDENTIFICATION

The construction industries are considered as the highly hazardous one among all other industries. Safety in construction is undoubtedly a major issue. The construction industry is an important sector of any national economy; especially regarding its employment potential. But accidents, incidents, injuries and fatalities continue to occur unabated on construction sites around the world at consistently high rate (Hinze 1997). The unsatisfactory safety record of the construction industry has always been highlighted. It is because the safety management system in a neglected area
and a function, that has not been pursued systematically in the construction industry. High rates of injury are primarily due to an inadequate or non-existence of a safety management systems. So it is necessary to develop a construction site based total safety management systems and implement the safety management policies in the site to avoid accidents.

In order to reduce the accident or incident level and therefore cut losses, it is important to ensure that safe working practice is observed. The only way to know the exists of safety really is measure it and is the saying goes ‘if you do not keep score, you are only practising’. Measurement is a pre-requisite to identify the factors that contribute to accident potential and need control. The current reactive approach adopted in most construction organisations does not reveal either how safe a site is or what the safety culture is. Merely relying on post-accident data will not reveal sufficient information in order to improve the safety level. Some authors dealt with climatic approach and behavioural approach to assess the level of safety in organisations, which will not give actual safety level at the site. So it is necessary that proactive safety performance measurement tools should be developed for measuring the level of safety implemented at site.

The present research work surveys the drawbacks in the existence safety performance measurement tools and developed a framework for new safety performance tool. In general, the safety management is considered as the most important concept in the construction site to reduce the rate of accidents, injuries and fatalities. It is necessary for Indian construction industry to find the factors affect safety at construction site, because of lack of research in these areas. The present research work has taken some important factors to know the level of safety maintained at construction site in India.
This research also focuses on workers attitudes and perception towards existing safety management systems at site.

As a result, safety management has gained great importance in construction industry in the recent years. This research analyzes how safety management procedures could be implemented their best in order to avoid accidents in construction sites. This study is conducted with reference to Indian construction industry.

1.4 RESEARCH OBJECTIVES

The following are the primary and secondary objectives of the study.

1.4.1 Primary Objectives

i. To analyze the major factors that affect safety with respect to construction industry in India. (Chapter 3)

ii. To develop a new model for construction safety management systems. (Chapter 4)

iii. To develop a new model for safety performance measurement and outcome indicators (positive performance indicator and negative performance indicators). (Chapter 5)

iv. To develop a new designed, planned and executed electrical safety audit method. (Chapter 6)

1.4.2 Secondary Objectives

i. To study the reasons behind accidents in construction sites.

ii. To explore the techniques that organizations in India adapt in order to provide safety at workplace.
iii. To explore how safety management procedures could be implemented at their best in construction industry.

1.4.3 Research Questions

i. What are the major reasons that cause accidents in construction sites?
ii. How does organization belonging to construction industry manage safety at workplace at present?
iii. How can safety be improved in construction industry?

1.5 LIMITATIONS OF THE STUDY

i. This study is limited to India alone.
ii. This study is limited to construction industry alone.
iii. This study exclusively takes into consideration accidents that might be caused in construction sites and not in any other location.
iv. This study discusses exclusively the safety management procedures associated with construction industry in India.

1.6 ORGANIZATION OF THE THESIS

The thesis consists of the following eight chapters:

i. *Chapter one* summarizes the literature on the vulnerable nature of construction industry in terms of fatal and non-fatal accidents. It then describes the background, statement of the problem, followed by the setting of the research objectives, research questions and their significance, assumptions, limitations, scope and significance of its solution.

ii. *Chapter two* provided a detailed literature review on the factors affecting safety in construction site, safety management system, safety performance measurement methods and electrical accidents in
developed countries and developing countries. This chapter gives an overview of current situation and proposed strategies with an overview of how general organizations perform safety management at various levels in order to create an environment that is free from hazards and accidents.

iii. **Chapter three** provides an analysis on the major factors affecting safety with respect to construction industry in India.

iv. **Chapter four** discusses in detail a newly developed site based safety management model and its implication at site.

v. **Chapter five** discusses a new model for safety measurement and outcome indicator to check its effectiveness.

vi. **Chapter six** presents a newly designed, planned and executed electrical safety audit method.

vii. **Chapter seven** provides the reader with the summary of the main research finding which is discussed in chapter three, four, five and six. Some of the important points are summarised and recommendations for further work are also outlined.
The following Figure 1.1 illustrates how the thesis is organized.

Figure 1.1 Structure of the thesis