CHAPTER 7
CONCLUSION

7.1 CONCLUSION

7.1.1 Factor Affecting Safety in Construction

From the analysis made on the safety management in construction industries and to find the safety issues, data’s are collected from 10 managers and 1500 workers from 10 different construction companies, the following facts could be inferred.

7.1.1.1 Quantitative study

The following are the findings that could be made from analyzing the data collected from 1500 workers of the 10 construction companies. The present research had taken 8 critical factors from the literatures and 41 questions were developed on the factors. This present research had identified from the analysis of respondents answer to questionnaire that following factors are major affecting construction site in India 1) Management attitude and perception towards safety, 2) Management commitment, 3) Safety communication and feedback, 4) Safety rules and procedure and 5) Perception about the equipments used in construction industry.

7.1.1.2 Qualitative study

The following are the findings that could be made from analyzing the data collected from ten managers of the construction companies:

i. All managers who were surveyed agreed that their organization provide safe work environment to the employees, safety training to
employees and top management, safety to the employees in their sites by conducting effective training sessions, to carry out regular safety inspections and instructions to the employees on safety aspect, hazard or accident reporting system.

ii. From the qualitative analysis, it was clear that there is need for enhancements of existing safety management system of the organization.

iii. It is clearly understood that poor communication or information sharing, carelessness and unawareness of the employee, and insufficient number of qualified and trained people are some drawbacks in safety management system in all organizations.

iv. It is clearly understood that, many of the managers suggests regular training, talking about health and safety, and talking about other injuries or accidents in the site are the way to improve safety in the organizations

From the quantitative and qualitative analysis, this present research concludes that main factors affecting was management factors. So it was required that organisation is in need of effective for total construction safety management system. This forms a basis to develop a new total construction safety management system model to improve above factors.

7.1.2  **Total Construction Safety Management System Model**

A new total construction safety management system model was developed in the present study for construction sector. In the quantitative and qualitative analysis, it was stated that a safety management model is required, for addressing the factors affecting in Indian construction industry. So this research proposed a new generic total construction safety management model exclusively for construction site. The proposed new model in this research
will reduce the accident rate in construction industry (i.e., Total construction safety management model).

i. This model is simple; if all the steps are followed then we could able to reduce the accident rate in construction site. Ultimately this total safety management approach will improve safety performance of the construction site. By this, we could achieve good safety culture at construction site.

ii. If the companies implement a generic safety management model, it yields the following benefit to the companies 1) operational cost saving, 2) reducing work related injuries and 3) clear demonstration of legal and regulatory compliance to regulatory authorities, customers and employees, increased access for new customers and business partner through an improved corporate image.

iii. Periodically, senior management should review safety management performance and audits (i.e., internal audit, third party audit or certification audit like ISO or OHSAS 18001:2007) of the safety management system. For ensuring that the system elements are appropriate, are being implemented and having a positive effect.

7.1.3 Safety Performance Measurement

In this research, the relation between management process interventions and management process outcomes based on performance measurement in safety at construction site had been analysed and a new key safety performance indicator measurement tool on HSE is developed.

i. Safety performance should also be carefully measured and monitored to ensure safety objectives and targets are being met. Measurement of safety performance should include both proactive indicators and reactive indicators.
ii. The performance measurement tool (i.e., Site Safety Meter) used earlier was having drawback in implementation. This research had developed a tool for performance measurement (i.e., key safety performance indicator) and successfully implemented for validation.

iii. The research successfully compared the safety management system compliance in a project before and after the implementation of key safety performance indicator. This created a competitive environment between areas in project to reduce the unsafe act/condition observations.

iv. The successful implementation of key safety performance indicator, indicate that there was 50% (from 355 observations to 120 observations) reduction in unsafe acts/conditions.

v. The feedback analysis was mainly focussed on the repetative hazards and random hazards evolved at site. In this stage, the feedback loop was successfully established down to contractors and also to workers. The feedback methods developed in this research help the project management to better understand the relationship between management processes and outcome indicator (i.e., unsafe acts/conditions) which was one of the main objective of the research.

7.1.4 Electrical Safety Audit

In this research, to mitigate the electrical related accidents in construction site new electrical safety audit tool has been developed.

i. Benefit of this proposed method will be to identify and eliminate of electrical safety hazards, compliance with statutory guidelines and industry safety related work practices, prevention of electrical related accidents and fire.

ii. This research had successfully implemented the electrical safety audit in a site; this tool had helped in identification of electrical hazards in
construction site. The review audit was also carried out to assess the level of implementation and awareness. All observed points were complied.

It can be concluded from the study that safety management is the most important in the construction industries and it adds several benefits to organizations by providing safety to the workplace and also to the workers.

7.1.5 Research Questions

Question 1: What are the major reasons that cause accidents in construction sites?

This study concludes that there are some common and usual type of accidents that happen in the construction industry includes construction site fall of person, fall of materials, crane accidents, scaffolding accidents, workers being over – run by machines, accidents due to electrical equipments, collapses in troughs, explosions etc. Most of the accidents happened in the construction site are due to the carelessness and unawareness of the employees, lack of training and poor communication among the workers, improper maintenance, inadequate resources, performing the work in short cut manner, not following safety rules and regulation at site, breaching safety norms are the major reasons that cause accidents. Each of these accidents can also be avoided through effective and efficient safety measures implemented at site. If total safety management model is proposed in this research is followed, then we can reduce the accident.

Question 2: How does organization belonging to construction industry manage safety at workplace at present?

This study concludes that the management is responsible for the effective maintenance program. At present organisation follows reactive indicators (Accident investigation, based on the cause of accidents corrective
action is taken at the site) to develop the safety system. Only a few proactive indicators are followed like safety inspection, training of employee etc. Due to lack of enforcement in the construction industry, the compliance to legal requirements is not met in the organisation. The management is reluctant to implement the safety rules and regulation in the construction site. At present organisation requires only the completion of project at the earliest, so that the profit will be more. Some organisations take short cut to complete the job without following the safety rule and procedure. The management must monitor the attitudes and behaviour of the employees in the workplace. The organization must motivate the workers in good safety behaviour and practices.

**Question 3: How can safety be improved in construction industry?**

This study concludes that safety can be improved in construction industries by following the systems (1) Preparation of a site safety plan before starting the job, (2) Formation of a site safety committee, (3) Screening and induction of workmen, (4) Training of workmen and staff and pep talk, (5) Group Risk assessment and Job Hazard Analysis, (6) Internal safety audit, (7) Regular safety inspection, (8) Proper selection and use of personal protective equipment, (9) Work permit system, (10) Management of First-aid, (11) Safety campaign, competition and motivation, (12) Safety Performance monitoring and measurement, (13) Accident dangerous occurrence reporting, investigation and analysis, (14) Safety reward and reprimand, (15) Evaluation of compliance to legal and other requirements, (16) Customer requirements, (17) Management review, (18) Identifying the safety related deficiency and (19) Management and monitoring the performance of contractor on safety etc., establishing corrective and preventive measures towards the safety, talking about other injuries or accidents in the site and regular training. The
regular inspections and daily meetings also help to improve safety in the organizations.

### 7.1.6 Recommendations

This research is limited to the construction companies in India alone. This study was conducted only to the 10 construction companies and also only with the 10 managers and 1500 workers. It is recommended that in future this study can be extended by conducting the research in many companies and with engineers, managers etc. and also in all over the world. It is strongly recommended that safety is the most important in construction industry. The organizations must give priority to secure the entire workplace. It is strongly recommended that to follow the total construction safety management model systems.

### 7.1.7 Challenges / Risk Faced at Construction Industry in India

The constraint / challenges /risks faced in India are shown in Table 7.1.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Constraint /Challenges /Risks</th>
<th>Solutions</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>Ownership for safety by line management:</strong> Safety is a line management function; however line managers often forget their role to enforce industrial safety at their work front and merely concentrate on achieving their physical progress. Moreover senior managers rarely instil and enforce the line managers with their responsibility on industrial safety nor they are made accountable for any safe lapse.</td>
<td>Every line managers have major responsibility to demonstrate the safety culture at work front. Senior managers should take account of this as well.</td>
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<td>2</td>
<td><strong>Illiterate workers at construction sites:</strong> The presence of illiterate workers, unskilled workers and the temporary nature of employment create challenges. It is generally observed that these workers are insensitive to unsafe conditions and unsafe acts. Further, the contractors, subcontractors, piece rate workers, labour supply</td>
<td>Make the employees / Workers safety sensitive by PEP talks. Safety induction training, refresher training program, trade wise training program should be conducted for workers. Client should add the safety cost</td>
</tr>
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</table>
| 3 | **Retention of experienced workforce:**  
Due to remoteness and lack of facilities in terms of entertainment and welfare, trained workforce leave the site for better prospects at the first opportunity. Especially most of the major construction sites will generally be in remote areas. | This aspect needs to be considered in the labour colony of the contractors. If the contractors provide good welfare facilities in labour colony and site. The retention rate will be high. |
| 4 | **Lack of comprehensive plan:**  
To reduce gestation period; presently projects are executed on a fast track with parallel activities. Currently projects are taking only 50% of the time what similar projects used to take earlier in the 90’s. | As a result of squeezed completion schedules, the total and comprehensive advance plan to integrate safety in the project management by contractors is often taking a backseat. A job hazard analysis for each hazardous job can be done breaking up the main activities to sub activities and detecting hazards at each such activity with possible solution. A proposed site based safety management system will help the contractor to implement safety and develop the safety culture at work place. |
| 5 | **Non- availability of trained manpower:**  
Mobilizing large number of workforce for a short period affects the HSE management at construction sites. It becomes imperative to employ more agricultural workers in construction site, due to non availability of trained workforce. These workforces are unaware of the hazards and risk existing in the industry. Training such workers in short duration to meet the required level of HSE standards becomes a task of overwhelming proportions. | Whenever a worker comes to site, induction training should be given and followed by multimedia film show focus on construction site activities and hazard associated with each activity. Trade wise (bar bender, rigger, carpenter, painter etc.) training should be given to workers. Daily pep talk and tool box talk should be given to all workers working at site by line manager before starting the job. |

### 7.2 SCOPE FOR FUTURE RESEARCH

1) Since this research has already developed a workable performance measurement framework, testing it on future construction projects would be valuable. This would help to further confirm and refine the system so that it becomes generic to construction.
2) The Other important Points of the Total Construction Safety Management System (TCSMS) may be studied in detail.

7.3 CONCLUDING REMARKS

This research work has made fundamental contributions in four areas:

1) It provides some insight into the main players of the Indian construction industry for a greater understanding of (a) Evaluating the influence of construction worker on their safety attitudes, perceptions and safety performance and (b) managers’ safety practices and their preferences in the Indian construction industry. The questionnaire surveys, face-to-face interviews and statistical data analyses provided useful insights into the influence of safety culture on workers attitudes, perceptions and managers’ safety practices.

2) Managing safety essentially involves four levels: the company policy level, project management level, site management level and individual level. Failure at the first level will increase the probability of failures at the second level and so on. Improper safety management leads to poor safety standards. So, it is necessary in this era of globalization that the Indian contracting companies must ensure that safety management function is integrated with overall project management system and safety culture is inculcated through the “Total construction safety management system model”. It is strongly recommended that creating awareness and excellent training makes safety workplace and this will avoid unnecessary accidents and injuries. Overall, the total construction safety management system model mainly relies on continuous monitoring of indicators of performance of the relevant processes and continuous improvements in these processes.
3) To monitor and improve the performance of contractor and reduce the accident rate Key Safety Performance Indicator (KSPI) was developed. The KSPI was compared with traditional method (Site Safety Meter) which demonstrates that the KSPI is more effective. Then a case study has been carried to illustrate the approach of KSPI in a residential building construction site. The overall scores were higher, which shows the importance of workers awareness. A significant finding was that there was a reduction in the occurrence of common repetitive hazards after performance measurement and feedback was implemented on project. The research work has found that feedback regarding the specific safety performance of individual trades could be a useful tool in motivating contractors to achieve better safety outcomes. Also the feedback helped reduce safety hazards, thereby encouraging continuous improvement.

4) Electrical Safety Audit (ESA) had helped in identifying the most serious hazard exists in the construction site and it had shown the management on implementation priority of the observations. The management had also acted positively to comply with all the observations. The review audit shows a remarkable improvement found at the construction site.

The organizations must enforce workers to follow the safety policies, rules and regulations to make a better safety and health management. The findings of the research work also lead to the contribution of models that would enable the stakeholders of construction industry of developing countries to adopt safety measures and prevent the occurrence of accidents. This research work also furnished solutions to the stakeholders of Indian construction industry for applying safety measures in practice. The stakeholders must always follow the proactive safety management systems, rather than reactive safety management systems.