BENCHMARKING THE CURRENT STATE OF CONSTRUCTION SAFETY PRACTICES IN PAKISTAN

by

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DEDICATED

TO

MY DECEASED FATHER

ACKNOWLEDGEMENT

I am thankful to Almighty Allah, who gave me strength to complete my research. I would like to pay debt of gratitude to my advisor Dr. Rafiq Muhammad Choudhry, for his fathomless guidance, valuable time and encouragement, to complete my research work. I am also extremely grateful to the committee members, Dr. Muhammad Nasrullah Khan, Dr. Hamza Farooq Gabriel and Engineer Zia Ud Din, for their sincere guidance to complete my research work. I owe my special thanks to the respondents for their valuable contribution to this research. In the end, I pay my earnest gratitude with sincere sense of respect to my mother and family for their unending support, encouragement, prayers and patience.

ABSTRACT

Construction industry (CI) is one of the most hazardous industries where workers are more prone to accidents. These accidents can be reduced by improving the safety performance of CI through a benchmarking approach. This approach helps the construction companies to compare their safety performance with the industry best practices. It ultimately leads the companies to superior safety performance by evaluating their weaknesses and incorporating the best safety practices. This study presents the mechanism to identify the weaknesses in current safety practices of CI of Pakistan through benchmarking and suggests measures to improve it. The study is undertaken via a questionnaire based survey comprising of 60 safety practices. Data collected from 54 construction projects located in 16 different cities of Pakistan, is analyzed using SPSS.

Results demonstrate that the safety performance of Pakistani CI is not satisfactory. Major findings of this study include; non-existence of a regulatory authority to implement safety, more emphasis on productivity by all stakeholders, clients aversion to provide any budget for safety, contractors′ reluctance to invest more on safety, and workers′ unawareness towards their rights. The most neglected safety practices requiring special emphasis are; (a) safety training for the workers of subcontractors, (b) refresher safety training sessions, (c) workers′ education for not taking unnecessary risks, (d) participation of subcontractors in safety meetings, and (e) providing job specific safety training. Benchmarking of eight mega projects against their safety performance indicates that the factor of *'safety training'* has the lowest safety performance level, followed by *'safety in the contract documents', 'safety meetings'* and *'worker's involvement'*. The study recommends establishing an administrative body for occupational safety and health under the ministry of 'Professional and Technical Training' which may work in collaboration with Pakistan Engineering Council (PEC) to provide safety training and evaluate the safety performance of all registered construction companies periodically. Safety credit points may be incorporated in the process of contractors′ registration, enlistment and renewal, and a record of occupational injuries and fatalities may be maintained and published annually so as to benchmark the safety performance of all registered construction companies.

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LIST OF ABBREVIATIONS

GoP	Government of Pakistan
MoPTT	Ministry of Professional and Technical Training
SBP	State Bank of Pakistan
PEC	Pakistan Engineering Council
USA	United States of America
UK	United Kingdom
ILO	International labour organization
OSHA	Occupational Safety and Health Administration
OHS	Occupational Health and Safety
SH&E	Safety, Health and Environmental
PPE	Personnel Protective Equipment
CIWCE	Centre for Improvement of working Conditions and Environment
SPSS	Statistical Package for Social Sciences
ANOVA	Analysis of Variance
RII	Relative Importance Index
SPI	Safety Performance Index
CI	Construction Industry

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CHAPTER 1

INTRODUCTION

1.1 Study Background

Construction industry (CI) is one of the most hazardous industries all over the world (Hinze, 1997; Kartam, 1997). Safety statistics for construction indicate high fatality and injury rates all over the world (Suazo and Jaselskis, 1993; Ahmed *et al*., 2000; Teo *et al.*, 2005). Fatal accidents in CI are estimated to be 60,000 per year around the world. Similarly work-related deaths in CI are estimated to be 25-40%, whereas CI employs only 6 to 10% of the total workforce (ILO statistics, 2005). In the United States, it was reported that CI accounted for 20% of all occupational fatalities, whereas they made up only 5% of the country's work force (National Safety Council 1997 statistics). This figure was reduced to 5.4% in USA by implementing safety practices (National Safety Council 2007 statistics). Research shows that the major causes of accidents are related to the unique nature of the industry, human behavior, ever-changing site conditions and poor safety management, which result in unsafe work methods, poorly-managed equipment operations and unsafe procedures (Abdelhamid and Everett, 2000). Construction companies around the globe are implementing safety, health and environmental management systems to reduce injuries, eliminate illness, and to provide a safe work environment for their employees (Choudhry *et al*., 2008a).

In Pakistan, main laws governing occupational health and safety are *'Factories Act 1934 (chapter 3)'* and *'Government of Pakistan labour policy 2010'* which contain special provisions to regulate the working conditions in all occupations but unfortunately they are not enforced in true spirit, due to the negligence of Government agencies and unawareness among the workers for their rights. Procedures for implementing and monitoring these safety laws do not exist and safety practices are generally not adhered to on most of the construction sites. There is no source of published data on construction related injuries and fatalities in Pakistan so benchmarking of safety practices basing on lagging indicators can not be performed.

The total labour force of Pakistan comprises of approximately 39.40 million people. The CI has a share of 2.5% in the GDP (SBP annual report 2010-2011) and it has employed 6.29% directly and 30-40% indirectly of the total labour force of Pakistan

(Survey of Pakistan 2008). Anecdotal evidence indicates that construction worker injuries and fatalities in Pakistan could be as high as 20-25% (Farooqui *et al.*, 2008). Construction accidents and associated damages caused to the employees, property and equipment, generate negative effects on the profitability and, to some extent, overall productivity in the CI. Informal assessments have identified that safety non-performance has not only led to unsafe project sites but has also resulted in construction delays, cost overruns, poor productivity and poor product and process (Farooqui *et al.*, 2008). Hence, there is an urgent need to form a safety regulatory authority, run safety awareness programs; arrange formal and informal education and training in safety for all stakeholders. There is also a need to change the mindset of project owners, designers and contractors towards the implementation of safety programmes in CI. Research (Choudhry *et al*., 2008b) demonstrated that constructors in the developing countries need to implement safety management systems to enhance their safety performance level.

In this research, a benchmarking approach has been introduced to measure and compare the current state of construction safety practices in CI of Pakistan. Conclusions and recommendations in relation to safety performance of Pakistani CI have been drawn based on statistical analysis of the data.

1.2 Research Significance

The objective of this research is the first sub-objective of an ongoing research project, *'to establish a center of excellence to conduct and promote construction safety research, education and training in Pakistan - Pak-US Science and Technology Cooperation Program'.*

The above mentioned project has following five sub-objectives:

a. To benchmark the current state of construction safety practices in Pakistan;
b. To develop construction safety guidelines for the Pakistani CI;
c. To develop adequate materials for conducting training on construction safety;
d. To conduct an international conference/symposium on construction safety in Pakistan; and
e. To develop a strategic framework to enforce and monitor safety on construction sites with the help of governmental agencies and to collect safety related data on an annual basis.

In our society where occupational health and safety is not taken seriously, this benchmarking study will help the public and private organizations involved in CI to develop *'safe work environment'* for millions of construction workers. Identification of good and most neglected safety practices may provide useful information to safety practitioners in making their sites safer. Moreover, it will develop awareness among all stakeholders that enforcement of safety on work sites will not only increase the productivity but will also reduce the overall cost of the project, by reducing the cost of health insurances and medical treatment. This effort will definitely fuel the evolutionary process of changing the mindset of all stakeholders to invest in safety for better productivity.

1.3 Research Objectives

The core objective of this research is, 'benchmarking the current state of construction safety practices in CI of Pakistan'. The sub-objectives are:

a. Measuring the performance level of safety practices in CI of Pakistan (by analyzing the data, collected through questionnaire based survey and interviews).
b. Identifying the most neglected safety practices (by relative importance index method).
c. Comparing the safety performance of under construction mega projects.
d. Suggesting measures to improve safety performance level in CI of Pakistan.

1.4 Scope and Limitation

The scope of this study is limited to CI of Pakistan and mainly covers the perception of key stakeholders i.e. clients, consultants and contractors/subcontractors about current safety practices. An effort has been made to include as many types of projects as possible in the survey like highways, buildings, bridges, runways, canal, tunnel and dam. Data is collected through questionnaire based survey and interviews, from 38 construction companies/organizations working on 54 diverse projects in 16 cities of Pakistan. Keeping in view the limited time and resources, the under construction projects located in Rawalpindi, Islamabad, Fateh Jhang, Muzaffarabad and few projects

in Lahore and Gujranwala are visited personally for data collection whereas the data from other cities is collected through mail/email.

The major limitation being faced is the lack of research in this area and non availability of reliable accident statistics. It is quite difficult to collect real time data as all stakeholders in CI are reluctant to share the actual data of injuries and fatalities. Owing to this limitation, only leading indicators (safety practices) are used to collect the data.

1.5 Organization of Thesis

The thesis is organized in five chapters with chapter 1 covering an introduction to safety practices and chapter 2 covering literature review. Chapter 3 covers methodology used in the research and chapter 4 covers results and analysis. The final (5^{th}) chapter presents the conclusions and recommendations.

1.6 Summary

This chapter gave a brief introduction to importance of safety in the CI and listed the objectives of this research. The theoretical base for this study comes from an extensive literature review (see Chapter 2). This chapter briefly highlighted the research significance, its scope and limitations. Furthermore, this chapter provided overview of this dissertation.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Safety is a mechanism to prevent the occurrence of an accident, whereas construction safety is the discipline of preserving the health of those who build, operate, maintain, and demolish engineering works and of others affected by those works (Davies and Tomasin, 1990). The aim of an effective safety system is to prevent and/or minimize the occurrences of accidents and hazards that threaten workers in the work place (Ayomoh and Oke, 2005; Farrow and Hayakawa, 2002). The CI employing the largest labour force has accounted for about 11% of all occupational injuries and 20% deaths resulting from occupational accidents (Arumugam *et al.,* 2007). According to ILO 2005 statistics, one in every six fatal accidents at work occurs on construction sites. Studies have shown that hazards can be controlled and accidents can be prevented through the implementation of basic safety practices leading to a sound safety program (Sawacha *et al.,* 1999). Workplace safety is a complex phenomenon and the subject of attitudes and safety performance in CI is even more complex (Choudhry *et al.*, 2008). Moreover, safety cannot be guaranteed by legislation or regulations alone, nor should safety be the sole responsibility of the employer, the employees must be involved (Baig, 2001). Thus we can conclude that safety is a team effort and it requires education and training.

2.2 Benefits of Implementing Safety in Construction Industry

According to Choudhry *et al.*, 2008, the benefits of implementing a systematic and effective safety, health and environmental (SH&E) management system could be the following:

a. Reducing the number of injuries to personnel and workers on construction sites through the prevention and control of hazards.
b. Minimizing the risk of major accidents.
c. Controlling construction site risks to enhance the productivity.
d. Reducing the cost of insurance as well as the cost of employee′s absences.
e. Minimizing legal costs of accident litigation, fines, reducing expenditures on emergency supplies.

f. Reducing accident investigation time, diverted supervisors′ time, clerical efforts, and the loss of expertise and experiences.

2.3 Safety Indicators

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. Focusing on these measures e.g. accident rates and compensation costs means that the "success of safety is measured by the levels of system failure" (Cohen, 2002).

In recent years, there has been a movement away from *'lagging indicators'* towards *'leading indicators'* for measuring safety, such as site investigation and measurement of safety climate and safety practices (Flin *et al.*, 2000). Leading performance indicators identify weaknesses in the safety management practices before they manifest as accidents (Mearns *et al.*, 2003).

2.4 Construction Safety Performance

This section presents two main differences for construction safety performance among developed and developing countries. First is the existence of legislation and its effective implementation; and second is hazard awareness. In developed countries, many safety acts and legislations are implemented effectively and nominated safety officers promote hazard awareness with the help of regular safety training sessions. Contrary to this, in developing countries, safety rules barely exist; and any that do are inappropriate, ineffective and out of date. Additionally, the regulatory authority is usually weak in implementing rules effectively, and work hazards are either not perceived at all, or perceived to be less dangerous than they actually are (Larcher and Sohail, 1999; Ali T.H., 2006).

2.4.1 Global Construction Safety Performance

Many construction companies around the globe are implementing safety, health and environmental management system to reduce injuries, eliminate illness, and to provide a safe work environment for their employees (Choudhry *et al.*, 2008). Protection of labour from occupational diseases and accidents in the CI of China is defined by law; for example, for construction sites having 50 employees or more, main contractors have

to nominate a full-time safety inspector; for sites with an area exceeding 10,000 m^2, there must be 2-3 safety inspectors; whenever the site exceeds 50,000 m^2, the main contractor has to establish a safety management team (Tam *et al.*, 2004).

In developed countries, recent technological advancement, on one hand, has contributed positively to industry productivity, but on the other hand, has created a more challenging and unsafe work environment (Farooqui *et al.*, 2007). Every construction worker is likely to be temporarily unfit for work at some time as a result of a minor injury or a health problem after working on a construction site (Ahmed *et al.*, 2000). Rowlinson (2003) reported that between 1989 and 1992, 256 people were injured in the Australian CI and fatality rate was 10.4 per 100,000 workers. In the United States, it was reported that CI accounted for 20% of all occupational fatalities (National Safety Council 1997). However this figure was reduced to 5.4% by implementing safety laws (National Safety Council 2007 statistics). In 2000, a study was conducted in China (Huang *et al.*, 2003), which revealed that 3,000 construction workers are killed in work related accidents each year. In Hong Kong, 275 reportable accidents per 1,000 workers per year were recorded in 1994 and this figure stood at around 150 in 2000 (Rowlinson, 2003). In comparison, 10 construction workers in every 1,000 suffer an injury in a year in Japan, and the figure is around 50 for the United Kingdom (Rowlinson, 2003). Safety programs applied by contractors operating in Egypt were less formal and the accident insurance costs were fixed irrespective of the contractor′s safety performance (Hassanein, 2008).

2.4.2 Construction Safety Performance in Pakistan

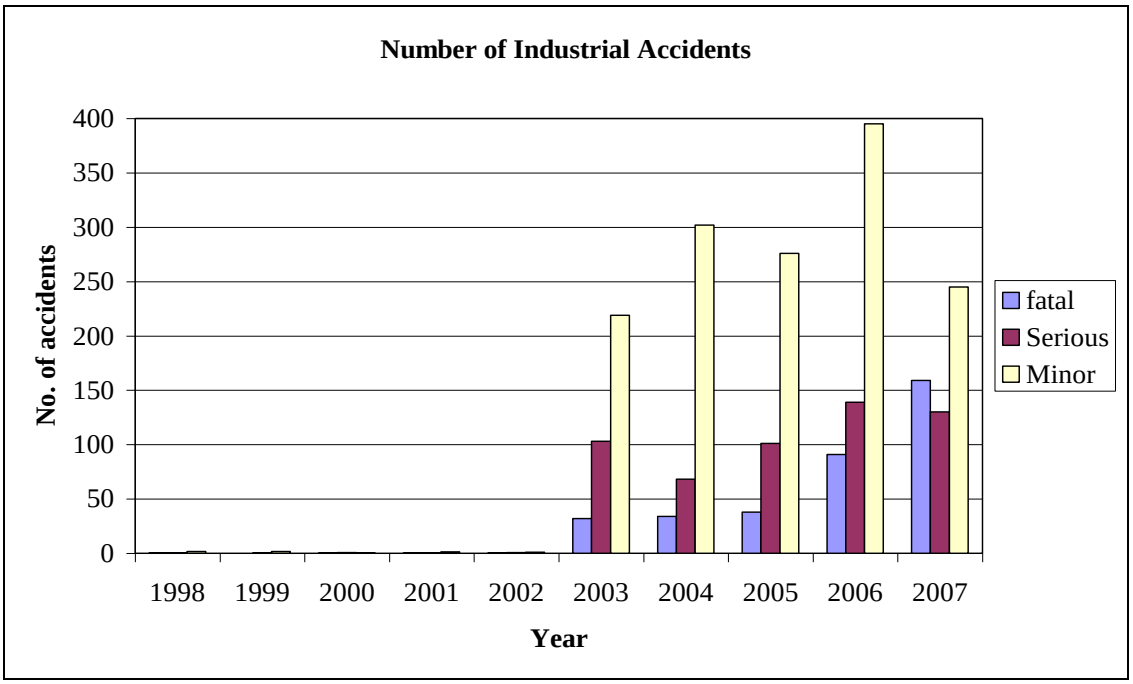
In Pakistan, currently there is no regulatory authority for occupational health and safety management like OSHA in USA (Ali T.H., 2006). The primary construction regulatory body i.e. Pakistan Engineering Council (PEC) has yet to lay down safety laws and regulations, to be adopted by all the stakeholders of CI (Ahmed, 2007).

Construction is more labor intensive than that of the developed countries, involving 2.5-10 times as many workers per activity (Koehn and Regmi, 1991). Typically workers tend to be unskilled and migrate in a group, with or without their families, throughout the country in search of employment. Communication problems related to differences in language, religion and culture tend to inhibit safety on the work site. Furthermore, most clients demand high speed and high quality of work at the lowest

cost. Project cost does not include any safety budget and costs are affected by the standard of workmanship specified, complexity of the work and contract conditions.

There is a significant difference between large and small contractors for their safety performance. Most of the large firms, registered with PEC in category C-A *(no limit category)*, have a safety policy and they also provide some training to workers and maintain safety personnel on the jobsite. Contrary to this, small firms do not have safety on their agenda so unsafe conditions exist on many sites and labourers are subjected to numerous hazards. On many sites, training programs for the staff and workers do not exist; therefore, orientation for new staff or workers is not conducted, 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, poor housekeeping, and substandard sanitation tend to exist on remote projects (Farooqui *et al.*, 2008).

Although some emphasis has been given to industrial safety but safety in the CI is ignored. Figure 2.1 shows the available data from labour division of Pakistan about industrial accidents in the factories. Graph explains that number of fatalities have increased from 30 (in year 2003) to 160 (in year 2007). This increase in frequency of accidents warrants the need of establishing a regulatory authority to enforce safety.



(Source: GoP Labour Division Statistics)

Figure 2.1: Number of Industrial Accidents in Pakistan

2.4.3 Common Problem Areas in CI of Pakistan

Following problem areas are common in CI of Pakistan (Farooqui *et al*., 2008).

a. While excavating in deep trenches (with no proper shoring or bracing), accidents due to cave-ins often occur.
b. Concreting is done mainly by labourers, and cement burns due to the unavailability of protective gloves and boots are common.
c. Workers fall from heights due to poor quality wooden scaffolds and unavailability of safety belts.
d. Workers sustain injuries on head, fingers, eyes, feet and face due to the absence of personal protective equipment.
e. There is improper housekeeping and water for drinking and washing is not sufficiently made available.
f. Lack of understanding of job and poor equipment maintenance are also major causes of accidents.
g. Injuries generally are unreported; however, if necessary, a labourer might receive first aid or preliminary medical care. In most cases, specialized medical treatment or compensation is not available. Workers consider that construction is a dangerous occupation and accidents are taking place due to their own negligence. However, major accidents involving the death of a worker are generally reported due to the financial expenses and litigation that could be involved.
h. Maintenance and inspection schedules often are not followed and only after a breakdown, equipment is repaired. This approach leads to low morale, loss of time, idle workers and project delays. It may also cause damage to property.
i. Electrocution is also a major hazard due to use of substandard electrical equipment and underground cables.
j. Workers, especially young ones, take chances and often do not follow safety norms or use personal protective equipment. Also labourers and staff are sometimes under the influence of alcohol and drugs.
k. Clients and consultants do stress safety before work commences, but as the work progresses their concern for deadlines becomes a priority and they tend to pay less attention to safety. Safety is considered to be the contractors' responsibility and clients do not feel any such moral responsibility.

2.4.4 Reasons for Safety Non Performance in Pakistan

Farooqui *et al*., (2007) identified a few major reasons for safety non-performance which includes: non existence of any regulatory agency; lack of professional construction management practices, 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 key issues like safety.

2.4.5 Safety Laws in Pakistan

The main law governing 'Health and Safety' of workers is the '*Factories Act 1934-chapter 3'* and *'Government of Pakistan Labour Policy-revised in 2010*'. PEC has also incorporated health and safety clauses in the contract document. Unfortunately, these laws are not enforced resulting in higher rate of occupational injuries and fatalities. Safety clauses in PEC contract documents are as under:

a. **Safety, Security and Protection of the Environment** *{Clause 19.1 of part-I (General Conditions of Contract) of PEC Standard Form of Bidding Documents}*:

   The Contractor shall, throughout the execution and completion of the works and the remedying of any defects therein:-

   (i) have full regard for the safety of all persons entitled to be upon the site and keep the site (so far as the same is under his control) and the works (so far as the same are not completed or occupied by the Employer) in an orderly state appropriate to the avoidance of danger to such persons,

   (ii) provide and maintain at his own cost all lights, guards, fencing, warning signs and watching, when and where necessary or required by the Engineer or by any duly constituted authority, for the protection of the works or for the safety and convenience of the public or others,

   (iii) take all reasonable steps to protect the environment on and off the site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of his methods of operation.

b. **Safety Precautions** *{Clause 19.3 of part-II (Particular Conditions of Contract) of PEC Standard Form of Bidding Documents}:*

(i) In order to provide for the safety, health and welfare of persons, and for prevention of damage of any kind, all operations for the purpose of or in connection with the contract shall be carried out in compliance with the safety requirements of the Government of Pakistan with such modifications thereto as the Engineer may authorize or direct and the contractor shall take or cause to be taken such further measures and comply with such further requirements as the Engineer may determine to be reasonably necessary for such purpose.

(ii) The Contractor shall make, maintain and submit reports to the Engineer concerning safety, health and welfare of persons and damage to property, as the Engineer may from time to time prescribe.

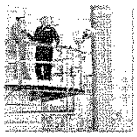
2.4.6 Safety Policies of Pakistani Construction Companies

Most of the construction companies in Pakistan do not have any safety policy, however some large construction firms registered with PEC in category CA (no limit category) have made their safety policies. It is important to highlight here that these safety policies are not implemented in true spirit.

2.4.6.1 DESCON′ Safety Policy

DESCON is one of the renowned construction firms, having its head office at Lahore. Its projects are wide spread all over the country. DESCON has an independent department in the head office under the supervision of a director, looking after the safety aspects of its construction projects. It provides safety training to its staff also. Figure 2.2 shows the DESCON′s health and safety policy which says that quality, health, safety, environment and community responsibilities are an integral part of all its operations.

QHSE Policy



Descon's team at all levels shall endeavor to ensure the satisfaction of all stakeholders by providing the best value in every product and service by recognizing that Quality, Health, Safety, Environment and Community responsibilities are an integral part of our operations.

We shall achieve this by:

- Establishing and reviewing QHSE objectives and targets.
- Developing and implementing management structures and procedures.
- Monitoring, evaluating and continually improving our QHSE performance.
- Recognizing that QHSE is everyone's direct responsibility.
- Continually enhancing awareness, skills and systems efficiency.
- Participating in product and process improvement initiatives, risk mitigation and prevention measures.
- Making each team member accountable for QHSE matters.
- Meeting all internal and external commitments.
- Abiding by the applicable legal framework requirements related to QHSE.
- Ensuring that the QHSE systems of our suppliers and subcontractors are compatible with our own commitments.
- Exercising integrity and respect in dealing with each other, customers, suppliers and society at large.
- Communicating this policy to all stakeholders, providing training and encouraging behavior that upholds this policy.

DIMS / QHSE Policy
Rev. 02, Jan 01, 2010

Dr. Salman Zakaria
Chief Executive Officer

Figure 2.2: DESCON's Health and Safety Policy

2.4.6.2 Habib Rafiq Limited's (HRL) Safety Policy

HRL is also a renowned construction company having better safety performance level in CI of Pakistan. Figure 2.3 shows the health and safety policy of HRL, which says that the ultimate aim of HRL is to achieve zero accident, zero injury, and zero property damage.

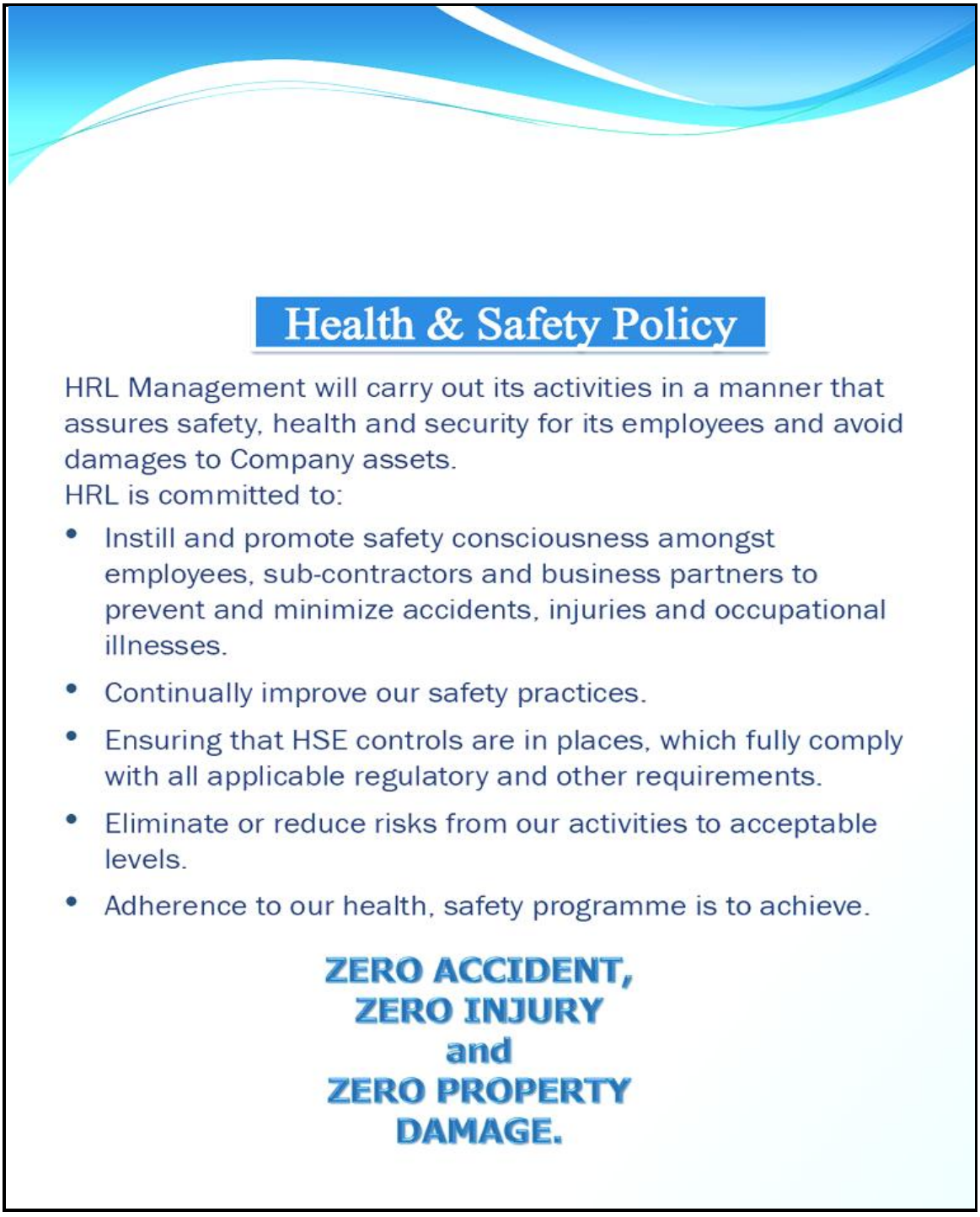


Figure 2.3: Habib Rafiq Limited's Health and Safety Policy

2.5 Key Safety Factors Used in Construction Industry

The term safety practice which comprises of certain procedures in the safety management system is commonly applied in most developed countries. These practices can be applied in developing countries with some adjustment depending upon the local conditions. The key factors of safety in construction (safety practices and safety improvement) as defined by *Permana* in 2007 are shown in Figure 2.4.

Figure 2.4: Key Safety Factors used in CI *(Permana, 2007)*

2.6 Benchmarking

2.6.1 History

The term *benchmarking* was first used by cobblers to measure people's feet for shoes. They would place someone's foot on a ‘bench’ and mark it out to make the pattern for the shoes.

Benchmarking is primarily used to measure the specific performance gap for improving the health of any business. UK construction industry is carrying out benchmarking since late 1990s through its industry association and with financial support from the UK Government.

2.6.2 Definitions of Benchmarking

Rank Xerox, a pioneer in benchmarking, defines benchmarking as *‘the continuous process of measuring products, services and practices against the toughest competitors or those recognized as industry leaders’* (Rothman, 1992).

It is the practice of identifying, understanding and adapting the successful business practices and processes used by other companies (or other departments within same company) to increase the business success. Competitive analysis can be used along with benchmarking to identify gaps and provide strategic direction for improvement.

Benchmarking is a systematic method by which organizations can measure themselves against the industry leaders and it can lead the organizations to superior performance. It helps a company to learn its strengths and weaknesses and those of other industrial leaders and incorporate the best practices into its own operations. In short, it is a tool for continuous improvement.

It can also be defined as *‘the process of comparing one's business processes and performance metrics to industry bests and/or best practices from other industries’.* Dimensions typically measured are quality, time and cost but other functions can also be measured like safety performance. Also referred to as "*best practice benchmarking*" or "*process benchmarking*", it is used in management and particularly strategic management, in which organizations evaluate various aspects of their processes in relation to best practice companies' processes. This then allows organizations to develop plans on how to make improvements or adapt specific best practices, usually with the aim of increasing some aspect of performance.

2.6.3 The Essence of Benchmarking

a. It is the continuous process of comparing a company's strategy, products, practices and processes with those of world leaders and best-in-class organizations in order to learn how they achieved excellence and then setting out to match and even surpass them. Successful benchmarking not only needs to be regular and continuous but also needs to be conducted by the organization (Ahmed *et al*., 1998).

b. In other words, it is *"moving from where we are to where we want to be."*

2.6.4 Factors to be Kept in Mind to Ensure Success with Benchmarking

a. Benchmarking must have the full support of senior management.

b. Training is critical for the benchmarking team.

c. Benchmarking should be a team activity.

d. Benchmarking is an ongoing process. It must be part of an organisation's strategy and development. If well monitored, it serves as an important segment of a total quality management system.

e. Benchmarking efforts must be organised, planned and carefully managed.

2.6.5 Barriers to Successful Benchmarking *(Elmuti,1998; Monkhouse,1995; Rothman,1992)*

There are several factors which hinder the benchmarking process including:

a. **Inadequate people or technology resources.** A business should make sure that it has the resources (in terms of workforce, technology or funding) to both launch a thorough benchmarking program and implement its findings.

b. **Unwillingness or inability to accept the legitimacy of business ideas or practices from outside sources**. Many employees and organizations are resistant to change, because of general contentedness, fear of the unknown, perceived challenges to their abilities, etc. Resistance can be minimized, if owners and managers make it clear that benchmarking is not a fault-finding exercise, rather it is an established program to help the company to grow and prosper in a fast-changing business world.

c. **Speed of in-house benchmarking processes**. Effective benchmarking programs are given mandates to conduct their investigations in a timely manner so that improvements can be implemented quickly.

d. **Inadequate follow-up training**. Benchmarking programs can uncover many areas in which improvements can be made. But if the company does not provide sufficient training to its workers to implement the changes in an efficient manner, then the initiative becomes a waste of time and resources.

2.6.6 Benchmarking Methodology

There is no single benchmarking process that has been universally adopted. Wide appeal and acceptance of benchmarking has led to the emergence of various benchmarking methodologies. First book on benchmarking, written and published by *'Kaiser Associates'*, is a practical guide and it offers a 7-step approach to benchmarking. Details of all the activities included in each step are given in Table 2.1.

Table 2.1: Benchmarking 7-Steps Model by Kaiser Associates

Step	Activity	What is included
1	Identify what to benchmark	(i) Clarify the benchmarking objective (ii) Decide whom to involve (iii) Define the process (iv) Consider the scope (v) Set the boundaries (vi) Agree on what happens in the Process (vii) Flow chart the process
2	Determine what to measure	(i) Examine the flow chart (ii) Establish the process measures (iii) Verify that measures match objective
3	Identify who to benchmark	(i) Conduct general research (ii) Choose level to benchmark
4	Collect data	(i) Use a questionnaire (ii) Conduct a benchmarking site visit
5	Analyze data and determine the gap	(i) Quantitative data (ii) Qualitative analysis
6	Set goals and develop an *"Action Plan"*	(i) Set performance goals (ii) Develop an *"Action Plan"*
7	Monitor the process continuously	(i) Track the changes (ii) Make benchmarking a habit.

2.6.7 Benchmarking Approaches

Common approaches to benchmarking are internal, external (competitive and non-competitive) and world-class benchmarking.

a. **Internal Benchmarking** is done within one's organization or perhaps in conjunction with another division or branch office. It is the easiest to conduct since the data is readily available and confidentiality concerns are minimized.

b. **Competitive Benchmarking** involves analyzing the performance and practices of best-in-class companies whose performance becomes a benchmark to which a firm can compare its own performance and their practices are used to improve that firm's practices. However benchmarking the competition could be difficult since it might be impossible to collect or learn a competitor's secrets. Competitive benchmarking can be successful, if the cooperating companies share information on processes that do not define their market position (Spendolini, 1992).

c. **Non-competitive Benchmarking** is learning something about a process a company wants to improve by benchmarking with a firm, the company does not directly compete. An advantage of this type of benchmarking is that new processes which could easily be adapted to one's organization might be discovered.

d. **World-class Benchmarking.** This approach to benchmarking is the most ambitious. It involves looking towards the recognized leader for the process being benchmarked.

2.6.8 Types of Benchmarking

Three major types of benchmarking include performance benchmarking or operational benchmarking, process benchmarking or functional benchmarking and strategic benchmarking.

a. **Performance Benchmarking** involves pricing, technical quality and other quality or performance characteristics of products and services. It allows the initiator firms to assess their competitive position by comparing products and services with those of target firms. It is usually performed by direct comparisons or “reverse engineering" in which competitor's products are taken apart and analyzed. This process is also known as "*operational*

benchmarking" or "*competitive benchmarking*" and involves studying of products and processes of competitors in the same industry.

b. **Process Benchmarking** centers on work processes such as billing or employee training. It identifies the most effective practices in companies that perform similar functions, no matter in what industry. The initiating firm focuses its observation and investigation of business processes with a goal of identifying and observing the best practices from one or more benchmark firms.
c. **Strategic Benchmarking** examines how companies compute and seek the winning strategies that have led to competitive advantage and market success. It involves observing how others compete. This type is not industry specific, meaning it is best to look at other industries.

The benchmarking is further divided into following categories:

a. **Functional Benchmarking** - a company will focus its benchmarking on a single function to improve the operation of that particular function. Complex functions such as Human Resources, Finance and Accounting, and Information and Communication Technology are unlikely to be directly comparable in cost and efficiency terms and may need to be disaggregated into processes to make valid comparison.
b. **Operational Benchmarking** - embraces everything from staffing and productivity to office flow and analysis of procedures performed.
c. **Best-in-class Benchmarking** - involves studying the leading competitor or the company that best carries out a specific function.
d. **Product Benchmarking** - the process of designing new products or upgrades to current ones.
e. **Financial Benchmarking** - performing a financial analysis and comparing the results in an effort to assess overall competitiveness and productivity.
f. **Benchmarking from an investor perspective** - studying the peer companies that can be considered alternative investment opportunities from the perspective of an investor.
g. **Energy Benchmarking** - process of collecting, analyzing and relating energy performance data of comparable activities with the purpose of evaluating and

comparing performance between or within entities. Entities can include processes, buildings or companies.

2.6.9 Advantages of Benchmarking. The major advantages for using the benchmarking approaches are:

a. Benchmarking practice promotes a thorough understanding of the company's own processes i.e. the company's current profile (strength and weaknesses) is well understood.
b. It involves limitation and adaptation of the practices of superior competitors, rather than invention, thereby saving time and money.
c. It enables comparison of performance measures in different dimensions, each with best practice for that particular measure.
d. It focuses on performance measures and processes and not on products, thus it is not restricted to the industry to which the company belongs.
e. It extends beyond these boundaries and identifies organizations in other industries that are superior with respect to chosen measures.
f. It allows the organizations to set realistic, rigorous new performance targets.
g. It allows the organizations to find specific gaps in performance and to select the processes to improve.
h. It provides basis for training human resources. Employees begin to see the gap between what they are doing and what best-in-class are doing.

2.6.10 Limitations of Benchmarking. Following limitations must be kept in mind while using benchmarking approaches:

a. Best-in-class performance is not a static but a *'moving target'.*
b. New technology can create quantum leap performance improvement.
c. Benchmarking is not a panacea that can replace all other quality efforts or management processes.
d. Benchmarking is not an *"instant pudding"*. It will not improve performance if the proper infrastructure of a total quality program is not in place.

2.7 Measurement of Safety Performance through Benchmarking

Safety performance measurement enables the top management of an organization to benchmark their performance against similar organizations (Allan St John Holt, 2005).

2.7.1 National Safety Council′s Benchmarking Model

For benchmarking the safety aspects, 'National Safety Council' of United States has developed a model safety management system which includes following nine elements organized into three key performance areas.

a. Leadership – Management
   - Management leadership and commitment
   - System management and communications
   - Assessments, audits and performance measurements

b. Technical – Operational
   - Hazard identification and risk reduction
   - Workplace design and engineering
   - Operational processes and procedures

c. Cultural – Behavioral
   - Involvement of workers and management
   - Motivation, behavior and attitudes
   - Training and orientation

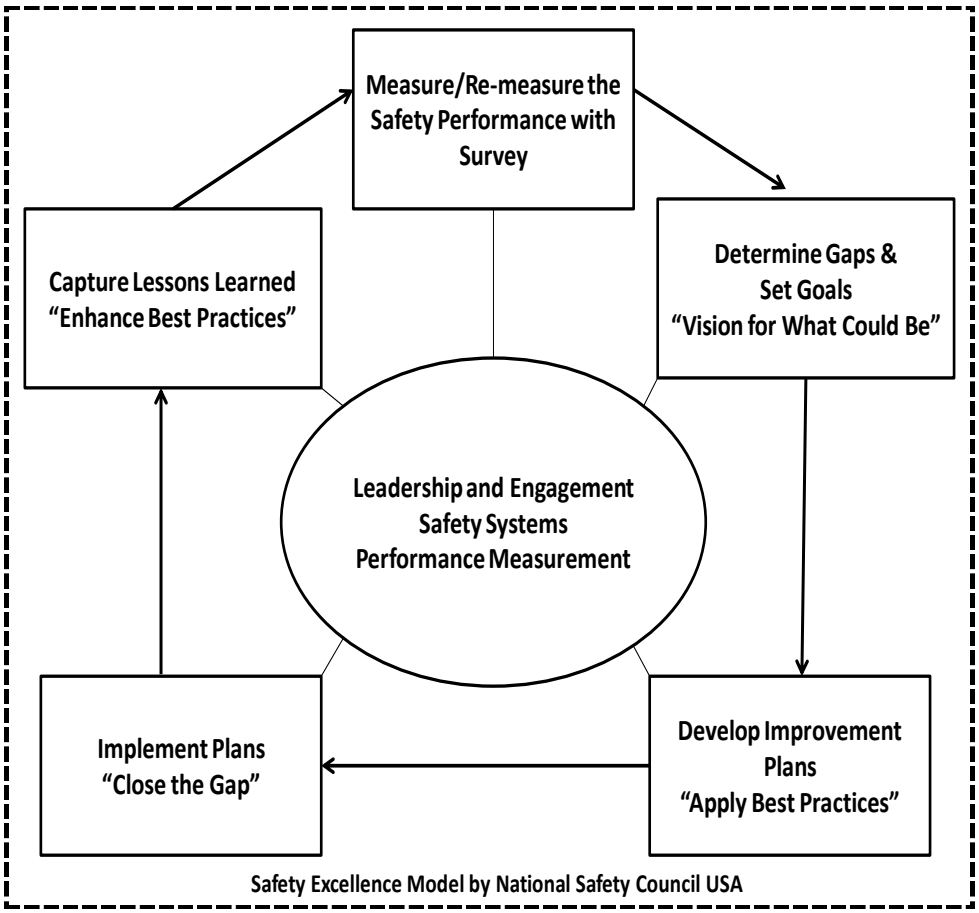
2.7.2 Leading Indicators and Benchmarking

Effectiveness of a safety management system is measured solely on the basis of its failures. Multiple points of measurement, both qualitative and quantitative, must be combined into a systematic approach that accurately assesses the effectiveness of the safety management system and discovers the root causes of deficiencies. Actual measures, whether proactive, reactive, trailing or leading, need to follow the four basic principle of good measurement: validity, reliability, practicality and utility.

2.7.3 Continuous Improvement through Measurement and Benchmarking

The 'Safety Excellence Model' shown in Figure 2.5 is a framework for applying a safety management system on a continuous basis. It is a process-oriented approach that emphasizes people's contributions to long-range, permanent solutions for problems. The

core requirements for safety excellence are leadership and engagement, safety systems, and performance measurement. The benefits of this model include alignment of actions with business objectives, more focused effort, and reduced injuries.



(http://www.nsc.org/safety_work/benchmarking_measurement/Pages/benchmarking_measurement.aspx)

Figure 2.5: Safety Excellence Model by National Safety Council of USA

2.8 Summary

In this chapter, construction safety is discussed in detail. Common problem areas in Pakistani CI, key factors for measuring safety performance and safety laws in Pakistan are explained. Types and approaches of benchmarking are also highlighted alongwith its advantages and limitations. Moreover, a 'safety excellence model' is discussed which can be used for enhancing the safety performance of CI of Pakistan.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

The research methodology adopted for this study is discussed and presented in this chapter. Research strategy shows how the researchers are going to carry out their study to achieve and answering research objectives (Saunders *et al.,* 2007). The main methods for collecting and generating research data are the questionnaire survey and interviews. This research is conducted as an exploratory study to benchmark the current state of construction safety practices in Pakistan and suggests measures to improve them. Schematic layout of the research methodology used in this research is given in Figure 3.1. After the preliminary study, detailed literature review is carried out and a number of already developed questionnaires are examined. One hundred and thirteen (113) safety practices which affect the safety performance in the CI are identified, from extensive review of literature (Nifraz Najumudeen, 2011; Choudhry *et al*., 2009; Sawacha *et al.*, 1999; Fang *et al.*, 2004; Farooqui *et al.,* 2008; Tam *et al.*, 2004; and Baig, 2001). These safety practices are then grouped into thirteen (13) safety factors basing on previous literature.

After the pilot study, the questionnaire is further reviewed and adjustments are made by reducing the safety practices to sixty (60), to make it suitable for the CI of Pakistan. A five-point likert scale, with 1 being very low and 5 being very high, is utilized to judge the current level of construction safety performance. The sample for this research is selected from population of construction enterprises in the industry. All the stakeholders of CI including clients, consultants and contractors/subcontractors are made part of this survey. The questionnaire is sent to the registered firms with the Pakistan Engineering Council (PEC). Out of 200 questionnaires sent out, 155 are received. Three incomplete questionnaires are excluded so final analysis is carried out basing on 152 questionnaires. Respondents to this survey include 39 clients, 26 consultants and 87 contractors/subcontractors.

The collected data is analyzed using MS excel and Statistical Package for the Social Sciences (SPSS-18). Two tests are applied to measure the internal consistency (reliability) of the questionnaire. The 1st test is Cronbach's Coefficient Alpha method and 2nd is Split-Half Method. The Shapiro-Wilk Normality Test is performed to check whether data is para-metric or non para-metric i.e. is it normally distributed or otherwise. Sampling error is calculated using descriptive statistics. Kruskal-Wallis test is performed to check the differences or similarities in the perception of all stakeholders about safety performance level. A 5% level of significance is considered to represent statistically significant relationships in the data. Performance level of current safety practices in CI of Pakistan is assessed using relative importance index (RII) method, and then under construction projects are benchmarked basing on their performance level.

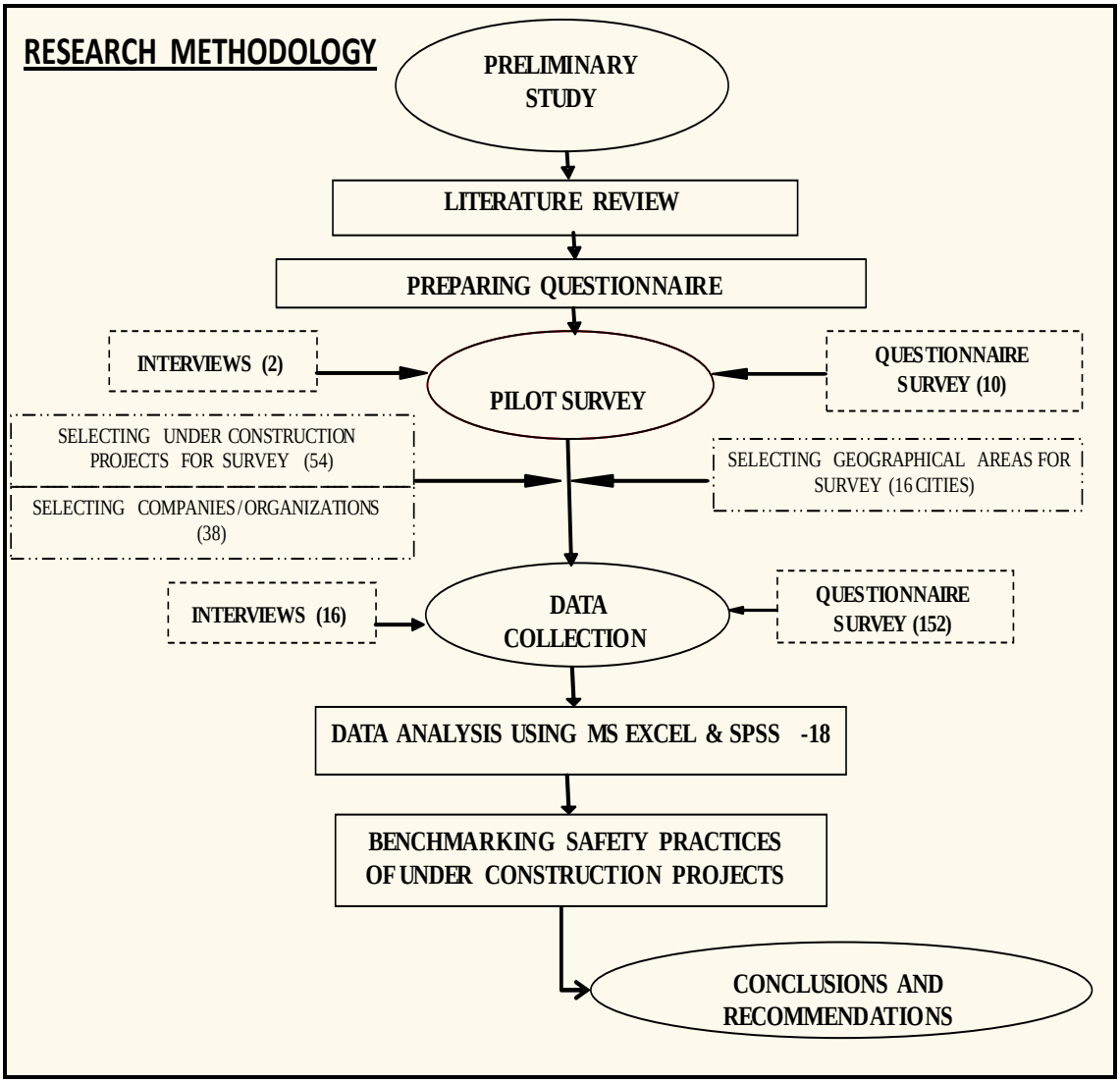


Figure 3.1: Research Methodology

3.2 Research Design

The research objectives have been established in the 1st chapter. The methods for achieving these objectives are discussed here in an appropriate manner. The research methods used in social sciences are experiments, surveys, analysis, case studies and histories. Moreover, method adopted for a particular research depends on the degree of research, type of the research operation (what, how, why), research focus, and control over variables (Yin J., 2006). While selecting an appropriate method for research, it is mandatory to consider the links between data collection and its analysis, as well as the main questions to be addressed, and the results. Therefore, when proceeding on a research, the research questions, the data analysis approach and the kind of data should be considered.

In this study, questionnaire survey is administered as it is the most appropriate method for this kind of study (Naoum, 2007). For the design of questionnaire, Nifraz Najumudeen′s questionnaire is referred which was used in 2011 to assess the safety practices in Sri Lankan CI. Instead of using "Yes/No" answers, a five point likert scale is used, to explore the complete range of possible replies between "Yes" and "No" (Fellow and Liu, 2003). The principal consideration for using likert scale is to determine the extent to which respondents agree or disagree with a particular statement or view (Cormack, 2000). The responses to each statement/question are then used to calculate RII ranging from 0 to 1. RII method has the limitation that it may capitalize on skewed data thus inflating the relative weight for a certain factor. In this research, the RII is renamed as safety performance index (SPI) and is used to rank the performance level of each safety practice in CI of Pakistan (Farooqui *et al.*, 2008).

Safety Performance Index = $\sum W / (A * N)$

$$SPI = [1 n_1 + 2 n_2 + 3 n_3 + 4 n_4 + 5 n_5] / [A * N]$$

where;

W : weighting given to each factor by the respondents ranging from 1 to 5

n_1 : number of respondents for very low performance of safety practice

n_2 : number of respondents for low performance of safety practice

n_3 : number of respondents for moderate performance of safety practice

n_4 : number of respondents for high performance of safety practice

n_5 : number of respondents for very high performance of safety practice

A: highest weight i.e. 5

N: sample size or number of samples i.e. 152

Other methods, such as interviews are chosen to complement and validate the survey questionnaire. Data is analyzed using MS excel and SPSS-18, to have frequency analysis, reliability analysis and SPI analysis. Kruskal-Wallis test is performed to check the differences in perception of all stakeholders about safety performance level. The selection of these statistical methods will be introduced in relevant chapters.

3.3 Survey Sample

3.3.1 Sample Selection

The purpose of statistics is to have summary measure about some characteristics of the population through sampling. For good results sampling should be a true representative of population. There are several ways of sampling depending on the attributes of the population. These are judgmental, random, and non-random samplings (Francis and Hoban, 2002). In judgmental sampling, sample selection takes place on the basis of researcher′s judgment, without using statistical sampling techniques. Judgmental sampling is prone to bias, so reason for using it should be clearly mentioned. Random sampling method is used when population structure has no significant variation. Random number table or software programmes are used for the selection of random samples with each of the members having equal chances of selection. Methods used in non random sampling are:

- Systematic Sampling
- Stratified Sampling
- Cluster Sampling

The sample for this research is selected from a population of construction enterprises in Pakistan. According to PEC statistical data, the number of building and civil engineering establishments registered with PEC until January 2012, reached 30000 but not all of them are executing construction projects. It is fairly a large population and the sample selection will represent various construction experts including clients, consultants and contractors with different categories and backgrounds. For this research, almost all under construction mega projects (21) in Rawalpindi/Islamabad are included in the survey, whereas 33 projects from other cities are also made part of this survey using random sampling technique. Obviously, surveying all the

organizations in the entire CI would yield the most representative results though hardly practicable due to amount of work and time involved.

The questionnaire was therefore distributed to 200 randomly selected potential respondents, working with 38 construction companies/organizations on 54 projects in 16 different cities of Pakistan. Main focus of the survey was on buildings, bridges, roads and runway projects so the questionnaires received back have following distribution according to the type of projects; buildings (90), roads (14), bridges (12), runways (11), hydro electric generation (5), dams (3), tunnels (2), hospitals (2), miscellaneous (11) and one each for canal and mobile tower.

Projects included in the survey have following distribution according to their location; Islamabad (12), Rawalpindi (8), Lahore (9), Karachi (6), AJK (6), Gujranwala (2), FATA (2), Gilgit (3), and one each at Fateh Jhang, Mansehra, Khushab, Sargodha, Bahawalpur and Dera Murad Jamali. Hence, this sample comprises of all type of projects and covers all major cities of Pakistan including FATA (Federally Administered Tribal Areas) and AJK (Azad Jammu and Kashmir).

Respondents are amply qualified and experienced. Around 55.3% (84) of the respondents have accumulated over 10 years of experience in CI, 28.9% (44) having 6-10 years construction experience, whereas only 15.8% (24) have less than 5 years of construction experience. Therefore the information provided by these professionals is quite reliable.

3.3.2 Sample Size

Factors which should be taken into account in determining an appropriate sample size are:

a. Sampling error
b. Population size
c. Confidence level

Equation (3-1) gives the formula which can be used to calculate the sample sizes (Dillman, 2000):

$$Ns = [(Np)(P)(1-P)] \; / \; [(Np-1)(B/C)^2 + (P)(1-P)] \qquad (3\text{-}1)$$

where;

Ns: sample size for the desired level of precision

Np: population size i.e. 30000

P: proportion of the population that is expected to choose one of the response categories (yes/no); $P = 0.5$

B: acceptable sampling error; (±10% or ±0.10)

C: Z statistic associated with the confidence level
(1.96 corresponds to 95% confidence level)

Acceptable sample sizes for various populations with different sampling errors for 95% confidence level are given in Table 3.1. These sample sizes can also be calculated using the formula given in equation (3-1).

Table 3.1: True Sample Size *(Dillman, 2000)*

Completed sample sizes needed for various population sizes and characteristics at three levels of precision.

	Sample size for the 95% confidence level					
	±10% Sampling Error		±5% Sampling Error		±3% Sampling Error	
Population Size	50/50 split	80/20 split	50/50 split	80/20 split	50/50 split	80/20 split
100	49	38	80	71	92	87
200	65	47	132	111	169	155
400	78	53	196	153	291	253
600	83	56	234	175	384	320
800	86	57	260	188	458	369
1,000	88	58	278	198	517	406
2,000	92	60	322	219	696	509
4,000	94	61	351	232	843	584
6,000	95	61	361	236	906	613
8,000	95	61	367	239	942	629
10,000	95	61	370	240	965	640
20,000	96	61	377	243	1,013	661
40,000	96	61	381	244	1,040	672
100,000	96	61	383	245	1,056	679
1,000,000	96	61	384	246	1,066	683
1,000,000,000	96	61	384	246	1,067	683

Sample size that represents the targeted population can also be determined by using equation (3-2) (Shash and Abdul-Hadi, 1993):

$$\mathbf{n = n' / (1 + n' / N)} \qquad (3\text{-}2)$$

where;

n: sample size from finite population

N: total population

n′: sample size from infinite population, which can be calculated as $n'=S^2/V^2$

S^2: standard error variance of population elements = P (1-P); maximum at P=0.5

V: standard error of sample population = 0.05 for confidence level 95%

There were 152 valid replies out of 200 showing an overall response rate of 76%. In the construction enterprises, a good response rate is around 30% (Black *et al.,* 2000). Therefore, the response rate in this research is acceptable. The sample size is 152 for this survey, however to know whether or not this sample size truly represents the population, Table 3.1 is used which exhibits sample sizes required for various population sizes and characteristics at three level of precision. These values can be verified using the formulae given in equations (3-1) and (3-2).

Until January 2012, more than 30000 building and civil engineering establishments have been registered with PEC. This number can be used as the population size. Confidence level is selected as 95%. It is also assumed that the answers will be homogeneous and will set the p value to 0.5 (means that probability of occurrence is 50%). Using a fifty-fifty split maximizes the question variance, which requires the largest possible sample to control for the differences among the response options. By applying these values in equations (3-1) and/or (3-2), the sample size comes out to be 96 for a sampling error of ±10%. Analysis of the collected data by SPSS, gave maximum sampling error as ±9.40% which is less than ±10% so any sample over 96 is quite acceptable for a sampling error of ±10%. Hence a sample comprising of 152 respondents is quite reliable for further analysis.

3.4 Design of Surveys

3.4.1 Review of Previous Studies

The significance of questionnaire design for an impelling survey has been highlighted by many researchers (Kim, 2010; Lingard *et al.*, 2010). Accordingly, a well designed questionnaire contains questions that respondents can tackle and answer without putting in much of the effort, which maintains their interest, and at the same time does not consume much of their time. Rate of response is influenced by numerous factors, such as the questionnaire's size and dimensions, type and color of paper used, cover pages, questions order, as well as the stamps and envelope used to mail the questionnaire (Memili *et al.*, 2011). Moreover, researchers are in favor of mixed-mode survey in order to obtain a better response rate. In this study, mixed mode survey was adopted, some respondents were interviewed and others were surveyed by mailed questionnaire. To achieve a high response rate combined survey method is highly recommended (Mbachu, 2008). Technological developments have also given rise to self-administering surveys such as web and electronic mails. Tailored Design Method formulated by Dillman (2000) helps to reduce survey error and to enhance response rates.

There are many ways to create sense of increased rewards, decrease social costs for being a survey respondent, and build the respondents′ trust (Dillman, 2000). Provision of rewards to respondents can be made by monetary or material incentives, ask for advice, make the questionnaire interesting, inform respondents that opportunities to respond are scarce, and offer a result summary.

3.4.2 Tailored Design Method

Tailored Design Method is adopted for survey in this thesis. Points which are taken care during the survey are:

Providing rewards

a. Use of complimentary phrases, such as "thank you for completing this questionnaire".
b. Respondents are given importance by exhibiting them that they are part of a carefully selected sample as per their experience and professionalism in the CI.
c. The significance of the study and its importance and relevance to the respondent's firm are also expressed in the covering letter of the questionnaire.

Reducing the cost for being a respondent

a. Questionnaire is having five point likert scale questions which require lesser time to answer as compare to open ended questions. Moreover it also reduces the mental effort of respondents while selecting the answer from a range of responses.
b. The structure of questionnaire is providing a vertical flow to the respondents while answering questions and all questions are grouped under various sections.
c. On the basis of availability of the addresses, questionnaires are also sent via mail/email to the respondents for getting their responses.

Establishing trust

a. The covering letter is printed on the letterhead with the logo of NUST.
b. The complete address, email and other contact information pertaining to the researcher are also provided on the covering letter.
c. Respondents are also assured that their confidentiality would be maintained and use of data would be restricted to the present study only.

According to Dillman (2000) , follow-up actions have tremendous effects on response rates. He also stated that without follow-up, the response rates would be much lesser, no matter how inspiring the mail package or interesting the questionnaire is. Researchers have to have a balance of the time and cost while implementing the follow-up (McGuinness, 2008). In present survey, two follow ups are conducted after two and four weeks of the first mailing. Specimen of the covering letter and questionnaire, used in this research for survey, are exhibited in Appendix-I and II respectively.

3.4.3 Reliability and Validity of Survey

The reliability and validity of a study determine that the research instrument fulfills its intended purpose. "*Reliability* refers to the consistency of a measure and to the probability of obtaining similar results if the measure is to be duplicated" (Oppenheim, 1992). Reliability can be measured in various ways however most commonly used method in researches is internal consistency. *"Validity* determines whether the score or question can measure what it is supposed to measure" (Oppenheim, 1992). To ascertain the reliability and validity of a questionnaire, researchers use numerous methods. As such, some will refer to the research instrument used in previous studies already been proven valid and reliable.

Same approach is adopted in this study. Prior to selecting the questionnaire, a comprehensive literature review is conducted and a questionnaire is drafted. Then a pilot survey along with the interviews of selected construction experts and academic researchers is carried out which resulted in few modifications in the questionnaire. It ultimately improved the reliability and validity of questionnaire. The data is analyzed using MS excel and SPSS-18 with the application of frequency analysis, reliability analysis, normality test and Kruskal-Wallis test for non parametric data to find out the significant difference between the opinion of client, consultant and contractors on any particular aspect of safety practices.

3.5 Statistical Terminologies

The statistical terminologies used in this research are adopted from Choudhry and Kamal (2008) and are explained below:-

3.5.1 Hypothesis Testing and Statistical Hypothesis

It is a very important phase of statistical inference and is a procedure which enables to decide on the basis of information obtained from sample data whether to accept or reject a statement/assumption about the value of a population parameter. Such a statement or assumption which may or may not be true is called statistical hypothesis. The hypothesis is accepted as being true, when it is supported by the sample data and is rejected when the sample data fails to support it.

3.5.2 Null Hypothesis and Alternative Hypothesis

Null hypothesis is the one which is to be tested for possible rejection under the assumption that it is true and is denoted by Ho. Any other hypothesis which is accepted when the null hypothesis is rejected, is known as alternative hypothesis.

3.5.3 Significance Level and Test of Significance

Significance level is the probability used as a standard for rejecting a null hypothesis Ho, when Ho is assumed to be true. Test of Significance is a rule or procedure by which sample results are used to decide whether to accept or reject null hypothesis.

3.6 Data Analysis Techniques

MS excel and SPSS-18 are used to analyze the data. The study follows usual level of significance i.e. $\alpha = 0.05$. Following statistical techniques are used for analysis.

3.6.1 Test for Normality

An evaluation of the data normality is a pre-condition for the use of numerous statistical tests. It is performed to know whether data is normally distributed or not, i.e. is the data parametric or non-parametric in nature. A more thorough test of normality suitable for data sets of about two thousands (2000) elements or less is presented by the Shapiro-Wilk test. To count as sufficiently normal, the Significance (Sig.) value should be non significant (i.e. it should be larger than 0.05). For the data set more than 2,000 values Kolmogorov-Smirnov test, also known as K-S Lilliefors, is more suitable. Hence in this study Shapiro-Wilk test is used to check the normality owing to the limitation of sample size.

3.6.2 Kruskal-Wallis Test and one way ANOVA

The Kruskal-Wallis test and one-way analysis-of-variance are used to determine whether three or more independent groups (client, consultant and contractor) are identical or diverse on some variable of interest. It is more appropriate for finding statistical evidence of *inconsistency* or differences in perception, using mean values or indices of the various groups. The Kruskal-Wallis test is used for non parametric data whereas one way ANOVA is used for parametric data. As the collected data did not pass the normality test so the Kruskal-Wallis test is used for further analysis. It is much less sensitive to outliers. The null hypothesis (Ho) for the test is that the means of variables are equal and is rejected if the result is significant. The results are tested against the hurdle of significance of 0.05. If significance value is more than 0.05 then it means that all the stakeholders have similar perception about the issue and vice versa.

3.7 Summary

This research study uses multiple or mixed research methods. Questionnaire survey is adopted as the main research instrument. In this chapter, the research method, design, sampling techniques and design of the survey are discussed. Above discourse provides a clear understanding of the research methodology used.

Chapter 4

DATA ANALYSIS AND RESULTS

4.1 Introduction

Safety performance of CI of Pakistan is not satisfactory. In both public and private sector, all stakeholders including clients, consultants and contractors do not give any priority to the safety and their emphasis is only on improving quality and reducing cost and time. Although Government has formulated labour laws but they are not enforced. Workers' rights are not respected by the clients and contractors. Moreover, workers are themselves not aware of their rights to work only under safe environment. Similarly there is no regulatory authority like OSHA which can implement safety rules and regulations on construction projects.

However, large construction companies registered with PEC in category C-A and working on mega projects like high rise buildings and underground projects, have started investing in safety but they are neither encouraged nor provided with any safety budget by the client. Contractors are bound by contract to provide safe work environment whereas clients consider themselves free from this responsibility. Even on one of the tallest under construction building project in Islamabad, independent safety manager is not appointed. The safety manager is primarily looking after the mechanical works whereas QHSE (quality, health, safety and environment) is his secondary responsibility.

Data collected through questionnaire based survey and interviews is analyzed using MS excel and SPSS-18. Results of the survey are discussed in the subsequent paragraphs.

4.2 Characteristics of Respondents-Frequencies and Percentages

4.2.1 Grouping of the Respondents

There are 152 valid responses out of 200, showing a response rate of 76%. Response by clients is 25.7 %, consultants 17.1% and contractors 57.2 %. Grouping and frequencies (percentages) of respondents are shown in Table 4.1 and Figure 4.1:

Table 4.1: Grouping of Respondents

Respondents	No of Questionnaires Returned	Percentage	Cumulative Percentage
Clients	39	25.7	25.7
Consultants	26	17.1	42.9
Contractors/Subcontractors	87	57.2	100
Total	152	100	-

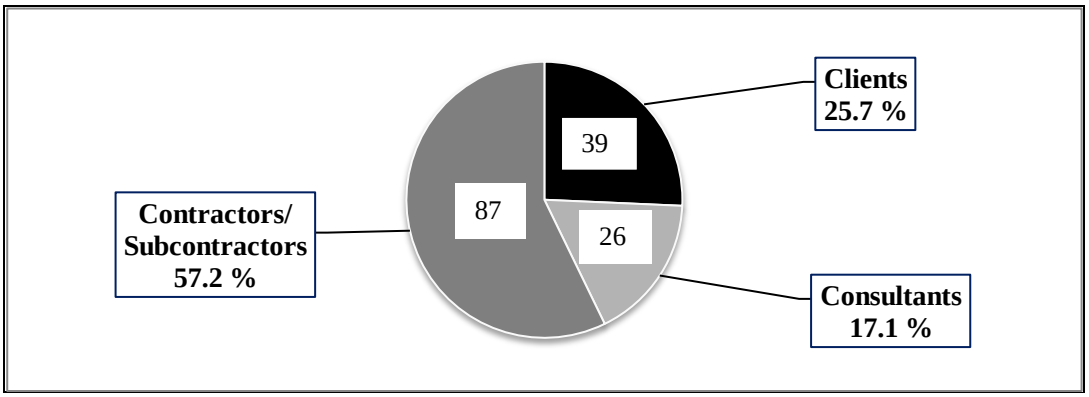


Figure 4.1: Grouping of the Respondents

4.2.2 Experience of the Stakeholders in the Construction Industry

Respondents are having varied experience in the CI as shown in Table 4.2 and Figure 4.2. Approximately 55.3% (84) of the respondents have accumulated over 10 years of construction experience, 28.9% (44) have 6 to 10 years of construction experience, whereas only 15.8% (24) have less than 5 years of construction experience. Therefore, the information provided by these professionals can be considered authentic and reliable.

Table 4.2: Experience of Respondents in Construction Industry

Experience of Respondents	Frequency of Respondents	Percentage of Respondents	Cumulative Percentage
0-5 years	24	15.8	15.8
6-10 years	44	28.9	44.7
11-15 years	58	38.2	82.9
16-20 years	15	9.9	92.8
20+ years	11	7.2	100.0
Total	152	100.0	-

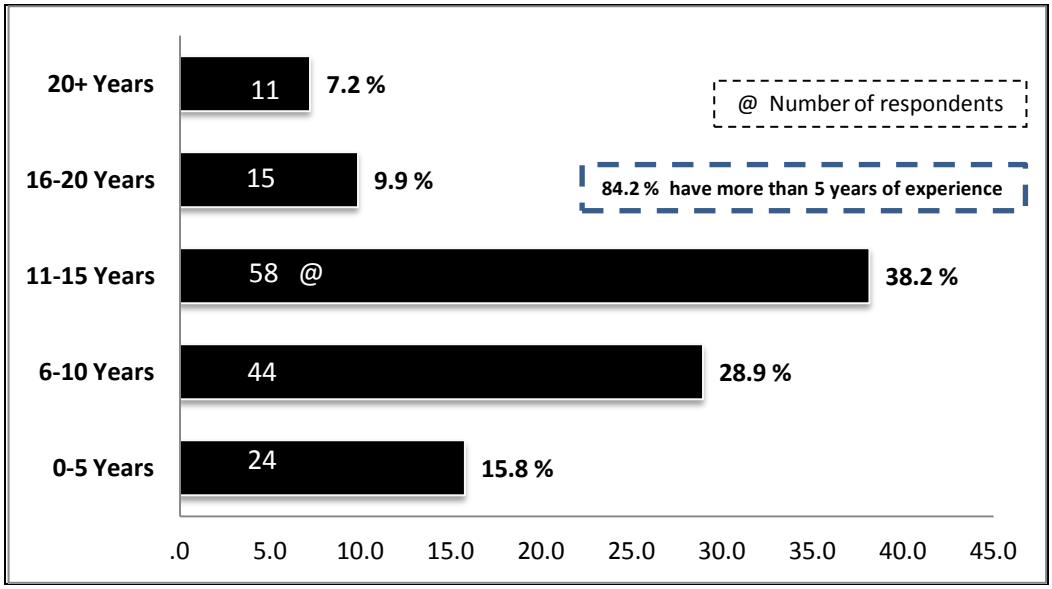


Figure 4.2: Percentage of Respondents basing on Industry Experience

4.2.3 Positions of the Respondents in the Construction Industry

Respondents to this survey belong to different levels in the CI. Table 4.3 and Figure 4.3 show the percentages of different positions holders who responded to this survey. Approximately 39.5% (60) of the respondents are managers at different levels, 27.6 % (42) field engineers, 12.5 % (19) supervisors/foremen, 11.2 % (17) workers and 4.6 % (7) each are performing the duties as safety officers and safety inspectors.

Table 4.3: Positions of the Respondents in Construction Industry

Positions of the Respondents	Frequency of Respondents	Percentage of Respondents	Cumulative Percentage
• Managers	60	39.5	39.5
• Field Engineers	42	27.6	67.1
• Safety Inspectors	7	4.6	71.7
• Workers	17	11.2	82.9
• Supervisor/Foreman	19	12.5	95.4
• Safety Officers	7	4.6	100.0
Total	152	100	-

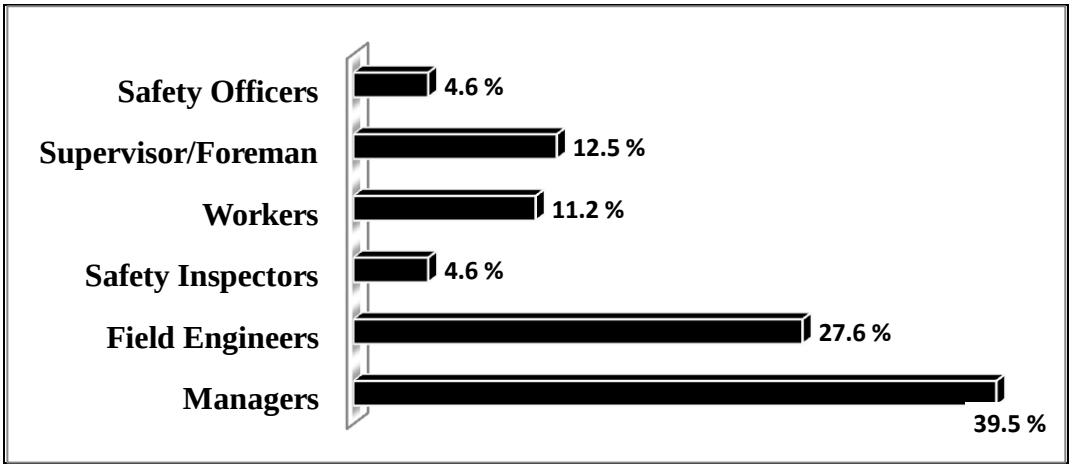


Figure 4.3: Percentage of the Respondents basing on their Position

4.2.4 PEC Category of the Respondents′ Companies

Respondents to this study are working in different construction companies on various projects. Distribution of the respondents basing on their PEC category is given in Table 4.4a. 53.31% (81) of the respondents are working with companies which are registered with PEC in C-A category, 14.47% (22) in C-B, 9.2% (14) in C-1, 7.9% (12) in C-2, 9.2% (14) in C-3, 2.63% (4) in C-4 and 3.29% (5) in C-5 category. Similarly distribution of construction companies basing on PEC categories is given in Table 4.4b which indicates that 11 companies are in C-A category whereas no company from C-6 category is included in the survey.

Table 4.4a: Frequency of Respondents basing on PEC Categories

PEC Category	Financial Limit of Each Category	Respondents Frequency	Respondents Percentage	Cumulative Percentage
C-A	No financial limit	81	53.31	53.31
C-B	2000 Million	22	14.47	67.78
C-1	1000 Million	14	9.2	76.98
C-2	500 Million	12	7.9	84.88
C-3	250 Million	14	9.2	94.08
C-4	100 Million	4	2.63	96.71
C-5	30 Million	5	3.29	100.0
C-6	15 Million	-	0	100.0
Total	-	152	100.0	-

Table 4.4b:Number of PEC Registered Construction Companies Included in Survey

PEC Categories	C-A	C-B	C-1	C-2	C-3	C-4	C-5	C-6	Total
No of Companies	11	5	4	3	3	2	2	-	30

4.2.5 Sectors of the Respondents

Respondents belong to both public and private sectors. 52% of the respondents are from public sector, whereas 48% are from private sector, as shown in Table 4.5.

Table 4.5: Frequency of Respondents basing on Type of Sectors

Type of Sectors	Respondents Frequency	Respondents Percentage	Cumulative Percentage
Public	79	52.0	52.0
Private	73	48.0	100.0

4.2.6 Location of the Respondents in Pakistan

Respondents to this survey are working on various projects (54) in 16 different cities of Pakistan. All the projects located in Rawalpindi, Islamabad, Fateh Jhang, Muzaffarabad, and few at Gujranwala and Lahore are visited personally whereas respondents from FATA (Federally Administered Tribal Areas), Gilgit, Mansehra, AJK (Bagh and Rawlakot), Sargodha, Khushab, Bahawalpur, Dera Murad Jamali and Karachi are contacted through mail/email for their response. Table 4.6 shows the location and number of projects alongwith the frequencies of respondents. Approximately 33.55% of the respondents are based in Islamabad, 23.68% Rawalpindi, 15.13% Lahore and 6.57% Karachi. Hence, this sample truly represents the CI of Pakistan.

Table 4.6: Location of Projects Included in the Survey

Location of Projects in Pakistan	Number of Projects	Frequency of Respondents
• Fateh Jhang	1	9
• Islamabad	12	51
• Rawalpindi	8	36
• Gujranwala	2	2
• Lahore	9	23
• Muzaffarabad AJK	3	5
• Bagh AJK	2	2
• Rawlakot AJK	1	1
• Bahawalpur	1	1
• Dera Murad Jamali	1	1
• Gilgit	3	3
• Karachi	6	10
• Khushab	1	1
• Mansehra	1	2
• Sargodha	1	1
• FATA (Tank / WANA)	2	4
Total	54	152

4.2.7 Type of Projects Included in the Survey

Projects included in the survey have following distribution; high rise buildings (9), residential buildings (5), non residential buildings (11), educational buildings (6), roads (8), bridges/flyover (4), dams (2), hospitals (2), tunnels (2), runways (2), hydro electric power project (1), mobile tower (1) and canal (1). More emphasis have been given to get the response from projects like high rise buildings and bridges/flyovers as higher degree of safety standards is needed on such projects. Hence, the sample size is a true representative of all type of construction projects. Table 4.7 explains the type of projects, frequencies and percentages of the respondents belonging to each type of project.

Table 4.7: Type of Projects Included in the Survey

Type of Projects	Number of Projects	Frequency of Respondents	Percentage of Respondents
• Bridges/Flyovers	4	12	7.9
• Buildings ▪ High rise ▪ Residential ▪ Non residential ▪ Educational	31 *(9)* *(5)* *(11)* *(6)*	90	59.2
• Canal	1	1	0.7
• Dams	2	3	2.0
• Hospitals	2	2	1.3
• Hydro Electric Project	1	5	3.3
• Mobile Tower	1	1	0.7
• Roads	8	14	9.2
• Runways	2	11	7.2
• Tunnels	2	2	1.3
• General questionnaires	-	11	7.2
Total	**54**	**152**	100.0

4.2.8 Type of Construction Companies/Organizations Included in the Survey

The construction companies who responded to this survey are all registered with PEC in different categories. The survey comprises of the responses from 30 construction companies (28 local and 2 foreign) and 8 departments/organizations. List of the companies/organizations included in the survey is given in Table 4.8.

Table 4.8: Name of Companies/Organizations Included in the Survey

Type of Companies/Organizations	No of Respondents	Type of Companies/Organizations	No of Respondents
Pakistani Companies (28)			
• DESCON	8	• FWO	15
• Al-Ghurair Giga DHA	11	• Guarantee Engineers	10
• Pak Gulf Const Ltd	9	• Moin Sons Pvt Ltd	7
• Echo West Intl Pvt Ltd	1	• Izhar Gp of Companies	8
• Tricon Developers Lahore	2	• AREAA Construction	1
• Bashir & Sons AJK	2	• Turcon Const Coy Bagh	1
• Builfast Countrywide	1	• Habib Const Svcs	4
• United Engineers Company	1	• Tameer Associates	1
• UN Office Shelter Project Sind	1	• Creek View and Terrace Karachi	1
• Paragon Constructors	1	• MCE Engineering Svcs	1
• Creek Developers Private Limited Karachi	1	• Principal Builders & Contractors Karachi	1
• Bahria Town Rawalpindi	1	• DBH JV @	10
• ATCON-Lahore	1	• Ericsson	1
• EA Consulting Pvt Ltd	4	• Miscellaneous companies	12
Foreign Companies (2)			
• China State Construction Engineering Corporation (CSCEC)	2	• China Machinery and Energy Company (CMEC)	2
Departments/Organizations (8)			
• NHA	5	• WAPDA	1
• NESPAK	2	• C&W Punjab	1
• CIWCE Lahore *	1	• Civil Aviation Authority	1
• MES	18	• PEC	1

* CIWCE: Center for Improvement of Working Conditions and Environment, Punjab
@ DBH JV: DHA, Bahria & Habib Rafiq Limited Joint Venture
Intl: International
Const: Construction
Svcs: Services
MES: Military Engineering Services

4.2.9 Name of Projects Included in the Survey

Respondents to this survey are working on 54 construction projects in 16 different cities of Pakistan. Name of projects included in survey are enlisted in Table 4.9.

Table 4.9: Name of Projects Included in the Survey

Name of Projects	Name of Projects
• Neelum Jhelum Hydro Electric Power Project AJK	• New International Airport Islamabad
• APS Kachehry Rawalpindi	• Chandni Chowk Flyover
• FFC Tower Rawalpindi	• Lignum Tower DHA-II Islamabad
• Gold Crest Tower DHA-II	• World Trade Centre DHA-II
• Attock Oil Office Bldg Morgah	• Centaurus Islamabad
• DHA Valley Islamabad	• NFRD School & College Rawat
• NHA Bridge in Muzaffarabad	• Retaining Wall Muzaffarabad
• State Life Building Islamabad	• Const of NUST HQ Building
• MOQs Dhamial Rawalpindi	• Flats near MCS Rawalpindi
• Emigration Tower Islamabad	• Widening of Kashmir Highway
• Defence Villas Islamabad	• Defence Complex Islamabad
• Tricon Corporate Centre Lahore	• Flats behind Army Medical College Rawalpindi
• Fly Over Gujranwala City	• Sialkot-Gujranwala Road
• Forensic Science Lab Lahore	• Bab-e-Pakistan Lahore
• University of Lahore Campus	• Askari-X, Housing Lahore
• City Development Project Rawalakot AJK	• Reconstruction of District HQ Bagh AJK
• Air Craft Taxi Track Sargodha	• Degree College Bagh AJK
• Technical Block Khushab	• Jhimpir Wind Power Project-Sind
• Bahria Institute Karachi	• UN Shelter Project Sind, Pakistan
• Gomal Zam Dam	• Tank WANA Road FATA
• Const of MOQs Malir Cantt	• Extension of Officers Mess Gilgit
• Jaglot-Chilas Road	• Gilgit-Jaglot Road
• Construction of BTS Ericsson	• Kachi Canal Dera Murad Jamali
• Karachi Port Trust	• DHA-VIII Karachi
• DHA Lahore Roads	• Const of Sheds MES Lahore
• Marala Hydropower Project Punjab	• Construction of Laboratory in APS Bahawalpur
• King Abdullah Teaching Hospital Mansehra	• Lahore Road Rehabilitation Project (LRRP)
Total = 54	

4.3 Statistical Analysis

4.3.1 Reliability of the Sample

4.3.1.1 Cronbach's Coefficient Alpha Method

Cronbach's Coefficient Alpha method is the most common measure of internal consistency (reliability). It is most commonly used to check the reliability of scale when questions are asked on likert scale. If Cronbach's Coefficient Alpha value is higher than 0.7, this means that the data is acceptable for analysis whereas if its value is higher than 0.9, this means that the data is excellent for further analysis (Li, 2007). For the collected data, its value is calculated as 0.968 using SPSS, as given in Table 4.10. Its higher value indicates that the data is consistent and reliable for further analysis.

Table 4.10: Reliability Statistics

<table>
<tr><th colspan="4">Case Processing Summary</th><td rowspan="2">Cronbach's Alpha</td><td rowspan="2">0.968</td></tr>
<tr><td colspan="2"></td><td>N</td><td>%</td></tr>
<tr><td rowspan="3">Cases</td><td>Valid</td><td>152</td><td>100.0</td><td rowspan="3">Number of Items</td><td rowspan="3">60</td></tr>
<tr><td>Excluded[a]</td><td>0</td><td>.0</td></tr>
<tr><td>Total</td><td>152</td><td>100.0</td></tr>
<tr><td colspan="4">a. Listwise deletion based on all variables in the procedure.</td></tr>
</table>

4.3.1.2 Split-Half Method

It also checks the reliability of data while splitting it in two equal parts of 30 items each. For 1st part Cronbach's Alpha value is 0.945 and for the 2nd part its value is 0.943. Higher value of Split-Half coefficient alpha (closer to 1) indicates that the data is quite reliable for further analysis.

Table 4.11: Reliability Statistics

<table>
<tr><td rowspan="5">Cronbach's Alpha</td><td rowspan="2">Part 1</td><td>Value</td><td>0.945</td></tr>
<tr><td>No of Items</td><td>30[a]</td></tr>
<tr><td rowspan="2">Part 2</td><td>Value</td><td>0.943</td></tr>
<tr><td>No of Items</td><td>30[b]</td></tr>
<tr><td colspan="2">Total No of Items</td><td>60</td></tr>
<tr><td colspan="4">a. The items are: SP01, SP02, SP03, SP04, SP05, SP06, SP07, SP08, SP09, SP10, SP11, SP12, SP13, SP14, SP15, SP16, SP17, SP18, SP19, SP20, SP21, SP22, SP23, SP24, SP25, SP26, SP27, SP28, SP29, SP30.</td></tr>
<tr><td colspan="4">b. The items are: SP31, SP32, SP33, SP34, SP35, SP36, SP37, SP38, SP39, SP40, SP41, SP42, SP43, SP44, SP45, SP46, SP47, SP48, SP49, SP50, SP51, SP52, SP53, SP54, SP55, SP56, SP57, SP58, SP59, SP60.</td></tr>
<tr><td colspan="4">SP: safety practice</td></tr>
</table>

4.3.2 Normality Test

To check the normality of the collected data, 'Shapiro Wilk normality test' is conducted because sample size is less than 2000. It is performed to know whether the data is normally distributed or not, i.e. is the data parametric or non-parametric in nature. Significance values found are 0.000 which are less than 0.05. (significance value should be larger than 0.05 for the data to be sufficiently normal). Therefore, data is not normally distributed and non parametric tests are required for further analysis. Table 4.12 shows the data regarding test of normality by Shapiro Wilk test.

Table 4.12: Tests of Normality- Shapiro Wilk Test

Safety Practices	Shapiro-Wilk Test		Safety Practices	Shapiro-Wilk Test	
	Statistic	Sig.		Statistic	Sig.
SP01	0.897	.000	SP31	0.894	.000
SP02	0.868	.000	SP32	0.897	.000
SP03	0.896	.000	SP33	0.884	.000
SP04	0.900	.000	SP34	0.889	.000
SP05	0.881	.000	SP35	0.900	.000
SP06	0.877	.000	SP36	0.905	.000
SP07	0.896	.000	SP37	0.903	.000
SP08	0.884	.000	SP38	0.900	.000
SP09	0.896	.000	SP39	0.909	.000
SP10	0.870	.000	SP40	0.905	.000
SP11	0.872	.000	SP41	0.909	.000
SP12	0.891	.000	SP42	0.914	.000
SP13	0.907	.000	SP43	0.869	.000
SP14	0.879	.000	SP44	0.874	.000
SP15	0.888	.000	SP45	0.908	.000
SP16	0.910	.000	SP46	0.823	.000
SP17	0.906	.000	SP47	0.872	.000
SP18	0.897	.000	SP48	0.884	.000
SP19	0.874	.000	SP49	0.892	.000
SP20	0.913	.000	SP50	0.888	.000
SP21	0.909	.000	SP51	0.892	.000
SP22	0.908	.000	SP52	0.875	.000
SP23	0.883	.000	SP53	0.873	.000
SP24	0.908	.000	SP54	0.885	.000
SP25	0.903	.000	SP55	0.877	.000
SP26	0.887	.000	SP56	0.881	.000
SP27	0.874	.000	SP57	0.868	.000
SP28	0.875	.000	SP58	0.852	.000
SP29	0.885	.000	SP59	0.811	.000
SP30	0.904	.000	SP60	0.800	.000

Sig: significance value

4.3.3 Kruskal Wallis Test for all Safety Factors

As the collected data is non para-metric so Kruskal Wallis test is performed to check whether all stakeholders including clients, consultants and contractors/subcontractors, have similar perception regarding the performance level of all safety factors or otherwise. Table 4.13 explains that all stakeholders have similar perception about performance level (ranking) of all safety factors except '*Management's Commitment to safety*', '*Safety Rules/Procedure & Policies*' and '*Safety Training*'. Significance value of these three safety factors is less than 0.05, which means that stakeholders have given different ranking to these safety factors. So these three safety factors are further analyzed by finding significance value of each safety practice by Kruskal Wallis test.

Table 4.13: Kruskal Wallis Test[a,b] for all Safety Factors

S. No	Safety Factors	Significance
1	Management's Commitment to safety	**0.033**
2	Worker's Involvement	0.057
3	Safety in the Contract Documents	0.218
4	Safety Rules/Procedure & Policies	**0.013**
5	Accident Reporting & Investigation	0.123
6	Safety Training	**0.023**
7	Safety Meetings	0.091
8	Incentives/Disincentives for Workers	0.081
9	Use of PPE (Personnel Protective Equipment)	0.060
10	Housekeeping, Storage & Sensation	0.260
11	Quality of Scaffolding and Ladders	0.542
12	Precautions during Excavation & Shoring	0.795
13	Hoists & Cranes Operation	0.673

a. Kruskal Wallis Test
b. Grouping Variable: Stakeholders (Client, Consultant and Contractor)

4.3.3.1 Kruskal Wallis Test for Management's Commitment to Safety

All the stakeholders have different perception about the performance level of 'management's commitment to safety'. Nine safety practices related to this factor are analyzed through Kruskal Wallis test. Table 4.14 indicates that stakeholders differ in their perception about following two safety practices only:

- Top priority of higher management is the safety and not the productivity.
- There is no work pressure on workers and safety is given priority over time.

Table 4.14: Kruskal Wallis Test[a,b] for Management's Commitment to Safety

S. No	Safety Practices	Significance
01	Top priority of higher management is the safety and not the productivity.	**0.012**
02	There is no work pressure on workers and Safety is given priority over time.	**0.012**
03	Regular safety inspections conducted by Higher Management/Safety official.	0.115
04	Management motivates to work safely.	0.168
05	Company really cares about the health and safety of the people who work here.	0.322
06	Field Engineer, Supervisor & Safety Officer encourage reporting of hazards.	0.416
07	Management acts quickly to correct safety problems.	0.289
08	Good communication is established between management and workers.	0.427
09	Sufficient manpower and equipment are always made available by management, to do the job safely.	0.222
a. Kruskal Wallis Test b. Grouping Variable: Stakeholders (Client, Consultant and Contractor)		

In Table 4.15, SPIs of these two safety practices for all stakeholders are calculated separately. Results show that difference in opinion of stakeholders is due to less importance given to performance level of these safety practices by consultants whereas clients and contractors have almost similar perception.

Table 4.15: SPI of Stakeholders for Management's Commitment to Safety

S. No	Safety Practices	Stakeholders		
		Client	Contractor	Consultant
		SPI	SPI	SPI
01	Top priority of higher management is the safety and not the productivity.	0.5692	0.5862	**0.4615**
02	There is no work pressure on workers and safety is given priority over time.	0.5385	0.5494	**0.4231**

4.3.3.2 Kruskal Wallis Test for Safety Rules/Procedure & Policies

Stakeholders have different perception about the performance level of 'safety rules and procedures'. Six safety practices related to this factor are analyzed through Kruskal Wallis test. Results of the test are given in Table 4.16 which shows that stakeholders differ in their perception on following three safety practices:

- Safety audits are conducted regularly.

- Workers are medically examined regularly.
- Insurance coverage provided to workers.

Table 4.16: Kruskal Wallis Test[a,b] for Safety Rules/Procedure & Policies

S. No	Safety Practices	Significance
16	Company has developed its safety policy in the light of OSHA.	0.641
17	Site emergency plan is prepared and job hazard analysis is done for each task.	0.146
18	Safety audits are conducted regularly.	**0.030**
19	First aid facility is made available on site.	0.876
20	Workers are medically examined regularly.	**0.042**
21	Insurance coverage provided to workers.	**0.002**

a. Kruskal Wallis Test
b. Grouping Variable: Stakeholders (Client, Consultant and Contractor)

In Table 4.17, SPIs of these three safety practices for all stakeholders are calculated separately. Results show that difference in opinion of stakeholders is due to less importance given to performance level of these safety practices by consultants whereas clients and contractors have almost similar perception.

Table 4.17: SPI of Stakeholders for Safety Rules/Procedures

S. No	Safety Practices	Stakeholders		
		Client	Contractor	Consultant
		SPI	SPI	SPI
18	Safety audits are conducted regularly.	0.5385	0.5425	**0.4154**
20	Workers medically examined regularly.	0.6051	0.5885	**0.4692**
21	Insurance coverage provided to workers.	0.5641	0.5908	**0.4154**

4.3.3.3 Kruskal Wallis Test for Safety Training

As the stakeholders have different perception about the performance level of 'safety training' thus six safety practices related to the factor of safety training are analyzed through Kruskal Wallis test. Results of the test are given in Table 4.18 which reveals that stakeholders differ in their perception on following two safety practices:

- Refresher safety training sessions are periodically conducted for all workers.
- An organizational chart is displayed on site showing names, positions & responsibilities for safety compliance.

Table 4.18: Kruskal Wallis Test[a,b] for Safety Training

S. No	Safety Practices	Significance
26	Training for new workers is compulsory.	0.16
27	Refresher safety training sessions are periodically conducted for all workers.	**0.003**
28	Health and safety training is provided to the employees of subcontractors also.	0.564
29	Adequate job-specific safety training is given to workers before start of a job.	0.066
30	An organizational chart is displayed on site showing names, positions & responsibilities for safety compliance.	**0.020**
31	Safety posters and sign boards are used at important places for worker's awareness, in English and Urdu language.	0.505
a. Kruskal Wallis Test b. Grouping Variable: Stakeholders (Client, Consultant and Contractor)		

In Table 4.19, SPIs of these two safety practices for all stakeholders are calculated separately. Results reveal that consultants have given very low performance level to the safety practice of 'refresher safety training to the workers' as compared to clients and contractors. Similarly contractors have given higher performance level to the safety practice of 'organizational chart displaying safety responsibilities' than clients and consultants.

Table 4.19: SPI of Stakeholders for Safety Training

S. No	Safety Practices	Stakeholders		
		Client	Contractor	Consultant
		SPI	SPI	SPI
27	Refresher safety training sessions are periodically conducted for all workers.	0.4462	0.5057	**0.3385**
30	An organizational chart is displayed on site showing names, positions & responsibilities for safety compliance.	0.4872	**0.5655**	0.4385

4.4 Safety Practices

4.4.1 Allocation of Budget for Safety Compliance

Respondents are asked that how much budget is allocated for safety on their construction sites. Out of 152 respondents, 61.8 % (94) respondents agreed that no budget has been allocated for safety which is quite alarming for Pakistani CI. 32.2 %

(49) respondents said that safety budget on their projects is less than 1% and that too is only for providing personnel protective equipment (PPE) for the workers. 4.6 % of respondents had 1-2 % amount allocated for safety whereas 1.3 % respondents agreed that 2-4 % budget is earmarked for safety on their sites. It is important to highlight that no company has a safety budget above 4 % and most of the companies do not have safety policy. Figure 4.4 describes the allocation of safety budget in CI of Pakistan.

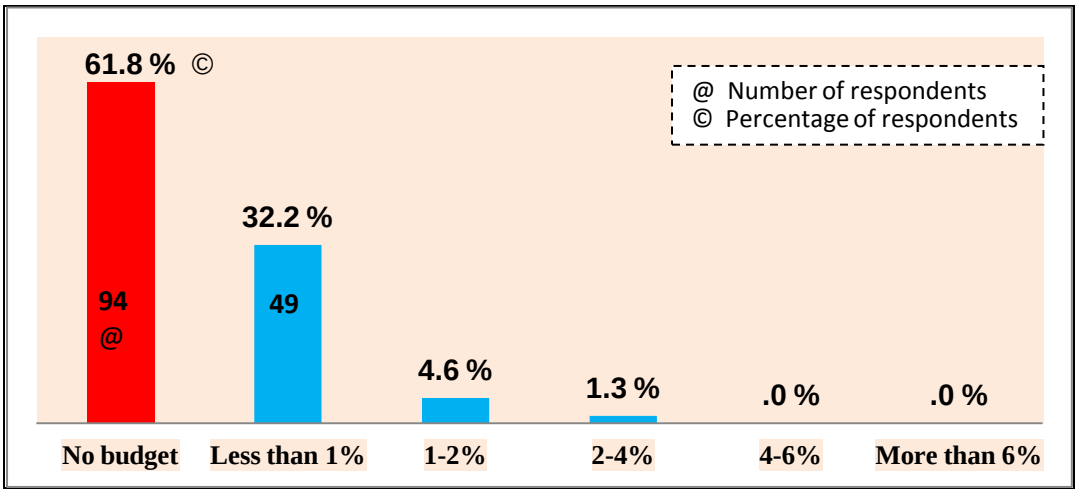


Figure 4.4: Allocation of Safety Budget in CI of Pakistan

4.4.2 Frequency of Tool Box Meetings on Project Sites

Figure 4.5 shows the frequencies of tool box meetings on construction sites. This is one of the most neglected aspects in CI of Pakistan. Ideally it may be held on weekly basis. 46.1% (70) respondents said that tool box meetings are never held on their projects, 33.6% (51) responded that tool box meetings are organized once in 15 days, 14.5% (22) said that it is held on weekly basis, 4.6% (7) respondents have it twice a week whereas 1.3% (2) have it on daily basis.

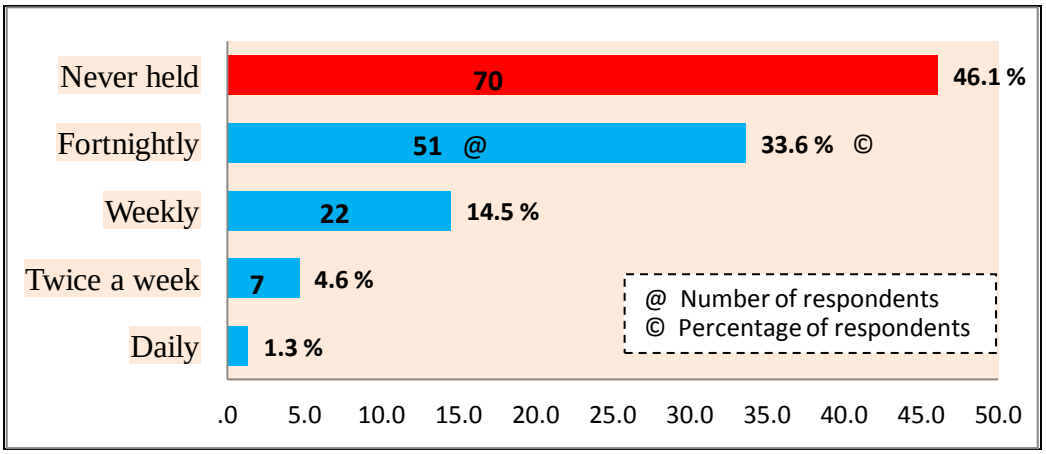


Figure 4.5: Frequency of Tool Box Meetings

4.4.3 Post Accident Safety Response Mechanism

Respondents are asked about post accident response mechanism usually followed on their work sites. Only 11.8 % (18) respondents said that immediate organization level action is taken on their projects whereas 34.2% (52) respondents agreed that only the accident is reported/recorded and no further safety measures are taken to reduce the probability of occurrence of any accident. It clearly indicates the least interest expressed by the management for the safety of their workers. Figure 4.6 elucidates various types of post accident response mechanisms.

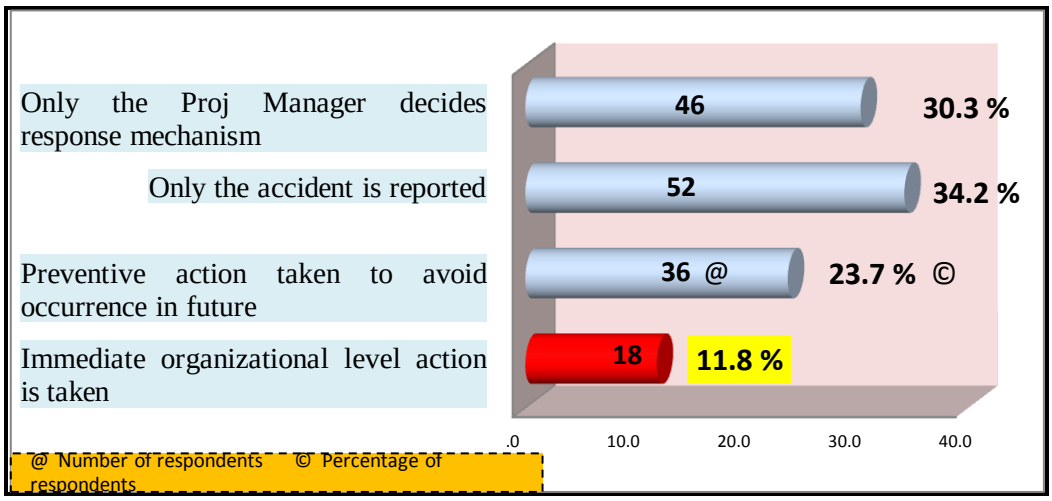


Figure 4.6: Post Accident Safety Response Mechanisms

4.4.4 Responsibility for Safety of Employees

Respondents are asked that who is responsible for safety of employees on their work sites. Ideally, project directors should be responsible for ensuring safety and safety staff should be there on work site to advise and assist on this important issue. Results of the survey are explained in Figure 4.7. 31.8% respondents agreed that employees are themselves responsible for their safety, 27.8% responded that safety officer is responsible to ensure safety of employees whereas only 16.2% agreed that project directors are responsible for ensuring safety. This situation can only be improved if higher management takes interest. In Pakistani CI, there exists no legislative body to regulate safety. When any accident happens on construction site, no one is blamed; only the victim and his belongings suffer. There is a need to develop a regulatory body to administer occupational safety and health issues in CI of Pakistan.

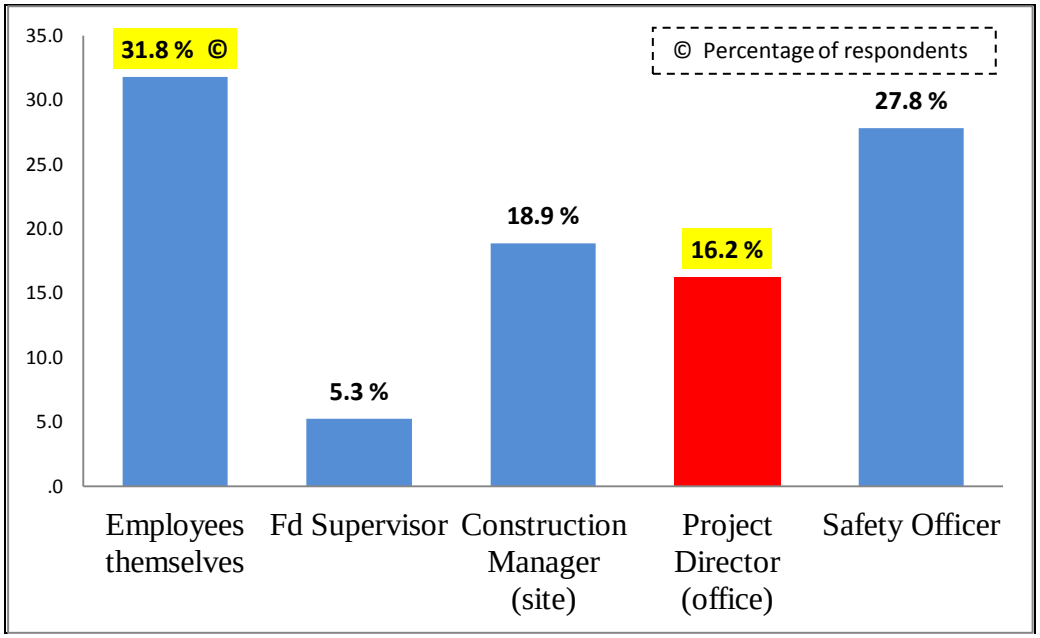


Figure 4.7: Responsibility for Safety of Employees

4.5 Ranking of Safety Factors by Mean and SPI

The questionnaire comprises of 60 statements/questions to assess the performance level of current safety practices. These safety practices are further grouped in 13 safety factors. The data collected through 152 respondents is analyzed using MS excel and SPSS-18. Means, percentages, safety performance indices (SPIs) and ranking of 13 safety factors is calculated which is given in Table 4.20. Mean value of safety practices in CI of Pakistan is assessed to be 3.069 which should ideally be closer to 5. Similarly Safety Performance Index (SPI) of the Pakistani CI is calculated as 0.6138. Out of 13 safety factors, the factor of *'Hoists and Cranes Operation'* has the highest value of SPI (0.7816) whereas *'Safety Training'* has the lowest value of SPI (0.5230). It implies that *'Safety Training'* is the most neglected aspect in Pakistani CI, followed by *'Safety in the Contract Documents'*, *'Safety Meetings'* and *'Worker's Involvement'*. On the other hand the factor of *'Hoists and Cranes Operation'* has better performance level, followed by *'Precautions during Excavation and Shoring'*.

Table 4.20: Mean, Percentage, SPIs and Ranking of Safety Factors

S. No	Safety Factors (13)	Mean of Safety Factors	Percentage (%) of Safety Factors	SPIs of Safety Factors	Overall Ranking of Safety Factors
1	Management's Commitment to Safety	3.1265	62.5292	0.6253	7
2	Workers' Involvement	2.6760	53.5196	0.5352	**10**
3	Safety in the Contract Documents	2.6184	52.3684	0.5237	**12**
4	Safety Rules/Procedures and Policies	2.8991	57.9824	0.5798	8
5	Accident Reporting and Investigation Mechanism	3.1842	63.6840	0.6368	5
6	Safety Training	2.6151	52.3020	0.5230	**13**
7	Safety Meetings	2.6272	52.5438	0.5254	**11**
8	Incentives/Disincentives for Workers	2.7993	55.9860	0.5598	9
9	Use of Personnel Protective Equipment (PPE)	3.1371	62.7412	0.6274	6
10	Housekeeping, Storage and Sanitation	3.4151	68.3026	0.6830	3
11	Quality of Scaffolding and Ladders	3.2467	64.9340	0.6493	4
12	Precautions during Excavation and Shoring	3.4901	69.8026	0.6980	2
13	Hoists and Cranes Operation	3.9080	78.1596	0.7816	1
Average of CI of Pakistan		3.0690	61.3794	**0.6138**	-

Note: Ranking score is based on the level of performance of each safety factor.

Figure 4.8 shows the ranking of all 13 safety factors basing on SPIs. Average value of SPI of CI of Pakistan is highlighted in light brown colour. Green colour highlights the better performance of *'Hoists and Cranes Operation'* and *'Precautions during Excavation and Shoring'* whereas the four most neglected safety factors of *'Safety Training', 'Safety in the Contract Documents', 'Safety Meetings'* and *'Worker's Involvement'* are highlighted in red colour.

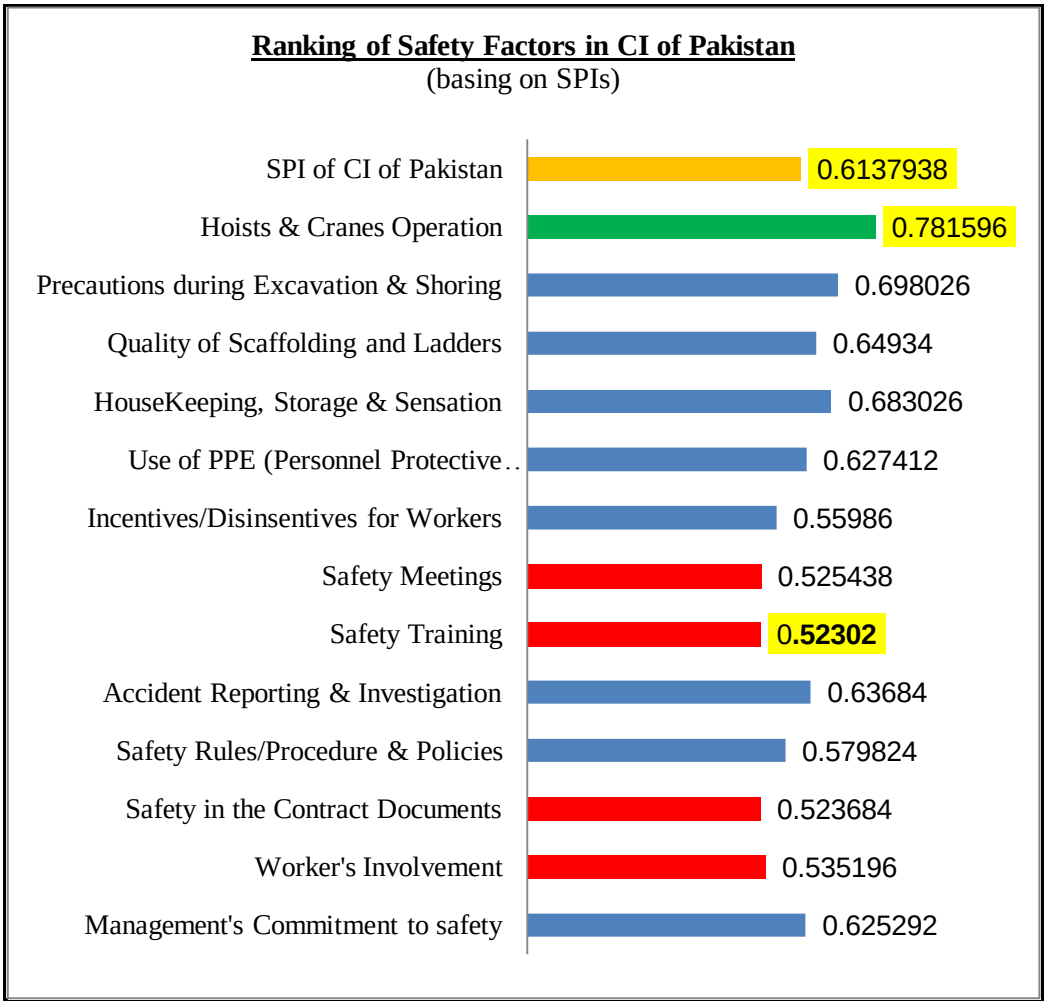


Figure 4.8: Ranking of Safety Factors in CI of Pakistan (basing on SPIs)

4.6 Ranking of all Safety Practices by Mean and SPI

The data collected through 152 respondents for sixty (60) safety practices have been analyzed using SPSS-18 and MS excel. The means, percentages, safety performance indices (SPIs) and ranking of all safety practices have been calculated. Table 4.21 shows the ranking of all safety practices within each factor and overall also. Mean value of all safety practices is computed as 3.069 and in terms of percentage safety performance level of CI of Pakistan is computed as 61.38% which should ideally be closer to 100. This warrants attention of all stakeholders to work for improvement of safety standards in the CI of Pakistan.

Table 4.21: Mean, Percentage, SPIs and Ranking of 60 Safety Practices

13 Safety Factors (60 Practices)		Mean of Safety Practices	Percentage (%) of Safety Practices	SPIs of Safety Practices	Ranking of Safety Practices basing on SPIs	
					Within factor	Overall (1 to 60)
1. **Management's Commitment to Safety**						
01	Top priority of higher management is the safety and not the productivity.	2.80263	56.0526	0.560526	8	41
02	There is no work pressure on workers and safety is given priority over time.	2.62500	52.5	0.525	**9**	**51**
03	Regular safety inspections conducted by higher management/Safety official	2.91447	58.2894	0.582894	7	37
04	Management motivates to work safely.	3.26974	65.3948	0.653948	3	20
05	Company really cares about the health and safety of the people who work here.	3.25000	65.000	0.65000	5	23
06	Field Engineer, Supervisor and Safety Officer encourage reporting of hazards.	3.39474	67.895	0.67895	1	13
07	Management acts quickly to correct safety problems.	3.24342	64.868	0.64868	6	24
08	Good communication is established between management and workers.	3.37500	67.500	0.67500	2	15
09	Sufficient manpower and equipment are always made available by management, to do the job safely.	3.26316	65.263	0.65263	4	21
2. **Workers' Involvement**						
10	Safety rules and procedures are strictly followed by workers.	2.64474	52.895	0.52895	2	49
11	Workers react strongly against any violation of safety rules by co-workers.	2.57237	51.447	0.51447	3	**54**
12	People here always work safely even when they are not being supervised.	2.50000	50.000	0.50000	**4**	**58**
13	Workers do not consider safety as a compulsion from the management.	2.98684	59.737	0.59737	1	33

13 Safety Factors (60 Practices)		Mean of Safety Practices	Percentage (%) of Safety Practices	SPIs of Safety Practices	Ranking of Safety Practices basing on SPIs	
					Within factor	Overall (1 to 60)
3. **Safety in the Contract Documents**						
14	Contractor was mandated in contract to submit his 'safety policy' for the project.	2.69079	53.816	0.53816	1	46
15	Contractor is bound to submit 'safety plan' before start of each task.	2.54605	50.921	0.50921	**2**	**55**
4. **Safety Rules/Procedures and Policies**						
16	Company has developed its safety policy in the light of OSHA.	2.74342	54.868	0.54868	5	44
17	Site emergency plan is prepared and job hazard analysis is done for each task.	2.78947	55.789	0.55789	3	42
18	Safety audits conducted regularly.	2.59868	51.974	0.51974	**6**	**53**
19	First aid facility is made available on site.	3.63158	72.632	0.72632	1	6
20	Workers medically examined regularly.	2.86184	57.237	0.57237	2	39
21	Insurance coverage provided to workers.	2.76974	55.395	0.55395	4	43
5. **Accident Reporting and Investigation Mechanism**						
22	A written accident reporting and investigation mechanism exists.	3.24342	64.868	0.64868	2	25
23	Accidents are always reported/recorded	3.46711	69.342	0.69342	1	9
24	Investigations are always carried out to identify the causes of accidents.	3.22368	64.474	0.64474	3	26
25	Near misses are also analyzed to mitigate the future hazards.	2.80263	56.053	0.56053	**4**	40
6. **Safety Training**						
26	Training for new workers is compulsory.	2.63158	52.632	0.52632	2	50
27	Refresher safety training sessions are periodically conducted for all workers.	2.30921	46.184	0.46184	5	**59**
28	Health and safety training is provided to the employees of subcontractors also.	2.30263	46.053	0.46053	**6**	**60**
29	Adequate job-specific safety training is given to workers	2.51316	50.263	0.50263	4	**56**

13 Safety Factors (60 Practices)		Mean of Safety Practices	Percentage (%) of Safety Practices	SPIs of Safety Practices	Ranking of Safety Practices basing on SPIs	
					Within factor	Overall (1 to 60)
	before start of a job.					
30	An organizational chart is displayed on site showing names, positions and responsibilities for safety compliance.	2.61842	52.368	0.52368	3	**52**
31	Safety posters and sign boards are used at important places for worker's awareness, in English and Urdu language.	3.31579	66.316	0.66316	1	17
7. **Safety Meetings**						
32	Tool box meetings are held weekly.	2.67763	53.553	0.53553	2	47
33	Safety is discussed in all progress and pre-construction meetings.	2.69079	53.816	0.53816	1	45
34	Subcontractor participates in safety meetings.	2.51316	50.263	0.50263	**3**	**57**
8. **Incentives/Disincentives for Workers**						
35	Workers completing the tasks, following safety standards, are rewarded.	2.67105	53.421	0.53421	**2**	48
36	Safety defaulters are penalized and then trained also.	2.92763	58.553	0.58553	1	36
9. **Use of Personnel Protection Equipment (PPE)**						
37	Company has an effective system for the issuance/ inspection/replacement of PPE	3.21053	64.211	0.64211	2	27
38	PPE used on site, is of good quality.	3.35526	67.105	0.67105	1	16
39	Workers are supposed to enter the work site with hard hats on.	3.20395	64.079	0.64079	4	29
40	Hearing protection and safety glasses are used when needed.	2.94079	58.816	0.58816	5	35
41	Workers at height always use safety belt along with lanyard, which is secured.	3.21053	64.211	0.64211	3	28
42	Safety nets used to prevent fall hazard, where safety belts can't be used.	2.90132	58.026	0.58026	**6**	38

13 Safety Factors (60 Practices)		Mean of Safety Practices	Percentage (%) of Safety Practices	SPIs of Safety Practices	Ranking of Safety Practices basing on SPIs	
					Within factor	Overall (1 to 60)
10. **Housekeeping, Storage and Sanitation**						
43	Site layout planning is done before start of work and materials are stored properly.	3.55921	71.184	0.71184	4	7
44	All openings and excavated areas are flagged / barricaded.	3.43421	68.684	0.68684	5	11
45	Sharp edges are covered/protected like nails and steel bars etc.	2.96053	59.211	0.59211	**10**	34
46	Sufficient lighting arrangements are made where required.	3.72368	74.474	0.74474	1	3
47	Adequate quantity of water for drinking and washing is supplied.	3.67763	73.553	0.73553	2	4
48	Walkways/staircases not littered with debris and wet spots cleaned up regularly.	3.15789	63.158	0.63158	9	31
49	Scrap is disposed off regularly.	3.19079	63.816	0.63816	8	30
50	No throwing or dropping of material/equipment carelessly.	3.40789	68.158	0.68158	6	12
51	On site material is secured against wind.	3.39474	67.895	0.67895	7	14
52	Ventilation ensured at confined spaces.	3.64474	72.895	0.72895	3	5
11. **Quality of Scaffolding and Ladders**						
53	Properly designed / fastened scaffolds are used which are inspected daily.	3.28289	65.658	0.65658	2	19
54	Guardrails are placed on working scaffold platforms to prevent any fall.	3.15132	63.026	0.63026	**4**	32
55	Good quality ladders are used on work site having no defective rungs.	3.26316	65.263	0.65263	3	22
56	Mobile Work Platforms (MWP) are always fixed firmly before using them.	3.28947	65.789	0.65789	1	18
12. **Precautions during Excavation and Shoring**						
57	Protection against trench cave-in is always ensured by sloping or shoring.	3.44737	68.947	0.68947	**2**	10
58	People employed in deep and narrow ditches kept under	3.53289	70.658	0.70658	1	8

13 Safety Factors (60 Practices)		Mean of Safety Practices	Percentage (%) of Safety Practices	SPIs of Safety Practices	Ranking of Safety Practices basing on SPIs	
					Within factor	Overall (1 to 60)
	continuous supervision					
13. **Hoists and Cranes Operation**						
59	Hoists and Cranes are inspected before their operation.	3.91447	78.289	0.78289	1	1
60	Objects are fastened before lifting them.	3.90132	78.026	0.78026	**2**	2
Average of CI of Pakistan		**3.068969**	**61.37938**	**0.6138**	-	-

4.6.1 Frequency Distribution of Safety Practices

Figure 4.9 exhibits the frequency distribution of the safety performance level calculated through the responses of 152 respondents. The x-axis represents the safety performance scores entered by the respondents ranging from 1 to 5 and y-axis represents the percentages of respondent for each level of safety performance. Frequency distribution analysis shows that only 7.56% respondents rated a score of 1 (very low), 23.103% rated a score of 2 (low), while a score of 3 (moderate) is rated by 31.37%, score of 4 (high) by 30.789% and score of 5 (very high) was rated by 7.17% respondents. It means that only 37.959% respondents consider that safety performance of CI of Pakistan is good whereas 62.033% respondents consider that safety performance of CI of Pakistan is not satisfactory. Hence, there is a need to improve upon the safety performance in CI of Pakistan.

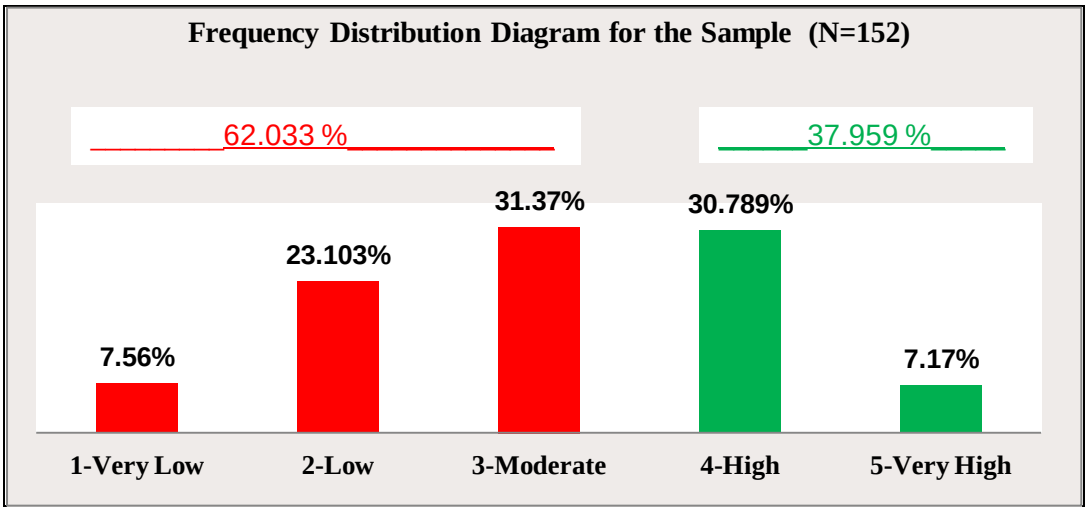


Figure 4.9: Frequency Distribution of Safety Practices

4.6.2 Ten (10) Better Safety Practices

Although perfection is needed in all the safety aspects, however ten (10) better safety practices in the CI of Pakistan are given in descending order, as under:

1) Hoists and cranes are inspected before their operation.
2) Objects are fastened before lifting them.
3) Sufficient lighting arrangements are made where required.
4) Adequate quantity of water for drinking and washing is supplied.
5) Ventilation ensured at confined spaces.
6) First aid facility is made available on site.
7) Site layout planning is done before start of work and materials are stored properly.
8) People employed in deep and narrow ditches/trenches are kept under continuous supervision.
9) Accidents are always reported/recorded.
10) Protection against trench cave-in is always ensured by sloping and shoring.

The SPIs for ten better safety practices are given in Figure 6.10. Safety practices which are ranked number 1 and 2 are highlighted in green and light green colours whereas average safety performance of CI of Pakistan is highlighted in brown colour.

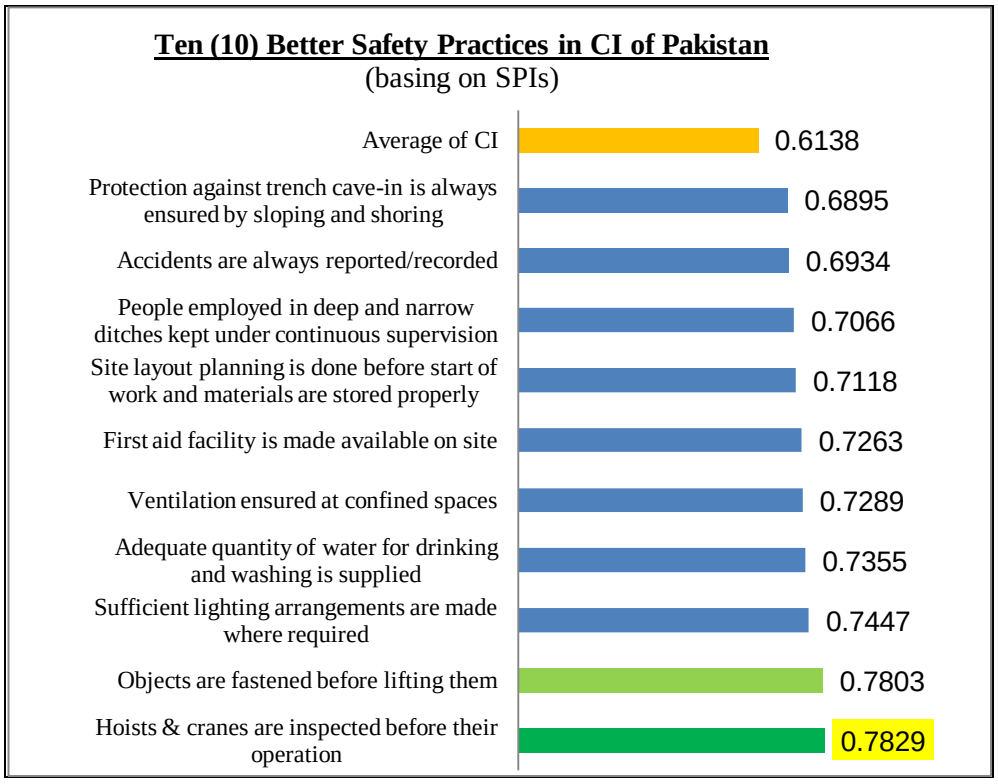


Figure 4.10: Ten (10) Better Safety Practices in CI of Pakistan

4.6.3 Twenty (20) Most Neglected Safety Practices

Following are the twenty (20) most neglected safety practices in the CI of Pakistan, which require special attention to enhance the safety performance level:

1) Health and safety training is not provided to the employees of subcontractor.
2) Refresher safety training sessions are not conducted for the workers.
3) Workers have a tendency to take unnecessary risks, when not supervised.
4) Subcontractors are not encouraged to participate in safety meetings.
5) No job specific safety training is given to workers before start of a job.
6) Contractor is not bound to submit 'safety plan' before start of each task.
7) Workers do not react against any violation of safety rules by co-workers.
8) Safety audits are not conducted regularly.
9) Organizational chart is not displayed on site showing names, positions and responsibilities of safety officials.
10) There exists work pressure to complete the task in-time, resulting in a compromise on safety.
11) Training is not given to the new workers.
12) Safety rules and procedures are not followed by workers.
13) Workers completing the task following safety standards are not rewarded.
14) Toolbox meetings are not held on weekly basis.
15) Contractor is not mandated in the contract to submit his 'safety policy' for the project.
16) Safety is not discussed in progress and pre-construction meetings.
17) Company has not developed its safety policy.
18) Insurance coverage is not provided to workers.
19) 'Site emergency plan' and 'Job hazard analysis' are not carried out.
20) Safety is not the top priority of higher management.

The SPIs for twenty most neglected safety practices are given in Figure 4.11. The most neglected safety practices which are ranked number 1 and 2 are highlighted in red colour, next three are highlighted in black colour, whereas average safety performance of CI of Pakistan is highlighted in brown colour.

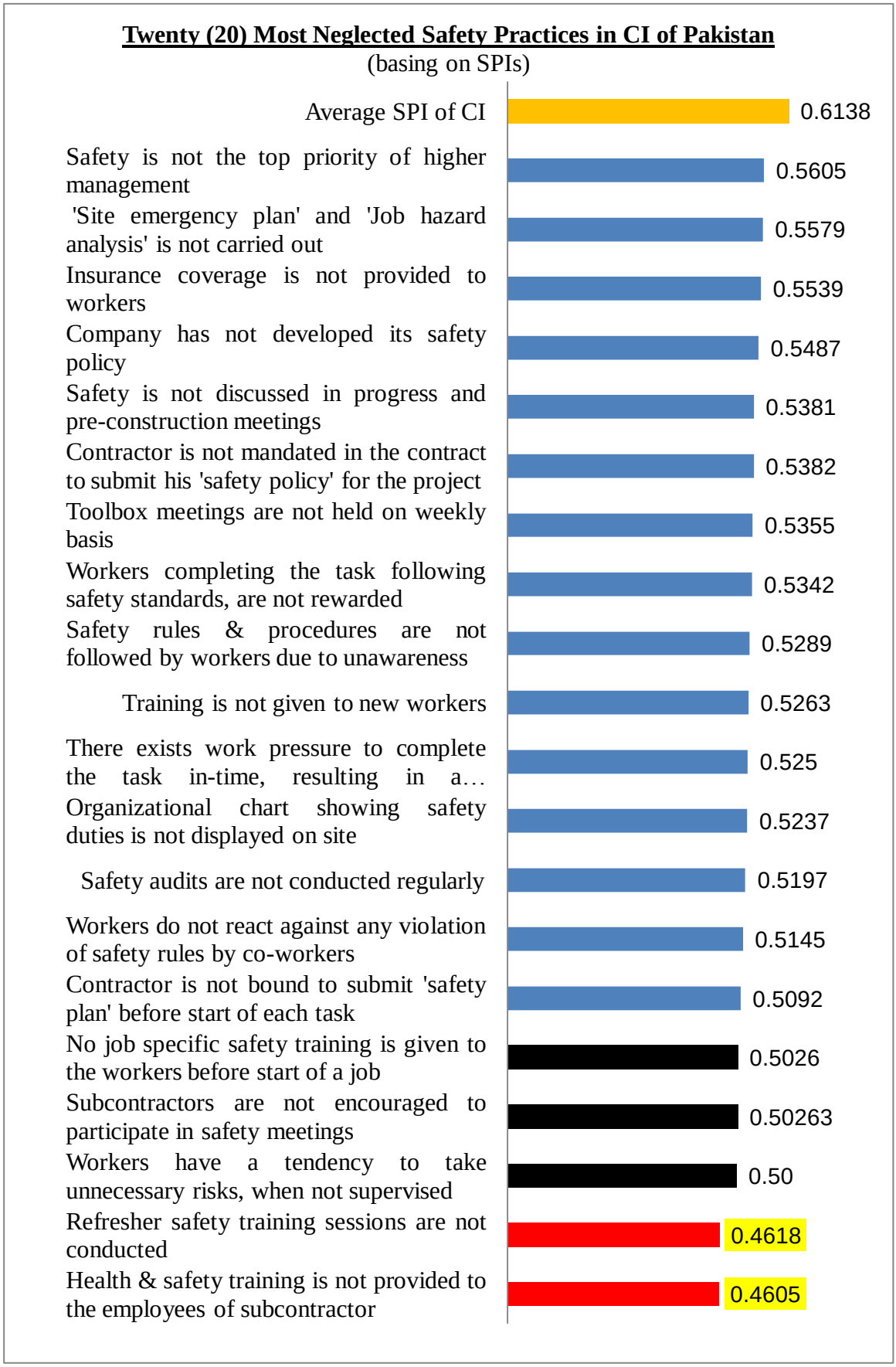


Figure 4.11: Twenty (20) Most Neglected Safety Practices in CI of Pakistan

4.7 Analysis of Safety Factors

Safety practices which are ranked closer to 1 indicate that their safety performance level is better whereas the safety practices which are ranked closer to 60 specify that their safety performance level is very poor.

4.7.1 Management Commitment to Safety

Commitment of the higher management towards safety compliance is analyzed through nine questions. Ranking of these safety practices is given below in Table 4.22. Results show that field engineers and safety officers always encourage the reporting of hazards on site and good communication is established at site between the workers and manager. One of the aspects which need drastic improvement is that 'workers are always under pressure to complete the assigned task in time and their safety is ignored most of the time'. This is due to the reason that top management always plans for higher productivity and not for safety.

Table 4.22: Management Commitment to Safety-Ranking

Management Commitment to Safety	**Ranking within this Factors**	**Overall Ranking**
Top priority of higher management is the safety and not the productivity.	8	41
There is no work pressure on workers and safety is given priority over time.	**9**	**51**
Regular safety inspections conducted by higher management / Safety officials.	7	37
Management motivates to work safely.	3	20
Company really cares about the health and safety of the people who work here.	5	23
Field Engineer, Supervisor and Safety Officer encourage reporting of hazards.	1	13
Management acts quickly to correct safety problems.	6	24
Good communication is established between management and workers.	2	15
Sufficient manpower and equipment are always made available by management, to do the job safely.	4	21

4.7.2 Workers′ Involvement

Commitment of the workers towards safety compliance is analyzed through four questions. Ranking of the related safety practices is given in Table 4.23. Overall this factor is ranked as 4th last so it needs special attention. Results show that workers do not follow safety rules and procedures willingly and do not feel comfortable wearing personnel protective equipment (PPE).There is a need to educate the workers about the importance of safety through training and media campaigns.

Table 4.23: Workers′ Involvement towards Safety-Ranking

Workers' Involvement towards Safety	**Ranking within this Factors**	**Overall Ranking**
Safety rules and procedures are strictly followed by workers.	2	49
Workers react strongly against any violation of safety rules by co-workers.	3	**54**
People here always work safely even when they are not being supervised.	**4**	**58**
Workers do not consider safety as a compulsion from the management.	1	33

4.7.3 Safety in the Contract Documents

Although safety clauses are part of the contract documents in most of the cases but no budget is allocated for safety by the client. Contractor is assumed to be responsible for providing safe work environment but no allowance is made in project cost for the safety. Contractor is even not asked to submit his 'safety policy' along with the bidding documents or prepare the 'safety plan' before executing any task. Safety budget is allocated only on the projects involving higher degree of danger like tunneling. Even for high rise buildings, no budget is allocated by the client for safety and it is left at the discretion of contractor. Ranking of the related safety practices is given in Table 4.24. Overall this factor is ranked 2nd last, among 13 safety factors. Situation can only be improved if PEC takes a leading role by ensuring compliance with the safety clauses already incorporated in PEC′s contract documents. The relevant clauses are FIDIC part-I clause 19.1 'Safety, Security and Protection of the Environment' and part-II clause 19.3

'Safety Precautions'. PEC can also amend the registration criteria for all the construction firms to have safety staff on their projects.

Table 4.24: Safety in the Contract Documents-Ranking

Safety in the Contract Documents	Ranking within this Factors	Overall Ranking
Contractor was mandated in contract to submit his 'safety policy' for the project.	1	46
Contractor is bound to submit 'safety plan' before start of each task.	**2**	**55**

4.7.4 Safety Rules/Procedures and Policies

Safety rules/procedures and policies are analyzed through six questions. Ranking of the related safety practices is given in Table 4.25. Results show that no safety audits are conducted by the companies. In most of the cases, work is carried out without any job hazard analysis and the workers are not provided with any insurance coverage. Companies do not have any safety policy. However first aid facility is made available on most of the sites.

Table 4.25: Safety Rules/Procedures and Policies-Ranking

Safety Rules/Procedures and Policies	Ranking within this Factors	Overall Ranking
Company has developed its safety policy in the light of OSHA.	5	44
Site emergency plan is prepared and job hazard analysis is done for each task.	3	42
Safety audits are conducted regularly.	**6**	**53**
First aid facility is made available on site.	1	6
Workers medically examined regularly.	2	39
Insurance coverage provided to workers.	4	43

4.7.5 Accident Reporting and Investigation

Ranking of the related safety practices is given below in Table 4.26. Results show that there exists a moderate level of mechanism to report and record the accidents on

many project sites but investigations to dig out the root causes of accidents are seldom carried out. Near misses are never analyzed. There is a need to develop a proper mechanism for accident reporting and investigation and this can only happen if a regulatory body monitors the safety performance on all ongoing projects in the country. It is important to mention here that 98% of the respondents did not share the record of injuries and fatalities owing to its confidentiality.

Table 4.26: Accident Reporting and Investigation-Ranking

Accident Reporting and Investigation	**Ranking within this Factors**	**Overall Ranking**
A written accident reporting and investigation mechanism exists.	2	25
Accidents are always reported/recorded	1	9
Investigations are always carried out to identify the causes of accidents.	3	26
Near misses are also analyzed to mitigate the future hazards.	**4**	40

4.7.6 Safety Training

This is the most neglected safety factor which is ranked last among all 13 safety factors. This factor is analyzed through six questions. Ranking of the related safety practices is given in Table 4.27. Results show that on some sites, workers are made aware through safety posters and safety signs but detailed training/briefing is not carried out for new workers. Refresher training is not at all conducted. Criteria for workers selection is their skill level only. No job specific training is given to workers to ensure their safety while performing hazardous task. Moreover, organizational chart showing safety duties is not displayed on most of the sites. Another gray area is that employees of subcontractor are not given any safety training and not provided with any safety equipment. This factor needs special attention by all the stakeholders in CI of Pakistan.

Table 4.27: Safety Training-Ranking

Safety Training	Ranking within this Factors	Overall Ranking
Training for new workers is compulsory.	2	50
Refresher safety training sessions are periodically conducted for all workers.	5	**59**
Health and safety training is provided to the employees of subcontractors also.	**6**	**60**
Adequate job-specific safety training is given to workers before start of a job.	4	**56**
An organizational chart is displayed on site showing names, positions and responsibilities for safety compliance.	3	**52**
Safety posters and sign boards are used at important places for worker's awareness, in English and Urdu language	1	17

4.7.7 Safety Meetings

This is also one of the most neglected safety factors which is ranked 3rd last among all 13 safety factors. Ranking of related safety practices is given in Table 4.28. Results show that tool box meetings are not held on most of the project sites. Moreover subcontractors are not encouraged to participate in safety meetings. Progress meetings are only focused on productivity issues where safety aspects are not discussed. This status quo can only be changed if all the stakeholders are made aware of this fact that productivity will certainly increase if safety of workers is ensured. Safe work environment will eventually reduce the cost and time needed to treat the injured workers.

Table 4.28: Safety Meetings-Ranking

Safety Meetings	Ranking within this Factors	Overall Ranking
Tool box meetings are held weekly.	2	47
Safety is discussed in all progress and pre-construction meetings.	1	45
Subcontractor participates in safety meetings.	**3**	**57**

4.7.8 Incentives/Disincentives for Workers

This factor is analyzed through two simple questions. Ranking of the related safety practices is given in Table 4.29. Results show that workers are counseled after committing any unsafe act and if they repeat the same then they are penalized in form of monetary loss. On the contrary, no incentives are announced for the workers for doing the job safely. However, incentives are awarded only for better productivity.

Safety can be improved if incentives are provided to the employees by the contractors (Larcher and Sohail, 1999). So, where the main concern of a contractor is how to save money and reduce the costs (Kartam *et al.*, 2000), the initiative for improved safety must come from the client. The clients should insist on having safety measures at the construction sites by incorporating the specific terms and conditions for safety provisions in the project contract documents.

Table 4.29: Incentives/Disincentives for Workers-Ranking

Incentives/Disincentives for Workers	**Ranking within this Factors**	**Overall Ranking**
Workers completing the tasks, following safety standards, are rewarded.	**2**	48
Safety defaulters are penalized and then trained also.	1	36

4.7.9 Use of Personnel Protective Equipment (PPE)

This safety factor is analyzed through six questions. Ranking of the related safety practices is given in Table 4.30. Almost all registered companies with PEC in C-A category are providing PPE to the workers, however quantity and quality of PPE is still a question mark. Most of the time, emphasis is on using safety helmet only whereas other PPEs are not given any importance. On a flyover project in Rawalpindi, PPE was issued to few of the workers but their quality was not good. On the same project, two workers were observed working on scaffold, under the supervision of a foreman; one was wearing safety belt whereas other was not having any safety equipment. On a high rise building project, a worker working on outer side of building was not feeling comfortable to reach a point from his platform so he unhooked his safety belt from the lanyard, performed the task and again fastened his safety belt.

Table 4.30: Use of PPE-Ranking

Use of PPE	Ranking within this Factors	Overall Ranking
Company has an effective system for the issuance/inspection/replacement of PPE	2	27
PPE used on site, is of good quality.	1	16
Workers are supposed to enter the work site with hard hats on.	4	29
Hearing protection and safety glasses are used when needed.	5	35
Workers at height always use safety belt along with lanyard, which is secured.	3	28
Safety nets used to prevent fall hazard, where safety belts can't be used.	**6**	38

4.7.10 Housekeeping, Storage and Sanitation

Respondents have ranked this factor higher than other safety factors. It is analyzed through ten questions. Ranking of the related safety practices is given in Table 4.31. Results disclose that housekeeping is generally satisfactory but the standard of sanitation (provision of lavatories for workers) is very poor. Arrangements for ventilation, lighting and drinking water are satisfactory. However, facilities including water for washing and bathing needs drastic improvements. Similarly all openings are needed to be barricaded and flagged.

Table 4.31: Housekeeping, Storage and Sanitation-Ranking

Housekeeping, Storage and Sanitation	Ranking within this Factors	Overall Ranking
Site layout planning is done before start of work and materials are stored properly.	4	7
All openings and excavated areas are flagged/barricaded.	5	11
Sharp edges are covered/protected like nails, steel bars.	**10**	34
Sufficient lighting arrangements made where required	1	3
Adequate quantity of water for drinking and washing is supplied.	2	4
Walkways/staircases not littered with debris and wet spots cleaned up regularly.	9	31
Scrap is disposed off regularly.	8	30
No throwing or dropping of material/equipment carelessly.	6	12
On site material is secured against wind.	7	14
Ventilation ensured at confined spaces.	3	5

4.7.11 Quality of Scaffolding and Ladders

Respondents have ranked this factor a bit higher than other safety factors. This safety factor is analyzed through four questions. Ranking of the related safety practices is given in Table 4.32. Results elucidate that standards of scaffolding and ladders are just satisfactory. On residential projects, low quality wooden scaffolds are usually used whereas mega projects are using good quality steel scaffolds but guardrails are mostly found missing on scaffolds' platforms. There is a need to educate all the stakeholders of CI to use guardrails on scaffolds to prevent any fall.

Table 4.32: Quality of Scaffolding and Ladders-Ranking

Quality of Scaffolding and Ladders	**Ranking within this Factors**	**Overall Ranking**
Properly designed / fastened scaffolds are used which are inspected daily.	2	19
Guardrails are placed on working scaffold platforms to prevent any fall.	**4**	32
Good quality ladders are used on work site having no defective rungs.	3	22
Mobile Work Platforms (MWP) are always fixed firmly before using them.	1	18

4.7.12 Precautions during Excavation and Shoring

This factor is ranked 2nd highest by the respondents and it is analyzed through two simple questions. Ranking of the related safety practices is given in Table 4.33. An effort is required to educate the stakeholders about precautions needed during excavation and shoring like the safety of operator performing excavation work using some machinery.

Table 4.33: Precautions during Excavation and Shoring-Ranking

Precautions during Excavation and Shoring	**Ranking within this Factors**	**Overall Ranking**
Protection against trench cave-in is always ensured by sloping or shoring.	**2**	10
People employed in deep and narrow ditches kept under continuous supervision.	1	8

4.7.13 Hoists and Cranes Operation

The factor of hoists and cranes operation is ranked number 1 by the respondents. Ranking of the related safety practices is given in Table 4.34. On most of sites, quality of hoists and cranes is good and their operation is always monitored. It is also ensured that objects are fastened properly before lifting. However, there is a need to educate the site supervisors to look for the safety of workers who help in fastening the objects with the crane.

Table 4.34: Hoists and Cranes Operation-Ranking

Hoist and Cranes Operation	Ranking within this Factors	Overall Ranking
Hoists and Cranes are inspected before their operation.	1	1
Objects are fastened before lifting them.	**2**	2

4.8 Benchmarking the Safety Performance of Under Construction Mega Projects

Safety performance measures are used primarily for comparisons among companies. In addition, they are also used as a means for pinpointing problem areas (Levitt and Samelson, 1987). According to Laufer and Ledbetter (1986), a key factor in the control and improvement of any performance aspect on site is the ability to measure the performances. Measuring safety performances is important to check the effectiveness of various training methods and it also serves as an instrument in choosing a contractor.

The data collected through questionnaire comprises of 152 respondents from 38 construction companies/organizations, working on 54 projects in 16 different cities of Pakistan. These respondents are contacted directly and through mail/email also. However following eight (8) under construction mega projects are visited personally and 8 to 11 questionnaires are filled on each project from different appointment holders including managers, field engineers, foreman and workers:

a. The Centaurus, Islamabad
b. New Islamabad International Airport
c. FFC Tower, Saddar Rawalpindi

d. Attock Oil Office Building, Morgah Rawalpindi
e. State Bank Building, Blue Area, Islamabad
f. DHA Valley Islamabad
g. World Trade Center DHA-II Islamabad
h. Chandni Chowk Flyover, Murree Road Rawalpindi

A comparison is made basing on safety performance index (SPI) value of each project, which is given in Figure 4.12. Results demonstrate that the project of '*Centaurus'* has better safety performance level, followed by '*New Islamabad International Airport'* and '*Fauji Fertilizer Tower'* respectively. The lowest safety performance level is observed at '*Chandni Chowk Flyover'*, followed by '*World Trade Center DHA-II Islamabad'* and '*DHA Valley Islamabad'*. Results also reveal that the safety performance of 3 projects out of a total of 8 mega projects is lower than the average safety performance level of CI of Pakistan which is assessed to be 0.6138.

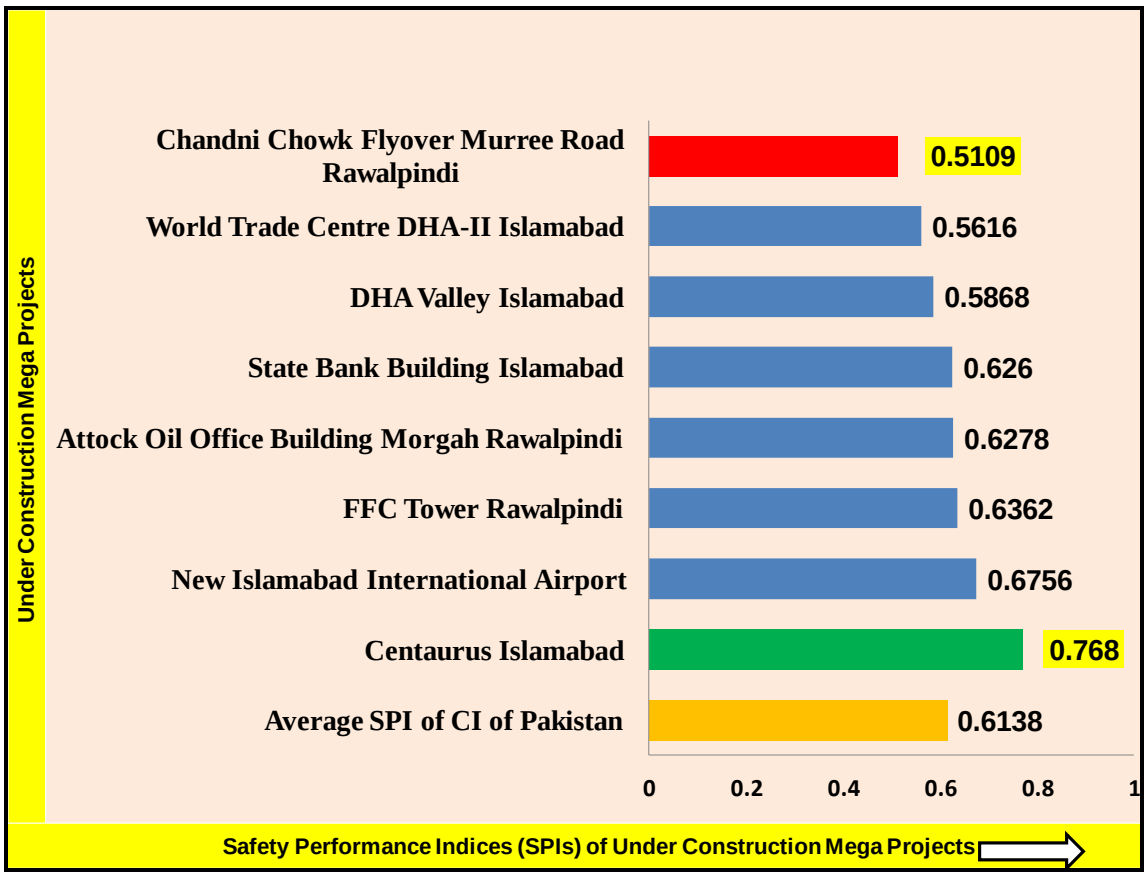


Figure 4.12: Benchmarking the Safety Performance of 8 Under Construction Mega Projects

Figure 4.13 presents the comparison of all safety factors on these projects. On all the projects, lowest safety performance level is observed for the factor of '*safety training*' followed by the factors of '*safety in the contract documents*', '*safety meetings*' and '*workers' involvement*' respectively whereas '*hoists and cranes operation*' has better safety performance level on these projects.

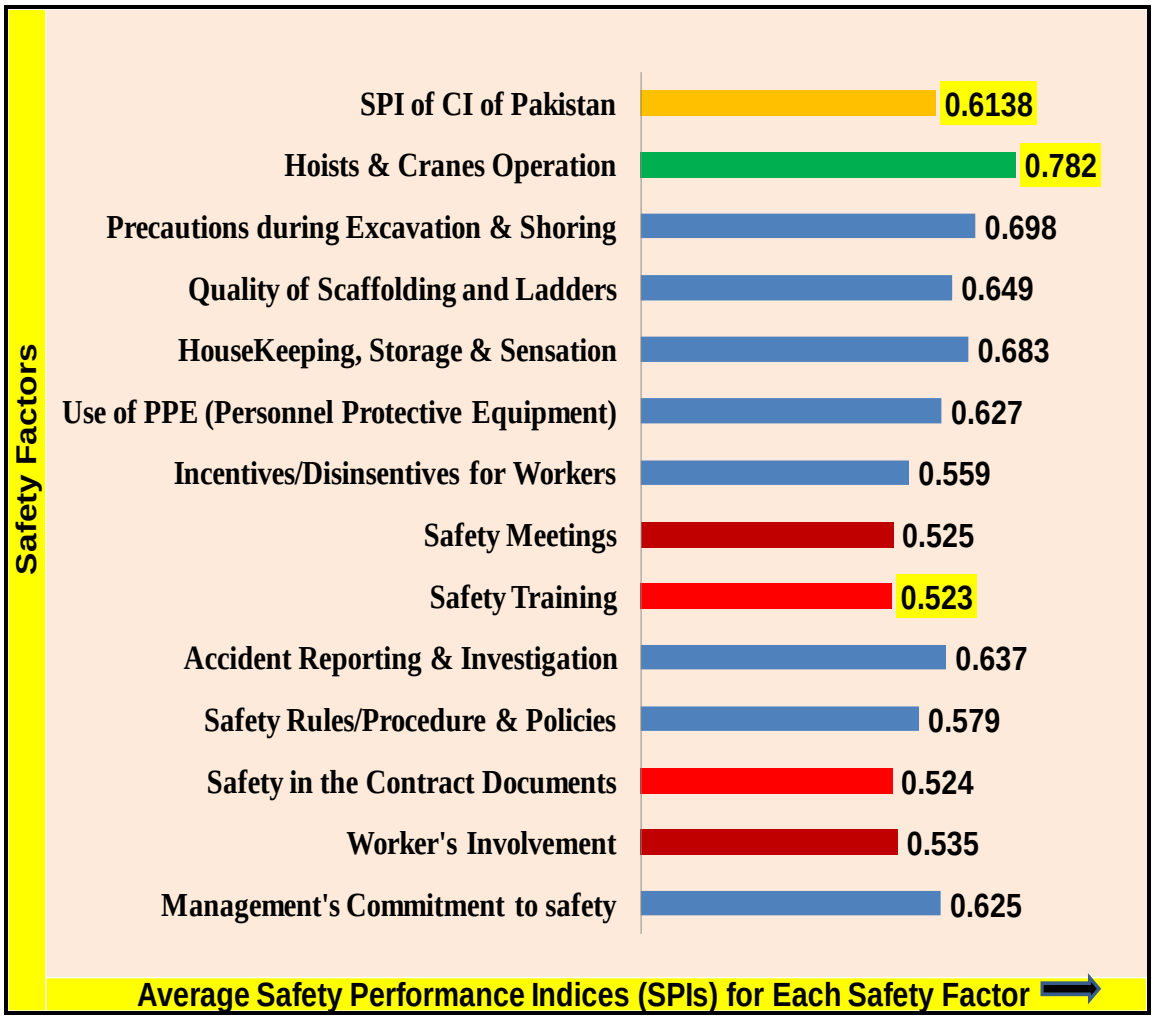


Figure 4.13: Benchmarking of Safety Factors

Detailed calculations of SPIs values for 8 under construction mega projects against 13 safety factors are tabulated in Table 4.35. Last row contains the average SPI values for each under construction mega project whereas right most column shows the average SPI values for all safety factors. Results indicate that the project of *'Centaurus'* has got better SPI values for all safety factors as compared to other under construction mega projects. Similarly lowest SPI values are observed for the factor of *'safety training'* on all under construction mega projects.

Table 4.35: SPIs for all Safety Factors on 8 Under Construction Mega Projects

Safety Factors (13)	SPIs for 8 Under Construction Mega Projects								
	Centaurus	New Islamabad Airport	FFC Tower Saddar	Attock Oil Building	State Life Building	DHA Valley	WTC DHA-II	Chandni Chowk Flyover	SPI of Each Safety Factor in CI
Management's Commitment to Safety	0.755	0.676	0.667	0.639	0.6	0.598	0.524	0.504	0.625
Worker's Involvement	0.628	0.598	0.557	0.525	0.516	0.516	0.45	0.441	0.535
Safety in the Contract Documents	0.661	0.644	0.489	0.487	0.471	0.47	0.475	0.478	0.524
Safety Rules/Procedure & Policies	0.715	0.678	0.644	0.625	0.612	0.52	0.477	0.452	0.579
Accident Reporting & Investigation	0.75	0.722	0.711	0.662	0.612	0.622	0.562	0.472	0.637
Safety Training	0.631	**0.559**	**0.559**	**0.516**	**0.529**	**0.556**	**0.447**	0.411	**0.523**
Safety Meetings	0.646	0.634	0.6	0.55	0.525	0.513	0.473	0.376	0.525
Incentives/Disincentives for Workers	0.657	0.656	0.64	0.537	0.612	0.48	0.46	0.378	0.559
Use of PPE	0.777	0.718	0.652	0.708	0.621	0.543	0.575	0.5	0.627
HouseKeeping, Storage & Sanitation	0.786	0.764	0.644	0.715	0.685	0.638	0.63	0.613	0.683
Quality of Scaffolding and Ladders	0.771	0.717	0.694	0.718	0.643	0.585	0.684	0.5667	0.649
Precautions during Excavation & Shoring	0.798	0.781	0.756	0.725	0.657	0.764	0.675	0.623	0.698
Hoists & Cranes Operation	0.826	0.811	0.807	0.775	0.805	0.73	0.725	0.725	0.782
Average SPI of Each Project	**0.768**	**0.676**	**0.636**	**0.628**	**0.626**	**0.587**	**0.562**	**0.511**	**0.6138**

Benchmarking of all safety factors on 8 under construction mega projects is graphically presented in Figure 4.14. The results indicate that the lowest safety performance is observed on the project of *'Chandni Chowk Flyover'* against all safety factors, whereas better safety performance is observed on the project of *'Centaurus'*.

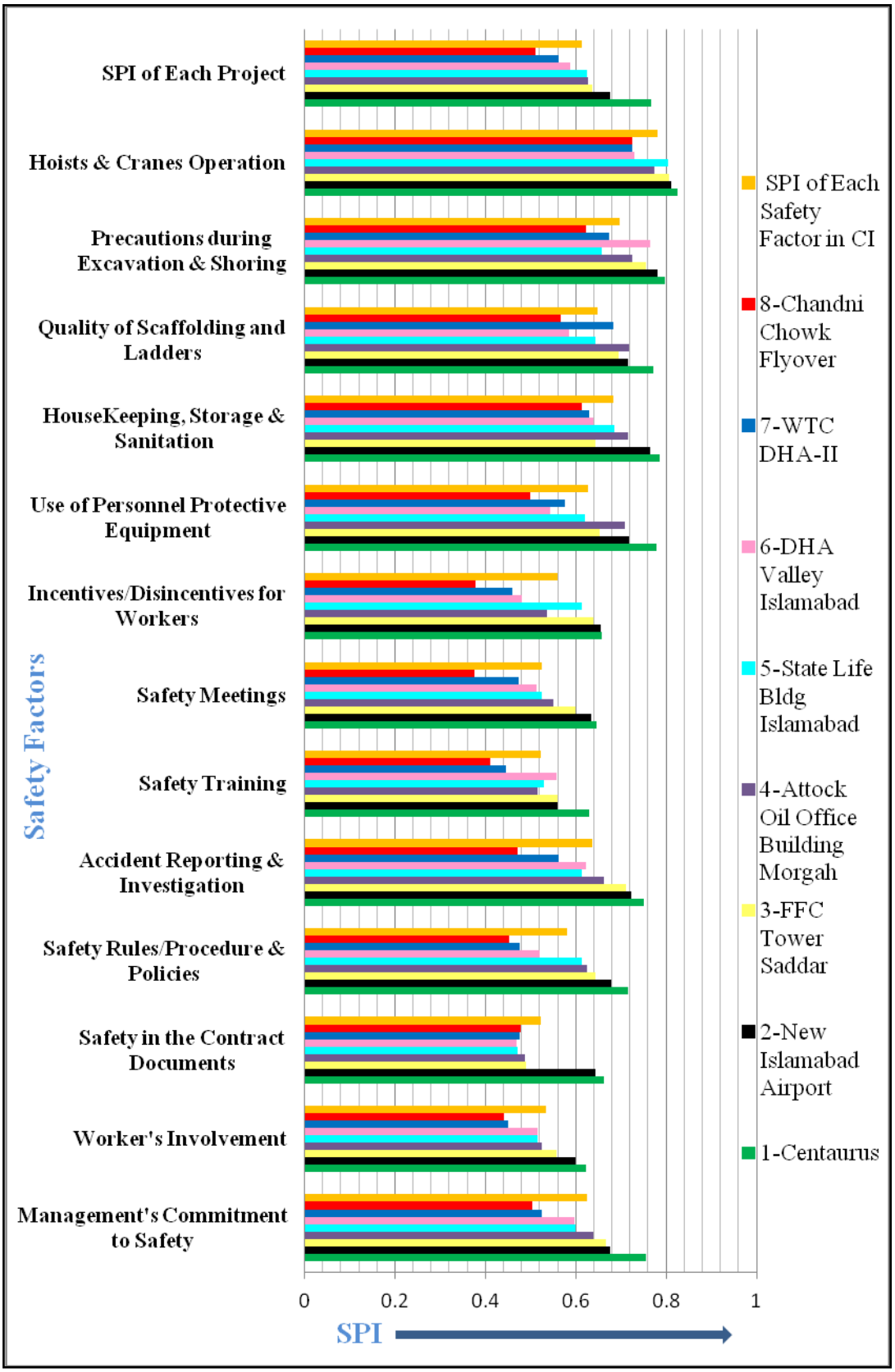


Figure 4.14: Benchmarking of all 13 Safety Factors on 8 Under Construction Mega Projects

4.9 Summary

In this chapter statistical analysis has been discussed. Sixty (60) safety practices (grouped in 13 safety factors) are analyzed using SPSS-18, so as to assess the safety performance level of CI of Pakistan. Data was collected from PEC registered construction companies working on 54 diverse projects in 16 cities of Pakistan.

Cronbach's Coefficient Alpha value (0.968) proved that the data is quite reliable for further analysis. Shapiro Wilk normality test confirmed that data is not normally distributed so non para-metric test (Kruskal Wallis test) is applied to judge the differences in perception of all stakeholders, about safety performance level in the CI of Pakistan.

Better performance level is observed for the safety factor of *'Hoists and Cranes Operation'*, followed by *'Precautions during Excavation and Shoring'*. The lowest safety performance level is observed for the factor of *'safety training'* followed by *'safety in the contract documents'*, *'safety meetings'* and *'workers' involvement'* respectively.

Ten better and twenty most neglected safety practices are also highlighted. The five most neglected safety practices requiring special emphasis, in descending order, are:

a. Health and safety training is not provided to the employees of subcontractor.
b. Refresher safety training sessions are not conducted for the workers.
c. People do not work safely even when they are not being supervised.
d. Subcontractors do not participate in safety meetings.
e. No job specific safety training is given to workers before start of a job.

Benchmarking of current safety practices is carried out on eight under construction mega projects, basing on their SPIs. Results indicate that the factor of *'safety training'* has the lowest safety performance level, followed by *'safety in the contract documents'*, *'safety meetings'* and *'worker's involvement'*.

Benchmarking study also highlights that the under construction mega project of '*Centaurus'* has better safety performance, followed by '*New Islamabad International Airport'* and '*Fauji Fertilizer Tower'* respectively. The lowest safety performance is observed at '*Chandni Chowk Flyover'*, followed by '*World Trade Center DHA-II Islamabad'* and '*DHA Valley'*.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Review of Research Objectives

The sub-objectives of this study are:

a. Measuring the performance level of safety practices in the CI of Pakistan (by conducting a questionnaire based survey and interviews).
b. Identifying the most neglected safety practices (by relative importance index method).
c. Comparing the safety performance of under construction mega projects.
d. Suggesting measures to improve safety performance level in the CI of Pakistan.

The first objective is met by collecting data for 60 safety practices (grouped in 13 safety factors) through a questionnaire survey from 54 construction projects in 16 different cities of Pakistan and then analyzing the collected data using SPSS-18 and measuring SPIs for each safety practice; second objective is achieved by identifying the most neglected safety practices in CI of Pakistan basing on SPI values. Third objective is achieved by making a comparison of eight under construction mega projects against their safety performance, and finally the fourth objective is attained by suggesting measures to enhance the safety performance in the CI of Pakistan.

5.2 Conclusions

The major findings of the study are:

a. Government of Pakistan has formulated labour laws, and PEC has incorporated safety clauses in the contract documents but they are not enforced due to the absence of a regulatory authority like OSHA.
b. Workers' rights are not respected and workers are also not aware of their rights to work only under *'safe work environment'*.
c. Safety performance of CI of Pakistan is not satisfactory (SPI of CI of Pakistan is measured as 0.6138 which should ideally be closer to 1).

d. 62.033% respondents consider that safety performance of CI is not satisfactory, owing to the absence of basic safety practices on construction sites.
e. Stakeholders′ emphasis is only on improving quality, and reducing cost and time.
f. No budget is allocated for safety by the client.
g. Most of the construction companies (61.8%) do not have any 'safety policy'.
h. Even on mega projects, there is no independent safety manager (safety is mostly given as a secondary responsibility).
i. Construction companies registered with PEC in C-A category have better safety performance.
j. Safety as a cost controlling measure is often overlooked whereas it can significantly impact the overall cost. There is a misperception among all stakeholders that investing in safety will increase the project cost.
k. Respondents are reluctant to provide record of injuries and fatalities, considering it confidential data.
l. Accidents are reported but mostly not investigated and no one is held responsible.
m. Tool box meetings are mostly not held and subcontractors are not encouraged to participate in safety meetings.
n. On the occurrence of any accident, immediate organization level action is taken only on 11.8 % projects.
o. On mega projects, workers are counseled after committing any unsafe act and if they repeat the same then they are penalized in form of monetary loss. On the contrary, no incentives are announced for the workers for doing the job safely.
p. Standard of housekeeping is generally satisfactory but sanitary facilities including provision of lavatories are very poor. Similarly openings are seldom protected against fall so this aspect needs attention.
q. Guardrails are mostly found missing on scaffold platforms and wooden scaffolds are still used on small projects however mega projects are using good quality steel scaffolds.
r. The factor of *'Hoists and Cranes Operation'* has better performance level (0.7816) in CI of Pakistan.
s. The factor of *'Safety Training'* has the lowest performance level (0.5230) in the CI.

t. Better safety practices in CI of Pakistan, in descending order, are:
    1) Hoists and cranes are inspected before their operation.
    2) Objects are fastened before lifting them with the crane.
    3) Sufficient lighting arrangements are made where required.
    4) Adequate quantity of water for drinking and washing is supplied.
    5) Ventilation is ensured at confined spaces.
    6) First aid facility is made available on site.

u. The most neglected safety practices in CI of Pakistan requiring special emphasis are given below, in their descending order:
    1) Health and safety training is not provided to the employees of subcontractors.
    2) Refresher safety training sessions are not conducted for the workers.
    3) Workers have a tendency to take unnecessary risks, when not supervised.
    4) Subcontractors are not encouraged to participate in safety meetings.
    5) No job specific safety training is given to workers before start of a job.
    6) Contractor is not bound to submit *'safety plan'* before start of each task.

v. Benchmarking of eight under construction mega projects against their safety performance indicates that the factor of *'safety training'* has the lowest safety performance level, followed by *'safety in the contract documents', 'safety meetings'* and *'worker's involvement'*. The projects are enlisted below in descending order of their safety performance:
    1) The Centaurus, Islamabad
    2) New Islamabad International Airport
    3) FFC Tower, Saddar Rawalpindi
    4) Attock Oil Office Building, Morgah Rawalpindi
    5) State Bank Building, Blue Area Islamabad
    6) DHA Valley, Islamabad
    7) World Trade Center DHA-II, Islamabad
    8) Chandni Chowk Flyover, Murree Road Rawalpindi.

5.3 General Recommendations for Improving Safety in Construction Industry of Pakistan

a. Government of Pakistan may:

1) Enforce already developed labour laws through legislation so that human values and workers′ rights are respected.
2) Launch media campaign for the awareness of workers for their rights.
3) Establish an administrative body for occupational safety and health for all industries under the '*Ministry of Professional and Technical Training*'.

b. PEC may work in collaboration with this administrative body to:

1) Prepare a safety manual for CI of Pakistan which can be followed by the construction companies.
2) Conduct safety awareness training sessions periodically for all stakeholders.
3) Incorporate safety credit points in the process of contractors′ registration, enlistment and renewal.
4) Design a system to monitor the safety performance periodically:
    i. This may be ensured by maintaining the record of injuries and fatalities for all registered construction companies.
    ii. This data may be published annually so as to benchmark the safety performance of registered construction companies.
5) Develop a criterion so that a fixed percentage (5%) of project cost is allocated for safety by the clients.

c. Points for all Stakeholders:

1) Clients and contractors may emphasize on safety at all times no matter how fast the construction needs to be completed and under what budget constraints.
2) Clients and contractors may accept only safety incorporated project plans and schedules from their project managers.
3) Facilities including water for drinking, washing and bathing may be provided for workers.

4) Work force of subcontractors may also be trained.
5) Site layout planning may be carried out and all openings may be barricaded and flagged.
6) Construction companies to have *'safety policy'*, prepare *'site emergency plan'* and carry out *'job hazard analysis'* for each task.
7) An organizational chart displaying safety duties may be placed at a prominent place on project sites.

5.4 Knowledge Contribution

This research study is the pioneer effort to benchmark the current state of construction safety practices in Pakistan. It will definitely help the stakeholders of CI to find the weaknesses in their safety practices. Comparison of safety practices on under construction mega projects will develop a sense of competition among the project owners to improve their safety performance. This effort will definitely fuel the evolutionary process of changing the mindset of all stakeholders to invest in safety for better productivity. Moreover, CI will take into account the well being of workers and will start valuing human life.

5.5 Recommendations for Future Research

a. This study may be repeated with a larger sample size covering all cities of Pakistan. *{sample used in this study was adequate for statistical analysis, having a sampling error of ±9.40%, however this error can be reduced by increasing the sample size}.*
b. Benchmarking requires team effort and it is a continuous process for enhancing performance level so for next benchmarking study, a group of students may be trained at university level for measuring safety performance and then dispatched to different cities to collect data for benchmarking analysis.

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APPENDIX-I

Covering letter

SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING (SCEE)

SURVEY QUESTIONNAIRE

To: _____

Subject: **Benchmarking the Current State of Construction Safety Practices in Pakistan**

Department of Construction Engineering and Management at School of Civil and Environmental Engineering (NUST) Islamabad is conducting a research survey for "benchmarking the current state of construction safety practices in Pakistan".

The construction industry (CI) is one of the most important industries, participating in our national infrastructure development. An increase in the volume of construction is a positive indicator of national development and economic prosperity. This research is aimed at identifying and improving the current safety practices in the CI of Pakistan so as to develop a *safe work environment* for all the stakeholders of CI.

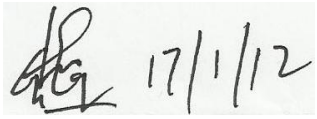
We are interested to find out how you feel about safety practices on your construction site. We are conducting confidential surveys. We would like you to complete the attached questionnaire, for which confidentiality is assured. The questionnaire is relatively simple to complete, asking about current standard of safety practices and your attitude towards safety issues. Your kind suggestions are also requested, to enhance safe working conditions in CI.

It is important for you to be completely honest about your feelings. All responses will be treated in strict confidence. This will assist us with analysis and interpretation of results.

We thank you for your assistance and cooperation in advance.

Yours sincerely,

HAFIZ ZAHOOR AHMAD KHAN
Post Graduate Student of Construction Engineering and Management
Email: szahoorahmadkhan@gmail.com
Contact: 03445544000



DR. RAFIQ MUHAMMAD CHOUDHRY
Professor and Head
Department of Construction Engineering and Management
National Institute of Transportation
School of Civil and Environmental Engineering
Sector H-12, NUST, Islamabad.

APPENDIX-II

Q u e s t i o n n a i r e

National University of Sciences and Technology, Islamabad

QUESTIONNAIRE

Subject: **Benchmarking the Current State of Construction Safety Practices in Pakistan**

General Information about the Respondent	
Personal Details: *(All the details will be kept confidential)*	
Name: (Optional)	
Name of Company:	
Telephone: (Optional)	
Email: (Optional)	
Please encircle appropriate category for each question below.	
Age (years)	1. Under 18 2. 18-25 3. 25-35 4. 35-50 5. 50+
Gender	1. Male 2. Female
Marital status	1. Married 2. Single
You belong to which stakeholder organization?	1. Owner 2. Contractor 3. Consultant 4. Subcontractor
Position/Appointment	1. Manager 2. Field Engineer 3. Inspector 4. Worker 5. Supervisor 6. Safety official
Experience in Construction Industry (years)	1. 0-5 2. 6-10 3. 11-15 4. 16-20 5. 20+
How long you have worked in this company (years)	1. Less than 1 year 2. 1-5 years 3. 6-10 years 4. 11-15 years 5. More than 15 years
Education	1. Below Primary 2. Primary 3. Secondary 4. Certificate/Diploma 5. College or Higher

BENCHMARKING THE CURRENT STATE OF CONSTRUCTION SAFETY PRACTICES IN PAKISTAN

Safety Factors/Practices *Please encircle one box to indicate the level of performance of each safety practice in your company*		**Very Low**	**Low**	**Moderate**	**High**	**Very High**
1. **Management's Commitment to Safety**						
01	Top priority of higher management is the safety and not the productivity.	1	2	3	4	5
02	There is no work pressure on workers and Safety is given priority over time.	1	2	3	4	5
03	Regular safety inspections conducted by Higher Management / Safety Officials.	1	2	3	4	5
04	Management motivates to work safely.	1	2	3	4	5
05	Company really cares about the health and safety of the people who work here.	1	2	3	4	5
06	Field Engineer, Supervisor and Safety Officer encourage reporting of hazards.	1	2	3	4	5
07	Management acts quickly to correct safety problems.	1	2	3	4	5
08	Good communication is established between management and workers.	1	2	3	4	5
09	Sufficient manpower and equipment are always made available by management, to do the job safely.	1	2	3	4	5
2. **Workers' Involvement**						
10	Safety rules and procedures are strictly followed by the workers.	1	2	3	4	5
11	Workers react strongly against any violation of safety rules by co-workers.	1	2	3	4	5
12	People here always work safely even when they are not being supervised.	1	2	3	4	5
13	Workers do not consider safety as a compulsion from the management.	1	2	3	4	5
3. **Safety in the Contract Documents**						
14	Contractor was mandated in contract to submit his 'safety policy' for the project.	1	2	3	4	5
15	Contractor is bound to submit 'safety plan' before start of each task.	1	2	3	4	5
4. **Safety Rules/Procedures and Policies**						
16	Company has developed its safety policy in the light of OSHA.	1	2	3	4	5
17	Site emergency plan is prepared and job hazard analysis is done for each task.	1	2	3	4	5
18	Safety audits are conducted regularly.	1	2	3	4	5
19	First aid facility is made available on site.	1	2	3	4	5
20	Workers medically examined regularly.	1	2	3	4	5
21	Insurance coverage provided to workers.	1	2	3	4	5

	Safety Factors/Practices *Please encircle one box to indicate the level of performance of each safety practice in your company*	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
5. **Accident Reporting and Investigation Mechanism**						
22	A written accident reporting and investigation mechanism exists.	1	2	3	4	5
23	Accidents are always reported/recorded.	1	2	3	4	5
24	Investigations are always carried out to identify the causes of accidents.	1	2	3	4	5
25	Near misses are also analyzed to mitigate the future hazards.	1	2	3	4	5
6. **Safety Training**						
26	Training for new workers is compulsory.	1	2	3	4	5
27	Refresher safety training sessions are periodically conducted for all workers.	1	2	3	4	5
28	Health and safety training is provided to the employees of subcontractors also.	1	2	3	4	5
29	Adequate job-specific safety training is given to workers before start of a job.	1	2	3	4	5
30	An organizational chart is displayed on site showing names, positions and responsibilities for safety compliance.	1	2	3	4	5
31	Safety posters and sign boards are used at important places for worker's awareness, in English and Urdu language.	1	2	3	4	5
7. **Safety Meetings**						
32	Tool box meetings are held weekly.	1	2	3	4	5
33	Safety is discussed in all progress and pre-construction meetings.	1	2	3	4	5
34	Subcontractor participates in safety meetings.	1	2	3	4	5
8. **Incentives/Disincentives for Workers**						
35	Workers completing the tasks, following safety standards, are rewarded.	1	2	3	4	5
36	Safety defaulters are penalized and then trained also.	1	2	3	4	5
9. **Use of Personnel Protective Equipment (PPE)**						
37	Company has an effective system for the issuance/inspection/replacement of PPE	1	2	3	4	5
38	PPE used on site, is of good quality.	1	2	3	4	5
39	Workers are supposed to enter the work site with hard hats on.	1	2	3	4	5
40	Hearing protection and safety glasses are used when needed.	1	2	3	4	5
41	Workers at height always use safety belt along with lanyard, which is secured.	1	2	3	4	5
42	Safety nets used to prevent fall hazard,	1	2	3	4	5

Safety Factors/Practices *Please encircle one box to indicate the level of performance of each safety practice in your company*		**Very Low**	**Low**	**Moderate**	**High**	**Very High**
	where safety belts can't be used.					
10. **Housekeeping, Storage and Sanitation**						
43	Site layout planning is done before start of work and materials are stored properly.	1	2	3	4	5
44	All openings and excavated areas are flagged / barricaded.	1	2	3	4	5
45	Sharp edges are covered/protected like nails and steel bars etc.	1	2	3	4	5
46	Sufficient lighting arrangements are made where required.	1	2	3	4	5
47	Adequate quantity of water for drinking and washing is supplied.	1	2	3	4	5
48	Walkways/staircases not littered with debris and wet spots cleaned up regularly.	1	2	3	4	5
49	Scrap is disposed off regularly.	1	2	3	4	5
50	No throwing or dropping of material/equipment carelessly.	1	2	3	4	5
51	On site material is secured against wind.	1	2	3	4	5
52	Ventilation ensured at confined spaces.	1	2	3	4	5
11. **Quality of Scaffolding and Ladders**						
53	Properly designed / fastened scaffolds are used which are inspected daily.	1	2	3	4	5
54	Guardrails are placed on working scaffold platforms to prevent any fall.	1	2	3	4	5
55	Good quality ladders are used on work site having no defective rungs.	1	2	3	4	5
56	Mobile Work Platforms (MWP) are always fixed firmly before using them.	1	2	3	4	5
12. **Precautions during Excavation and Shoring**						
57	Protection against trench cave-in is always ensured by sloping or shoring.	1	2	3	4	5
58	People employed in deep and narrow ditches kept under continuous supervision.	1	2	3	4	5
13. **Hoists and Cranes Operation**						
59	Hoists and Cranes are inspected before its operation.	1	2	3	4	5
60	Objects are fastened before lifting them.	1	2	3	4	5

Any additional comments/suggestions:

_____

_____

Information about the Construction Company of the Respondent		
Q. No	**Questions**	**Answers**
1	What is name of present project?	
2	What is total cost of this project?	
3	How much is company's annual turnover?	
4	How many floors this building has?	
5	How many full-time field workers does your company employ at a time?	
6	What percentage of the work is subcontracted?	
7	How many workers suffered work injuries last year that required a treatment?	
8	How much is the average annual expenditure on treatment of injured workers?	
9	How much is the average annual expenditure on funeral arrangement, legal requirements and compensation for death cases?	

Encircle the most appropriate option/category in the following questions

10. This project belongs to:- 1. Public sector 2. Private sector

11. In which category, your company is registered with Pakistan Engineering Council (PEC)?

1. C-A 2. C-B 3. C-1 4. C-2 5. C-3 6. C-4
7. C-5 8. C-6 9. Not registered/Unknown

12. How much amount is allocated in project budget for safety implementation and support?

1. No budget allocated for safety 2. Less than 1%
3. 1-2% 4. 2-4%
5. 4-6% 6. More than 6%

13. Tool box meetings are held regularly:

1. Daily 2. Twice a week 3. Weekly
4. Fortnightly *(once in 15 days)* 5. Never held

14. Which of the following post-accident safety response mechanism is usually followed on site:

1. Immediate organizational level action is taken (investigation, penalization, etc.)
2. Preventive actions are taken for avoiding similar occurrences in future
3. Only the accident is reported (no further action taken)
4. Only the site/ project manager decides the response mechanism

15. Who is responsible for the safety of employees in the contractor's organization?

1. Employees (themselves)
2. Field supervisor
3. Construction manager (site)
4. Project director (office)
5. Safety officer

Thanks for your co-operation