

**DEVELOPMENT OF A FRAMEWORK FOR  
IMPLEMENTING SAFETY ON CONSTRUCTION SITES**

by

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A thesis submitted in partial fulfillment of  
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**Waqas Ahmed**

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**DEDICATED  
TO  
MY PARENTS**

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(Waqas Ahmed)

## **ABSTRACT**

Safety management on construction sites has always been a major issue in the construction industry of Pakistan. The safety conditions on construction sites vary depending upon the nature of work and management commitment towards implementing safety on construction projects. There is no requirement for implementing safety management system from the government in the country. Construction companies are lacking a framework to follow for implementing safety on construction projects. The safety framework can help construction professionals to implement and improve construction safety practices on their project sites. This study presents the development of a framework for implementing safety on construction sites. Extensive literature review was carried out to design a suitable safety framework. Questionnaire items were adopted from previous studies and modified through pilot survey for collecting data from construction project. In addition to questionnaire survey, ten safety management interviews were conducted. These interviews were conducted from the representatives of contractors to obtain insights about the safety management practices in the construction industry of Pakistan. Safety management survey was conducted on seventy construction sites in different cities of Pakistan with the help of an instrument covering seven aspects of construction safety management, which are health and safety policy, safety organization, safety training, safety inspections, safety promotion, personal protection program, and documentation and accident prevention. The collected data was analyzed by using software SPSS 17. The results reveal that top management of construction companies needs to show commitment for developing and implementing safety management systems to improve safety conditions on construction sites. Results emphasize the requirement of competent staff which need to be appointed to implement safety on construction sites. Interviewees agreed that at the government level, it is imperative to establish a government agency to supervise and control the implementation of safety on construction sites in the construction industry. Finally, a safety framework is presented which the companies can adopt and embrace. The findings of this research will help Pakistani construction companies to improve safety on construction sites.

# TABLE OF CONTENTS

<b>ACKNOWLEDGEMENT</b> .....	<b>v</b>
<b>ABSTRACT</b> .....	<b>vi</b>
<b>TABLE OF CONTENTS</b> .....	<b>vii</b>
<b>LIST OF TABLES</b> .....	<b>xi</b>
<b>LIST OF FIGURES</b> .....	<b>xii</b>
<b>CHAPTER 1</b> .....	<b>1</b>
<b>INTRODUCTION</b> .....	<b>1</b>
1.1    BACKGROUND .....	1
1.2    PROBLEM STATEMENT .....	2
1.3    SIGNIFICANCE OF THE STUDY.....	3
1.4    RESEARCH OBJECTIVES .....	3
1.5    SCOPE OF THESIS .....	3
1.6    ORGANIZATION OF THESIS .....	3
<b>CHAPTER 2</b> .....	<b>6</b>
<b>LITERATURE REVIEW</b> .....	<b>6</b>
2.1    INTRODUCTION .....	6
2.2    CONSTRUCTION INDUSTRY IN DEVELOPING COUNTRIES .....	6
2.3    CONSTRUCTION INDUSTRY OF PAKISTAN.....	7
2.4    IMPORTANCE OF SAFETY .....	8
2.5    CONSTRUCTION SAFETY IN PAKISTAN.....	8
2.6    SAFETY MANAGEMENT SYSTEMS.....	11
2.6.1    Literature on Safety Management.....	21
2.6.2    Benefits of implementing SH&E Management System .....	22
2.7    SAFETY POLICY .....	23
2.8    SAFETY ORGANIZATION .....	23
2.9    SAFETY TRAINING .....	24
2.10   SAFETY INSPECTIONS .....	25

2.11	SAFETY PROMOTION.....	26
2.12	PERSONAL PROTECTION PROGRAM .....	26
2.13	DOCUMENTATION AND ACCIDENT PREVENTION .....	27
2.14	KEY FACTORS OF SAFETY IN CONSTRUCTION .....	27
<b>CHAPTER 3 .....</b>		<b>29</b>
<b>RESEARCH METHODOLOGY .....</b>		<b>29</b>
3.1	INTRODUCTION .....	29
3.2	RESEARCH DESIGN .....	29
3.3	RESEARCH METHOD.....	31
3.3.1	Data Collection .....	31
3.3.2	Safety Management Survey .....	32
3.3.3	Safety Management Interviews.....	33
3.3.4	Construction Safety Framework Development.....	33
<b>CHAPTER 4.....</b>		<b>34</b>
<b>DATA ANALYSIS AND RESULTS .....</b>		<b>34</b>
4.1	INTRODUCTION .....	34
4.2	SAFETY MANAGEMENT SURVEY RESULTS .....	34
4.2.1	Health and Safety Policy.....	40
4.2.2	Safety Organization .....	40
4.2.3	Safety Training.....	41
4.2.4	Safety Inspections .....	42
4.2.5	Safety Promotion .....	42
4.2.6	Personal Protection Program.....	43
4.2.7	Documentation and Accident Prevention .....	43
4.3	SAFETY MANAGEMENT INTERVIEWS RESULTS.....	44
4.4	CONSTRUCTION SITE SAFETY IMPLEMENTATION FRAMEWORK.....	56
4.4.1	Management Commitment.....	57



4.4.1.1	Safety Responsibility .....	59
4.4.1.2	Safety Committee.....	59
4.4.2	Safety Implementation .....	60
4.4.2.1	Safety Policy .....	60
4.4.2.2	Safety Rules .....	62
4.4.2.3	Safety Organization .....	62
4.4.2.4	Safety Responsibility .....	62
4.4.2.5	Safety Management System.....	62
4.4.2.6	Compliance with Safety Legislations .....	63
4.4.2.7	Safe Working Environment .....	63
4.4.2.8	Safety Induction and performance Monitoring.....	63
4.4.2.9	Selection of Subcontractors .....	63
4.4.3	Safety Training.....	64
4.4.3.1	Safety Training.....	64
4.4.3.2	Updated Safety Information.....	64
4.4.3.3	Safety Promotion .....	64
4.4.4	Emergency Response Procedures .....	64
4.4.4.1	Emergency Response Plan and Procedures .....	65
4.4.5	Accident Investigation .....	66
4.4.5.1	Accident Recording .....	66
4.4.5.2	Accident Analysis .....	66
4.4.6	Safety Review .....	67
4.4.6.1	Safety Hazard Review.....	67
4.4.6.2	Site Safety Policy Review.....	67
4.4.6.3	Safety Audit .....	68
<b>Chapter 5</b>	.....	<b>69</b>
<b>DISCUSSION</b>	.....	<b>69</b>
5.1	INTRODUCTION .....	69

5.2	DISCUSSION ON RESULTS FOR THE SAFETY MANAGEMENT SURVEY.....	69
5.3	DISCUSSION ON MANAGEMENT INTERVIEWS .....	70
5.4	DISCUSSION ON CONSTRUCTION SAFETY FRAMEWORK .....	71
	<b>CHAPTER 6.....</b>	<b>74</b>
	<b>CONCLUSIONS AND RECOMMENDATIONS.....</b>	<b>74</b>
6.1	INTRODUCTION .....	74
6.2	REVIEW OF RESEARCH OBJECTIVES .....	74
6.3	CONCLUSIONS.....	75
6.4	RECOMMENDATIONS .....	76
	<b>REFERENCES.....</b>	<b>78</b>
	Appendix I: Cover Letter of Safety Management Questionnaire .....	81
	Appendix II: Safety Management Questionnaire .....	82
	Appendix III: Descriptive questions for interview .....	85
	Appendix IV: List of Construction Sites for Safety Management Survey .....	86
	Appendix V: List of Respondent’s Ages and Experiences .....	90
	Appendix VI: Data in SPSS and Results .....	93

## LIST OF TABLES

<b>Table 4.1:</b> Questionnaire Results .....	37
<b>Table 4.2:</b> Details of Interviewees .....	45
<b>Table 4.3 :</b> Requirements for Health and Safety Committees.....	59
<b>Table 5.1:</b> Comparison of Safety Implementation Framework.....	72

## LIST OF FIGURES

<b>Figure 1.1:</b> Thesis Organization.....	4
<b>Figure 2.1:</b> No. of Industrial Accidents in Pakistan.....	11
<b>Figure 2.2:</b> HS(G) 65 Model.....	14
<b>Figure 2.3:</b> BS OHSAS 18001 Model .....	17
<b>Figure 2.4:</b> Flow Diagram Based on the ILO Approach.....	20
<b>Figure 2.5:</b> Key Factors of Safety in Construction (Permana 2007) .....	27
<b>Figure 3.1:</b> Research Methodology .....	30
<b>Figure 4.1:</b> Overall Responses Chart .....	35
<b>Figure 4.2:</b> Respondent's Age Percentage Distribution Chart.....	35
<b>Figure 4.3:</b> Respondent's Experience Percentage Distribution Chart .....	36
<b>Figure 4.4:</b> Control Chart for Positive Response Rate.....	38
<b>Figure 4.5:</b> Control Chart for C-A Category Companies.....	39
<b>Figure 4.6:</b> Construction Site Safety Implementation Framework .....	58



## **INTRODUCTION**

### **1.1 BACKGROUND**

The safety of workers on construction sites is a complex phenomenon. Construction is always risky because of outdoor operations, work-at-heights, complicated on-site plants and equipment operation coupled with workers attitudes and behaviors towards safety (Wilson, 1989; Choudhry, 2008). However, safety is not a luxury and should be considered as an important function to be set against unnecessary loss of property, injury or death. Preventing occupational injuries and illness should be a primary concern of all employees.

Construction is a high hazard industry that comprises a wide range of activities involving construction, alteration, and/or repair. Examples include residential construction, bridge erection, roadway paving, excavations, demolitions, and large scale painting jobs. Construction workers engage in many activities that may expose them to serious hazards, such as falling from rooftops, unguarded machinery, being struck by heavy construction equipment, electrocutions, silica dust, and asbestos.

Concerning the safety aspects within the construction industry, it is apparent that the implementation of safety best practices is still far from good. Even when the industry has improved, not only in number but also in their scale and which sometimes involves overseas companies where international safety regulations should be applied. The roles, regulations and laws in Pakistan about the safety of construction works are not clear. As a result, accidents in the construction industry, in spite of everything, are increasing.

Considering the adverse impacts of accidents, construction safety management is of genuine concern to all stakeholders in the construction industry. Government, unions and insurers have spent a great deal of time and effort attempting to evolve legislation, rules and regulations to help reduce the large loss of life and limbs, and the high number of “lost-work days” (Goldsmith, 1987; Dorji and Hadikusumo, 2006). In USA, the practice of safety in construction is regulated

by governmental agencies such as Occupational Safety and Health Administration (OSHA), which provides strict rules and regulations to enforce safety and health standards on job sites. However, legislation alone cannot reduce accident rates unless craftsmen and management take positive actions to integrate these rules into their everyday activities by implementing a safety management program. Safety management is an approach aimed at removing or minimizing the forces which causes losses through injured workers, or damaged equipment and facilities (Dorji and Hadikusumo, 2006).

This research aims for development of a framework for implementing safety on construction sites in the construction industry of Pakistan. The construction safety framework is helpful for promoting safety culture for the Pakistani construction companies. There is no framework that has been established in this context. The development will enable construction professionals to quantify and analyze safety on their construction sites in a consistent manner.

## **1.2 PROBLEM STATEMENT**

Safety management system needs to be considered as the basis for safely managing site operations. It consists all the requirements i.e policies, objectives, roles, responsibilities, accountabilities, codes, standards, communications, processes, procedures, tools, data and documents that are necessary for imparting safety on construction sites.

Implementation of construction safety practices in Pakistan will not be achieved without the concern and involvement of the government. Construction accidents, which often occur, are due to neglecting certain safety regulation. These cases of accidents have been going on since the early development of the construction industry. Every case of construction accident involving casualty of an individual or to a number of workers had never been investigated thoroughly and ironically the matters are finally resolved with conclusion of careless conduct.

In developing countries like Pakistan, safety rules usually do not exist; if any exist, the regulatory authority is usually very weak in implementing such rules effectively. Further, work hazards at the construction workplace are either not perceived at all, or perceived to be less dangerous than what they actually are. In

Pakistan, the framework of the existing occupational and health conditions is fragmented and inadequately enforced, making construction sites more hazardous. It may even be argued that relevant regulations are outdated and irrelevant in day-to-day construction operations (Ali, T. H., 2006).

### **1.3 SIGNIFICANCE OF THE STUDY**

The construction safety framework which is going to be established for implementing safety on the construction sites is helpful for the local construction companies to improve their overall performance relating to safety and to remain in the dynamic business in construction industry in the future. Also some data will be gathered which serves as a reference for future research based on the safety framework and also contribute to the local construction industry.

### **1.4 RESEARCH OBJECTIVES**

The main objectives of the study are;

- To study the safety management system required for safely managing operations on construction sites.
- To develop a safety framework for implementing safety on construction sites.

### **1.5 SCOPE OF THESIS**

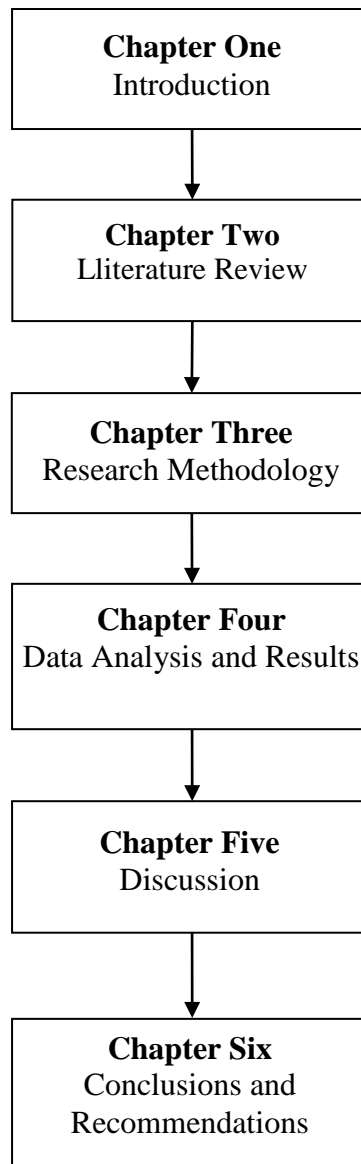
The study covers 55 construction sites. The construction companies working at these sites are registered with Pakistan Engineering Council (PEC) in CA, CB, C1, C2, C3, and C4 categories. Seven aspects, health and safety policy, safety organization, safety training, safety inspections, safety promotion, personal protection program and documentation and accident prevention are covered in the safety management survey. The interviews are conducted with the senior management level, including Deputy Project Director, Project Coordinator, Project Directors, Project Managers, Site Engineers, Safety Managers and Safety Officers of the construction companies at sites and head offices.

### **1.6 ORGANIZATION OF THESIS**

This thesis consists of six (6) chapters followed by references and nine (9) appendices of supporting information as well as the results of data collection and



analysis as shown in Figure 1.1. Survey instruments, statistical analysis and discussions are given in the thesis.



**Figure 1.1:** Thesis Organization

Chapter 1 introduces construction safety, describes background, problem statement, significance of the study, research objectives and scope of the thesis.

Chapter 2 presents literature review which includes introduction, construction industry in developing countries, construction industry in Pakistan importance of safety, construction safety in Pakistan, safety management systems, seven aspects of construction safety i.e safety policy, safety organization, safety training, safety inspections, safety promotion, personal protection program and

documentation and accident prevention and in the end key factors of safety in construction are given.

Chapter 3 mainly focuses on research methodology. It includes introduction, research design, research method for data collection, safety management survey, safety management interviews and development of construction site safety implementation framework.

Chapter 4 is about data analysis and results. It starts with introduction and followed by results and analysis of safety management survey, results and analysis of safety management interviews and construction site safety implementation framework model is developed and explained.

In chapter 5, discussions are given for safety management survey, management interviews and construction safety framework. Comparison of construction safety framework is made with other frameworks from previous studies.

Chapter 6, conclusions and recommendations are given based on the safety management survey and management interviews.

## **LITERATURE REVIEW**

### **2.1 INTRODUCTION**

This chapter presents brief review of research study already conducted on safety management in construction industry of developed and developing countries. The importance of safety is discussed The main focus is on the safety conditions in construction industry of Pakistan and the previous studies being conducted in safety and the safety practices in the construction industry of Pakistan. A detailed study on safety management systems is also carried out. In order to implement safety on construction sites, an exploratory study is carried out in order to develop the framework for local construction companies to implement safety on their construction sites.

### **2.2 CONSTRUCTION INDUSTRY IN DEVELOPING COUNTRIES**

Construction within developing countries often fails to meet the needs of modern competitive businesses in the marketplace and rarely provides the best value for clients and taxpayers (Datta, 2000; Ali, T. H., 2006).

In adopting different approaches to health and safety in developed and developing countries, two main differences can be identified. The first is the existence of legislation and its effective implementation; the second is hazard awareness. In developed countries, many safety acts and legislation exist and are implemented effectively. Nominated safety officers promote hazard awareness with the help of regular safety training sessions. In developing countries, however, safety rules barely exist at all; and any that do are inappropriate, ineffective, out-of date and based on conditions that prevailed while the country was still being colonized. 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 & Sohail, 1999; Hinze et al., 1999; Ali T.H., 2006).

International labour organization (ILO) attributes the poor health and safety records in construction projects within developing countries to:

- The high proportion of small firms and high number of self-employed workers;
- The variety and comparatively short life of construction sites;
- The high turnover of workers;
- The large proportion of seasonal and migrant workers; and
- Various trades and occupations working in the same area.

### **2.3 CONSTRUCTION INDUSTRY OF PAKISTAN**

According to Ali, T.H., 2006, Pakistani construction industry is more labour intensive, with moderately less use of mechanisation. Therefore, compared with other industries in Pakistan (like the manufacturing industry), this industry is labelled as being backward because of its relative lack of use of the latest advances in technology, management styles and procedures. Indeed it invests very meagre amounts in research and development which hinders the industry's ability to adopt new technology and processes. Despite the use of less mechanisation, Pakistan's construction industry is still characterized as pressured and adversarial, with long working hours comprising underpaid jobs. Further, construction projects in Pakistan generally run over time and over cost schedules; do not necessarily meet user expectations; and often require remedial works due to construction defects. Usually finance, time schedules and standards of work are the main conflicting issues, leading to project disputes and thus litigation.

Furthermore, in Pakistan, most clients demand high speed, high quality work at the lowest cost. Time and financial pressures often mean that the client does not give sufficient time for preparation of the design. Costs are affected by the standard of workmanship specified, the complexity of the work and the contract conditions. The working pattern of the local construction industry has the same convention as other construction industries elsewhere. Consultants (architects and engineers) usually work directly for the client, and their appointment is made well before the design and construction cost, and to choose the appropriate type of contract.

As with other developing countries, the fact that the government is a major public sector client has a profound effect on Pakistan's construction industry, both directly and indirectly.

## **2.4 IMPORTANCE OF SAFETY**

Workplace safety is a complex phenomenon and the subject of attitudes and safety performance in the construction industry is even more complex. The risk of a fatality in construction is five times more likely than in a manufacturing based industry. It is not only the workers who suffer from an accident but, directly or indirectly the employer, contractor and the public in general also suffers. The economic effects of an accident can be devastating, apart from human cost of suffering. Accidents at work place occurs either due to lack of knowledge or training, a lack of supervision, or a lack of means to carry out the task safely, or alternatively, due to an error of judgement, carelessness, or apathy. 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; Baig, 2001). Safety cannot be guaranteed by legislation or regulations alone, nor should safety be the sole responsibility of the employer, the employees must be involved. Safety must be a team effort and it requires education and training.

## **2.5 CONSTRUCTION SAFETY IN PAKISTAN**

Pakistan is a developing country that is currently enjoying relatively strong growth in construction activities. Unfortunately, the enforcement of safety regulations is not widespread within Pakistan. Some people may even argue that the framework of existing occupational and health conditions of Pakistan's construction industry is fragmented and inadequately enforced. Likewise in any industry, good health and safety conditions constitute good and safe business practice. Therefore, it is believed that the integration of safety and health measures into a total management system, within the construction sector in Pakistan, could contribute significantly to the cost efficiency, quality assurance and environmental protection of the companies and its employees (Ali T.H., 2006). The main law governing Occupational Health and Safety (OHS) is the *Factories Act 1934*. The

Hazardous *Occupation Rules of 1978* regulate certain occupations as hazardous, and contain special provisions to regulate the working conditions in those occupations. Unfortunately, construction has never been added to such laws or provisions. Other laws dealing with OHS are:

- The Mines Act 1923;
- Workmen's Compensation Act 1923;
- Dock Labourer Act 1934;
- Social Security Ordinance 1965; and
- Shop and Establishment Ordinance 1969.

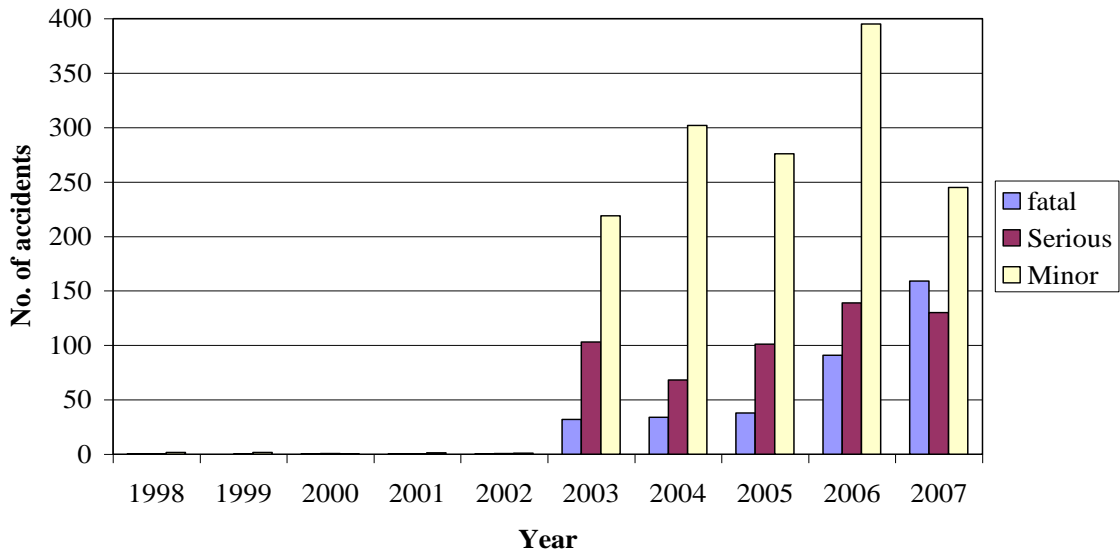
Regrettably, the health and safety measures prescribed in most of the above laws have not kept pace with the rapidly changing times, conditions or industry requirements. Many of the sectors, with serious OHS hazards (including those with most of the workers) are not covered by these laws, even though they contain very few technical standards. These laws urgently require revision and updating (Awan, 2001; Ali, T.H., 2006). Additionally, due to the lack of enforcement of labour law, the majority of construction accidents are not reported to the Labour Department. Usually only those incidents that result in fatalities, or gain media interest, are reported. It therefore seems unlikely that available occupational health and safety data would be reliable. Thus, without the proper information on the basic causes of accidents and injuries, it is difficult to initiate effective measures to reduce the frequencies of accidents, or to improve the overall safety standards within the construction industry of Pakistan. Furthermore, as majority of construction companies belong to the private sector, and due to limited financial and technical resources, poor working conditions are quite common.

Choudhry et al. (2008) in his study revealed that on construction sites in Pakistan, the implementation of safety management does not occur. Data on injuries and fatalities rates are not easily available, and published research on construction safety is not available either. Both are required to raise the level of safety awareness in the country. In these circumstances, the Directorate of Workers Education (DWE) established in 1982 under the Ministry of Labour, is an educational and training organization responsible for creating awareness and

providing knowledge and information to workers, trade union leaders and management representatives about labour and social issues by mounting various courses round the year. Strict regulations do exist on child labour and the provision of a minimum wage. This minimum wage differs in urban and rural areas. The central government periodically revises labour force wages. In summer, the temperature is extremely hot (above 40°C) in most parts of the country. On construction projects, employees often work in sizzling heat and it is common for workers to become ill due to heat exhaustion. There is a dire need for contractors to implement a safety, health and environmental management system providing standards and procedures for various construction operations.

Developing countries like Pakistan have yet to respond to recent technological improvements. Lack of response to technology, however, has not resulted in safer construction sites. In fact, a larger share of construction work being performed by human resources has led to increased number of site accidents. In Pakistan, roughly 6-7% labour is directly attached with the construction industry. Informal assessments have identified a few major reasons for safety non-performance which include: lack of development of construction sector in the shape of mechanization and industrialization; lack of professional construction management practices which has not only led to unsafe project sites but also resulted in construction delays, cost overruns, poor productivity and poor product and process quality; inadequate safety provisions laid by the existing regulatory environment which has failed to establish safety as a major industry objective; insufficient and incentive less insurance mechanisms which have failed to establish safety as a business survival issue; and unfavorable business environment which has led to adversarial business relationships among stakeholders resulting in controversies, conflicts, claims and litigation and hence diverting the focus away from issues like safety (Farooqui et al., 2008). Data records are insufficient for the number of accidents occurring on construction sites. Figure 2.1 shows the available data from labour division of Pakistan about the industrial accidents in factories registered under Factories Act-1934:

**Number of Industrial Accidents**



**Figure 2.1:** No. of Industrial Accidents in Pakistan (Source: Labour Division)

## 2.6 SAFETY MANAGEMENT SYSTEMS

The safety management system should include the part of the general management system which includes the organizational structure, responsibilities, practices, procedures, processes and resources for determining and implementing the major accident prevention policy. It is recognised that the safe functioning of an establishment depends on its overall management. Within this overall management system, the safe operation of an establishment requires the implementation of a system of structures, responsibilities, and procedures, with the appropriate resources and technological solutions available. This system is known as the Safety Management System (SMS). Thus any Safety Management System is a constituent part of the overall management system of the establishment, which may in turn be dependent on a management system developed for a larger entity such as a company or group of companies. The Safety Management System may also involve integration with a management system which addresses other matters, such as the health of workers, the environment, quality, etc. It is possible to develop a Safety Management System by extending the scope of an existing management system, but it will be incumbent upon the operator to ensure, and demonstrate where necessary, that the management system has been fully developed to cover



major-accident controls and meet the requirements of the organization (Mitchison & Porter, 1996). Preventing injuries to workers is essential to effective organizational management in the construction industry. It is generally accepted that achieving a high level of safety performance requires the implementation of an effective safety program. The critical elements of an effective construction safety program are:

- Emergency response planning
- Frequent safety inspections
- Job hazard analysis
- Record keeping and accident analysis
- Safety and health committees
- Safety and health orientation
- Site-safety manager
- Site-specific safety plan
- Subcontractor selections and compliance
- Substance abuse programs
- Training and regular safety meetings
- Upper Management Support
- Worker participation and involvement

In a report given by Wrightson *et al.* (2009), Environment, Health and Safety Committee Note on Occupational Health and Safety Management Systems show that Legislation in the United Kingdom requires that employers have appropriate arrangements in place for the management and control of health and safety at work. In order to achieve these requirements employers need to have an effective occupational health and safety management system that is clearly defined and well documented. There are a number of occupational health and safety management systems which can be applied including the HSE Guidance Booklet HS(G)65 “Successful health and safety management”, the British standard BS OHSAS 18001:2007 “Occupational health and safety management systems – Requirements” and the international Labor Office ILO-OSH 2001 “Guidelines on

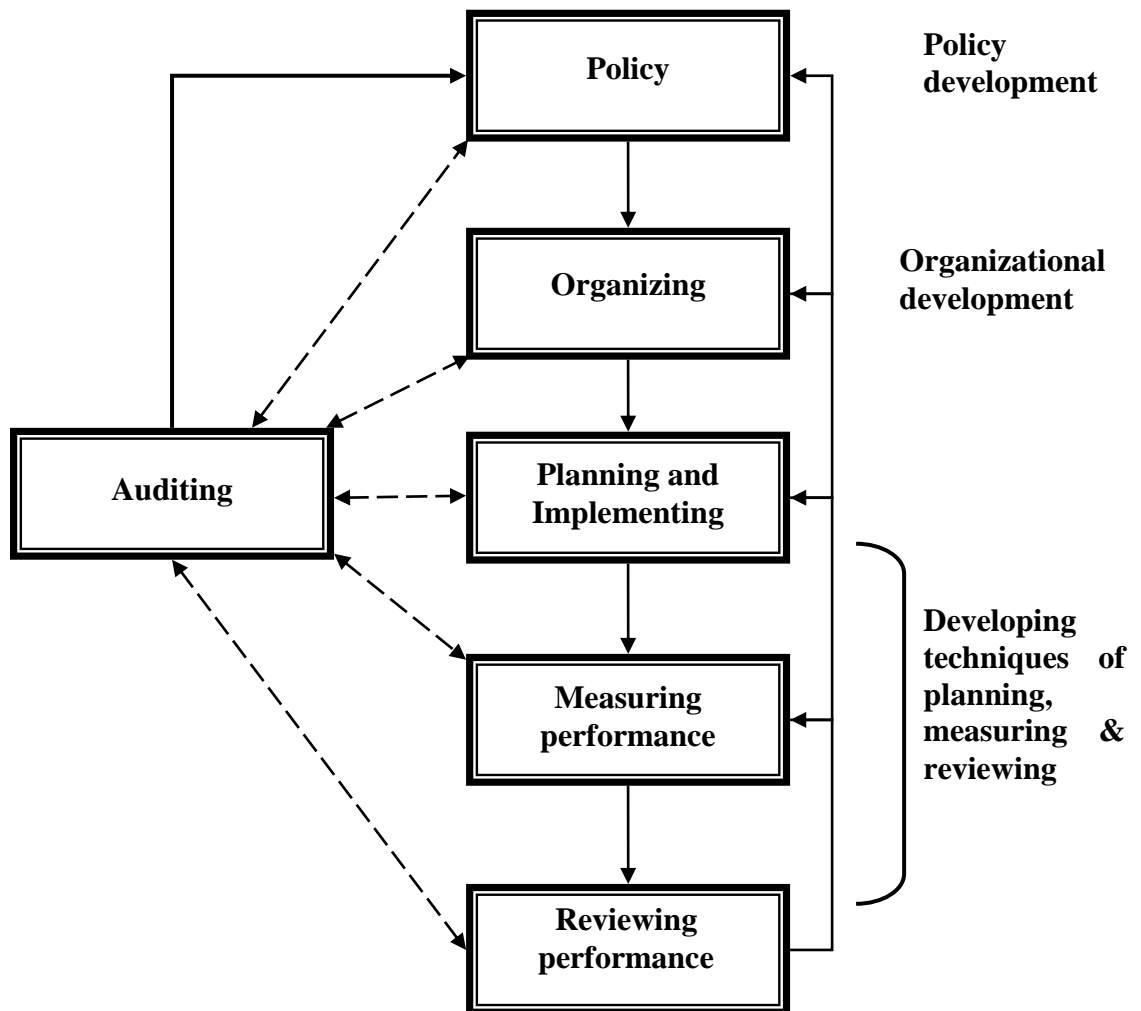
occupational safety and health management systems”. Each of these management systems is based on the “plan–do-check-act” management model and embodies the principal of continual improvement as exemplified in the British Standard for quality assurance systems. The international safety management systems models are shown in the following three headings:

**i) HS(G) 65 Model**

The Health and Safety Executive first published “Successful health and safety management”. HS(G)65, in 1991 and the revised edition was published in 1997. HS(G)65 takes the “plan-do-check-act” management model and translates it into the five key elements of a successful health and safety management system. The five elements are:

- Policy
- Organizing
- Planning and Implementing
- Measuring performance
- Reviewing performance

These elements are inter-linked and are subject to auditing as shown in the HS(G)65 occupational health and safety management system model in figure 2.2 below. In this model the policy should set out a clear direction for the organization to follow. It should demonstrate the organization’s intention to achieve and maintain high standards of health and safety and the commitment to continuous improvement. The policy should establish the health and safety management system and the responsibilities for achieving its objectives.



**Figure 2.2:** HS(G) 65 Model (Adopted from Wrightson *et al.*, 2009) **Feedback loop to improve performance**

Organizing for health and safety requires both management and employees to be actively involved and committed to the policy. This participation can be achieved by ensuring management control, the effective co-operation of employees and their safety representatives, the establishment of an effective safety communication system, achieving co-ordination of activities and ensuring the competence of all employees.

Planning and implementing requires a systematic approach to implementing the policy and the establishment of an effective management system for the minimization of risks. Risk assessment methods should be used to establish priorities and objectives for eliminating hazards and reducing risks. If possible, risks should be eliminated through the selection and design facilities, equipment and processes. If risks cannot be eliminated, they should be minimized by the use

of physical controls or, as a last resort, through safe systems of work and the use of personal protective equipment. Performance standards should be established and should be used for the measuring of performance. Actions should be identified for the promotion of a positive health and safety culture.

Measuring performance reveals how effectively the health and safety management system is functioning. This can be done both from an active and a reactive perspective. Active monitoring is intended to measure the achievement of objectives and standards. This involves inspections and checks to ensure standards are being implemented and that the management controls are operating correctly. Reactive monitoring involves the collection and analysis of failures of the health and safety management systems. Organizations need to learn from accidents, ill-health, property damage and near misses. Information from both active and reactive monitoring can be used to identify causes of failures or sub-standard performance and to refine the management system to prevent recurrences and to improve performance.

The systematic review of performance should be based on both the data from monitoring and the results of audits of the management system. The review should consider the standard of compliance with the health and safety policy and legislative requirements, the accident and ill-health performance and how well objectives have been met.

## **ii) BS OHSAS 18001 Model**

Following the introduction of the Management of Health and Safety at Work Regulations 1992 there was a demand for guidance on good practice for the establishment of occupational management systems. As a result the British Standards Institution (BSI) published the guidance document BS 8800:1996 “Guidance on occupational health and safety management systems” which was updated in 2004.

Following the publication of BS 8800:1996 there was pressure from commercial organizations for the preparation of a “specification” against which organizations could be audited and could obtain third party certification. As a result BSI, in association with other national standards bodies, certification bodies and

specialist consultancies, developed the Occupational Health and Safety Assessment Series document OHSAS 18001:1999 “Occupational health and safety management systems- Specification”. This document has been used extensively in over 70 countries worldwide. This document was revised in 2007 for worldwide application (OHSAS 18001:2007) and has been adopted in the UK as British Standard BS OHSAS 18001:2007 “Occupational health and safety management systems – Requirements”. Organizations are able to achieve accredited certification under this standard. The management model used in BS OHSAS 18001 is based on the BS EN ISO 14001 environmental model and is shown in Figure 2.3 below.

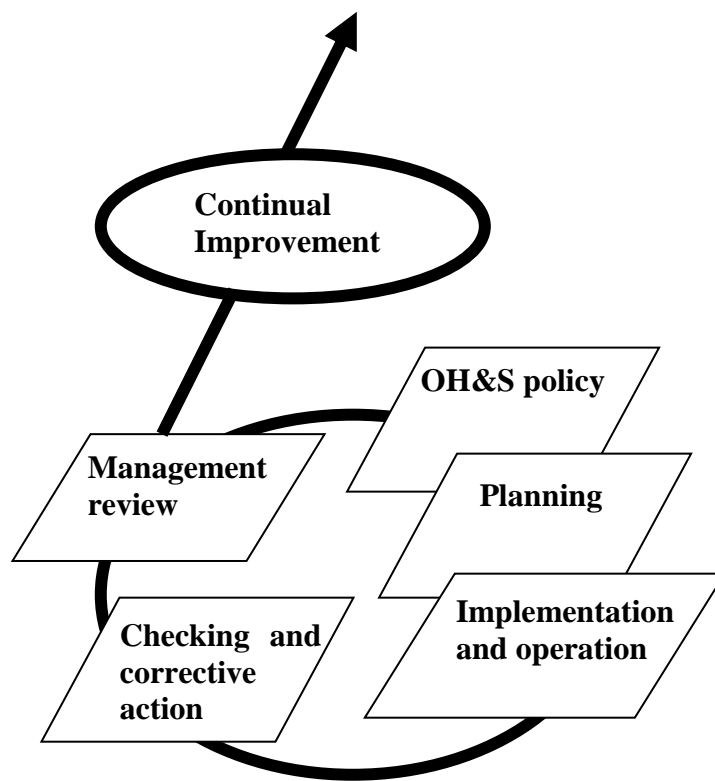
In this model the occupational health and safety (OH&S) policy must state the overall objectives and a commitment to the prevention of injury and ill-health and continual improvement in OH&S management and OH&S performance. The policy must be defined and authorized by top management.

Planning should include: hazard identification, risk assessment and risk controls; legal and other requirements; and objectives and the OH&S management programme. This programme should describe how the organization establishes and maintains systems and procedures for achieving its objectives.

Implementation and operation includes: resources, roles, responsibility, accountability and authority; competence, training and awareness; communication, participation and consultation; documentation; control of documents; operational control; and emergency preparedness and response.

Checking and corrective action relates to: performance measurement and monitoring; evaluation of compliance; incident investigation, nonconformity, corrective action and preventive action; control of records; and internal audit.

Management review requires the organization’s top management to review the OH&S management system at fixed intervals to ensure its continuing suitability, adequacy and effectiveness.



**Figure 2.3:** BS OHSAS 18001 Model (Adopted from Wrightson *et al.*, 2009)

BS OHSAS 18001 has two annexes which draw comparisons between BS OHSAS 18001:2007 and standards for environmental management systems, quality management systems and the ILO-OSH Guidelines.

The annexes demonstrate that there are no significant differences between any of these management systems. The requirements of the common elements used in all the systems show a large degree of overlap and most are common requirements. The differences between BS OHSAS 18001 and the environmental management systems and quality management systems standards relate largely to scope and the specific needs of OH&S requirements compared to those relating to quality and environment. The distinction between BS OHSAS 18001 and ILO-OSH 2001 is mainly in the order which the elements are addressed.

Detailed guidance on how to implement BS OHSAS 18001 is given in the second British Standard in the OH&S Management Systems Series, BS OHSAS 18002:2008 “Occupational health and safety management systems – Guidelines for the implementation of OHSAS 18001:2007”.

A third British Standard in the OH&S Management Systems Series is BS 18004:2008 “Guide to achieving effective health and safety performance”. This new standard is a revision of the former guidance document BS8800:2004 and is based on BS OHSAS 18001. It contains guidance on occupational health and safety management systems which can be used either as a standalone document to help establish a management system or as part of a programme under BS OHSAS 18001 to seek accredited certification.

BS OHSAS 18004 has a number of annexes which provide detailed information on elements of the management system in relation to:

- integration (of BS OHSAS 18001 management system);
- implementation and operation;
- promoting an effective OHSAS management system;
- setting objectives and planning and implementing OH&S programs;
- risk assessment and control;
- operational control;
- occupational health;
- worker involvement;
- emergency preparedness and response;
- measuring performance;
- incident investigation; and
- internal audit.

### **iii) International Standards**

Although there are formal international standards for managing quality (ISO 9000) and environment (ISO 14000), there is no recognised International Organization Standardization (ISO) certifiable standard for occupational health and

safety management. ISO has been wary of becoming involved in occupational health and safety. At an ISO Workshop in 1996 it was concluded that the time was not right for an occupational health and safety management standard. Later in 2000 ISO rejected an approach from the International Labour Organization (ILO) regarding an international standard. Consequently, after it reviewed over twenty national occupational health and safety management systems the ILO developed its own non-certifiable guidance, “Guidelines on occupational safety and health management systems – ILO-OSH 2001”. A flow diagram based on the ILO approach is given in Figure 2.4 below:

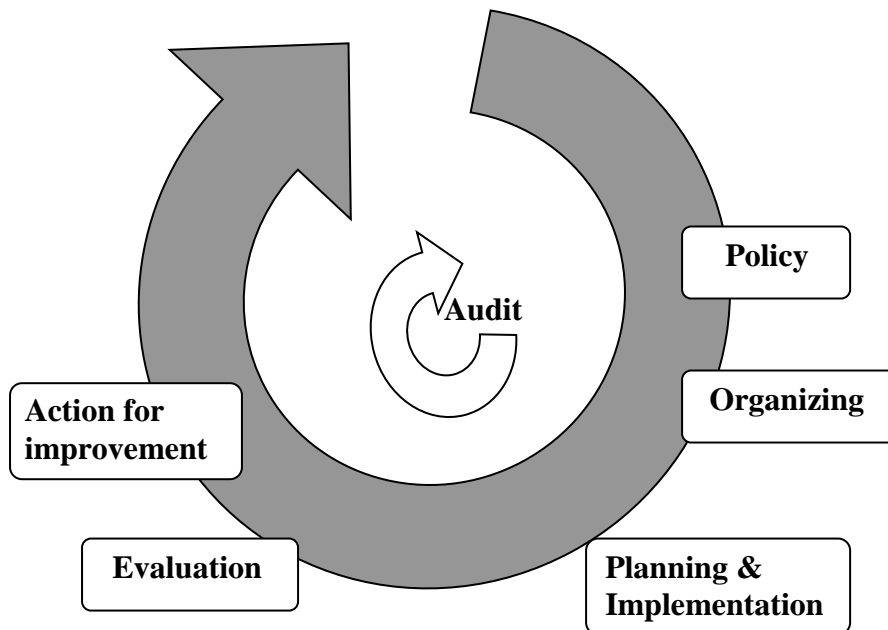
The Policy section covers both the occupational safety and health policy and worker participation. Organizing covers responsibility and accountability, competence and training, documentation and communication. Planning and implementation covers initial review, system planning, development and implementation, safety and health objectives and hazard prevention (prevention and control measures, management of change, emergency prevention, preparedness and response, procurement and contracting).

Evaluation covers performance monitoring and measurement, investigation of work-related injuries, ill health, diseases and incidents, and their impact on safety and health performance, audit and management review. Action for improvement covers preventive and corrective action and continual improvement. Although the ILO did not intend to make the standard certifiable, the Chinese Government has adopted the ILO system and has used it to develop a certification framework.

The increasing pressure to report performance and demonstrate corporate responsibility coupled with the popularity of ISO 9000 and ISO 14000 has led to a growing interest in OHSAS 18001. In the absence of an official ISO standard, OHSAS 18001:2007 has in effect become established as an “international certification standard”.

International certification bodies and national standards bodies in UK, Ireland, South Africa, Spain and Malaysia are using OHSAS 18001 for certification purposes. It is estimated that currently some 32,000 organizations in 82 countries have adopted OHSAS 18001.





**Figure 2.4:** Flow Diagram Based on the ILO Approach (Adopted from Wrightson *et al.*, 2009)

### **Which System to use?**

The choice of which system to adopt depends solely on the needs of individual organizations. However, the organization needs to ensure that their chosen system includes provision for continual improvement, involves stakeholders and auditing and is well documented in order to demonstrate effectiveness.

If an organization already has accreditation under BS EN ISO 9001 and BS EN ISO 14001 it may consider adopting BS OHSAS 18001:2007 as part of an integrated approach. BS OHSAS 18001:2007 is designed to be compatible with these standards for quality and environmental management systems.

### **2.6.1 Literature on Safety Management**

Hale et al. (1997) in the study shows that safety management has become a topic of increasing interest. These trends have produced a dramatic growth in the development and use of management system audits to assess whether an SMS is adequate and how it can be improved (e.g. International Loss Control Institute, 1990; HASTAM, 1989; Williams, 1986). Such audit systems are largely based on the collected experience of long years of consultancy or management and, with a few exceptions (e.g. Bellamy and Tinline, 1993; Brascamp et al., 1992; Det Norske Veritas, 1994), do not have explicit management models underlying them. As a result they can give the impression of being arbitrary lists of topics clustered under convenient headings which vary from one audit instrument to another. It is not clear whether they are too detailed or not complete enough (see e.g. Eisner and Leger, 1988, for criticism of one audit instrument). An explicit model of the SMS, which can present the dynamic nature of safety management processes, would provide a good starting point to assess the completeness of audits.

Many construction companies around the world are implementing safety, health and environmental management system to reduce injuries, eliminate illness, and to provide a safe work environment in their construction sites. A typical site-specific safety plan was utilized to provide safety guidance throughout the construction project (Choudhry et al., 2008). Protection of labour from occupational diseases and accidents in the construction industry in 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<sup>2</sup> there must be 2-3 safety inspectors; whenever the site exceeds 50,000 m<sup>2</sup>, the main contractor has to establish a safety management team (Tam et al., 2004).

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 (Cagno et al., 2003; Farrow and Hayakawa, 2002; Garrick, 2002; Gillen et al., 2001; Hamer, 2003; Ayomoh and Oke, 2005). The term safety management is used for convenience and for brevity, and wherever it is used be taken or refer the

management of occupational health and environment as well as safety. Safety management is concerned with, and achieved by, all the techniques, which promote the subject. Safety management is also concerned with influencing human behavior, and with limiting opportunities for mistakes to be made which result in harm and loss. To do this, safety management should take into account the ways in which people fail (Armstrong, 1980; Permana, 2007). Generally, safety management techniques are aimed at recognition and elimination of hazards, and the assessment and control of those risks are remained. Many risks cannot be confirmed to the construction process. They overlap with clients, other contractors and third parties (Wilson and Koehn, 2000; Permana, 2007). Some companies have become well known for the success of their safety management system. In the United Kingdom, leaders in the field even within smaller companies have devoted substantial time and money to the development of sophisticated management system (Holt, 2001 and Permana, 2007).

Management approach to health and safety in construction industry can be seen in three important ways – firstly, from legal point of view, the need to abide the rules and regulations of the place; second, the socio-humanitarian aspects which is to consider human lives involved; and finally, the financial-economic aspects of the accidents which have high direct and indirect costs. Construction safety management deals with actions that managers at all levels can take to create an organizational setting in which workers will be trained and motivated to perform safe and productive construction work (Levitt and Samelson, 1987; Dorji and Hadikusumo, 2006). The system should delineate responsibilities and accountabilities. It should also outline procedures for eliminating hazards and identifying potential hazards before they become the contributing factors to unfortunate accidents.

### **2.6.2 Benefits of implementing SH&E Management System**

According to Choudhry et al 2008, the benefits of implementing a systematic and effective SH&E management system could be the following:

- Reducing the number of injuries to personnel and workers on construction sites through the prevention and control of hazards;

- Minimizing the risk of major accidents;
- Controlling construction site risks to enhance productivity;
- Minimizing construction interruptions and reducing wastage of material and equipment damage;
- Reducing the cost of insurance as well as the cost of employee absences;
- Minimizing legal costs of accident litigation, fines, reducing expenditures on emergency supplies;
- Reducing accident investigation time, supervisors' time diverted, clerical efforts, and the loss of expertise and experiences.

## **2.7 SAFETY POLICY**

A health and safety policy is a written statement of principles and goals embodying the company's commitment to workplace health and safety (CSAO, 1993; Dorji and Hadikusumo, 2006). It demonstrates top management's commitment to ensure safe working methods and environment at the construction sites. Koehn et al. (1995) and Dorji and Hadikusumo (2006) states that in order to reduce financial risk, management support for safety programmes in both developed and developing countries should be considered as an economic necessity since accidents had proved quite costly to the contractor. This is in addition to the ethical and professional responsibility of the management for providing a safe work site for all employees. The safety policy elements which are applicable in Pakistan are written safety policy, proper posting of policy, effective implementation and policy updating.

## **2.8 SAFETY ORGANIZATION**

One of the essential elements of the safety management is the designation of individual with responsibilities and accountabilities in the implementation of the construction safety programme and plan. The organization should demonstrate how accountabilities are fixed, how policy implementation is to be monitored, how safety committees and safety representatives are to function, and how individual job descriptions should reflect health and safety responsibilities and associated accountabilities (Stranks, 2000; Dorji and Hadikusumo, 2006).

In order for the safety policy to be effective, both management and employees have to be actively involved and committed (Holt, 2001; Dorji and Hadikusumo, 2006). Having a well-trained safety representative on site can improve safety performance by undertaking fault spotting and insisting on corrective action being taken. Companies with effective safety committees are more likely to steps that improve safety performance than those without. This means that safety committees can play a positive role in the improvement of safety performance (Sawacha et al., 1999; Dorji and Hadikusumo, 2006).

## **2.9 SAFETY TRAINING**

In this section, some of the instructions and requirements for craft specific training are presented. It is the responsibility of the Contractor to ensure that employees do not perform work if they have not received the required training.

- i) **Meetings** – All meetings (staff, progress and others), have a portion of the agenda devoted to safety and accident prevention.
- ii) **Work Assignments** – All work assignments must include specific attention to safety instruction. Follow-up monitoring is required and additional training given where required in order to prevent accidents (Safety Action Plans / Safe Work Plan / Permits).
- iii) **Daily Tool Box Meetings** – Properly conducted and recorded daily craft toolbox safety meetings are required and should last 10 – 15 min prior to the start of work each day. Area supervision and foremen shall hold these meetings.
- iv) **Indoctrination / Orientation** – All employees will attend a site-specific orientation presented by Owner prior to the start of work and annually thereafter or as required by Owner when site conditions change such as when there is a change in the construction phase and/or during pre-commissioning and startup. The goals set for the project, the project safety rules and regulations and the No Accident philosophy will be communicated to all employees, supervisors and managers.

v) Supervisors – All field supervisors have to attend OSHA training course that aims to equip supervisors with the knowledge and skills to fulfill their safety roles, duties and responsibilities.

vi) Safety Officers Training – All safety officers will attend a Safety Personnel Development course. The course aims to equip the safety officers with the skills and knowledge to perform their duties. The course is similar to the supervisor training mentioned above but concentrates on the roles, duties and responsibilities of safety officers. In addition it includes safety administration and procedures and field execution safe work practices as per the project safety manual and procedures.

vii) Craft and Specific Training– Craft will be trained in the safety aspects of their job and will attend a training session of 8 hours minimum. Employees required to perform specific tasks will be trained in the safety aspects of those tasks.

## **2.10 SAFETY INSPECTIONS**

Baig (2001) in his study shows that inspection was and is one of the primary tools of the safety professional. It is the tools used since many decades, before 1931 it was virtually the only tool. However every safety professional should ask one key question who is engaged in inspection: “Why am I inspecting?”. The answers to this question dictate how, when and where to inspect. If the primary intent is to detect hazards that have not been seen before, the inspection is different from the way it is done if the primary interest is in checking on the inspections the department supervisor has made. Some of the answers to the question “Why inspect?” are:

- To check the results against plan
- To reawaken interest in safety
- To teach safety be example
- To detect and reactivate unfinished business
- To improve safety standards
- To spot unsafe conditions
- To measure the supervisor’s performance in safety

Checklist is simple and effective means of measuring safety performance. The safety walkthrough inspection (or compliance checklist) is the best tool to monitor the engineering aspect of safety program.

## **2.11 SAFETY PROMOTION**

On a construction site, it is necessary to have safety precaution sign boards for electrical shock, danger deep excavation, man at work, speed limit, safety first, heavy machinery at work, first aid sign, no smoking, emergency evacuation, danger high voltage, main switch, main isolator, use the right tool for the job, reduce the speed limit and prevention is better than cure etc at site. The arrangements for new safety sign boards for the site are to be made immediately at the start of the work. Sign boards should be in a language easily understandable by all the workers on a construction site.

Incentives for safety can also be setup for entire projects. Such incentives differ from those set up for workers and supervisors in that they are contractually established and they accrue to the benefit of the contractor. Whether the contractor shares the benefits with site personnel is generally up to the contractor. Naturally, the magnitude of the benefit is established by the project owner. There is no established protocol for determining the amount. Some baseline of performance should be considered. A beginning point could be the injury frequency average for the industry. From that it would be possible to estimate the numbers of OSHA recordable injuries and lost-workday injuries that could be expected on the project. The total amount of the award might be paid to the contractor if the project injury frequency is below some prescribed value. The amount of the award might be approximate in some manner. For example, if the injury frequency is half the industry average, the contractor might receive half the award amount. Various schemes can be developed for compensating the contractor for good safety performance (Hinze, 1997).

## **2.12 PERSONAL PROTECTION PROGRAM**

At the start of the project, a hazard assessment should be performed to determine any hazards that require the use of PPE. This assessment is designed to identify potential hazards to foot, head, eye, face, body and hand. Hazards should be

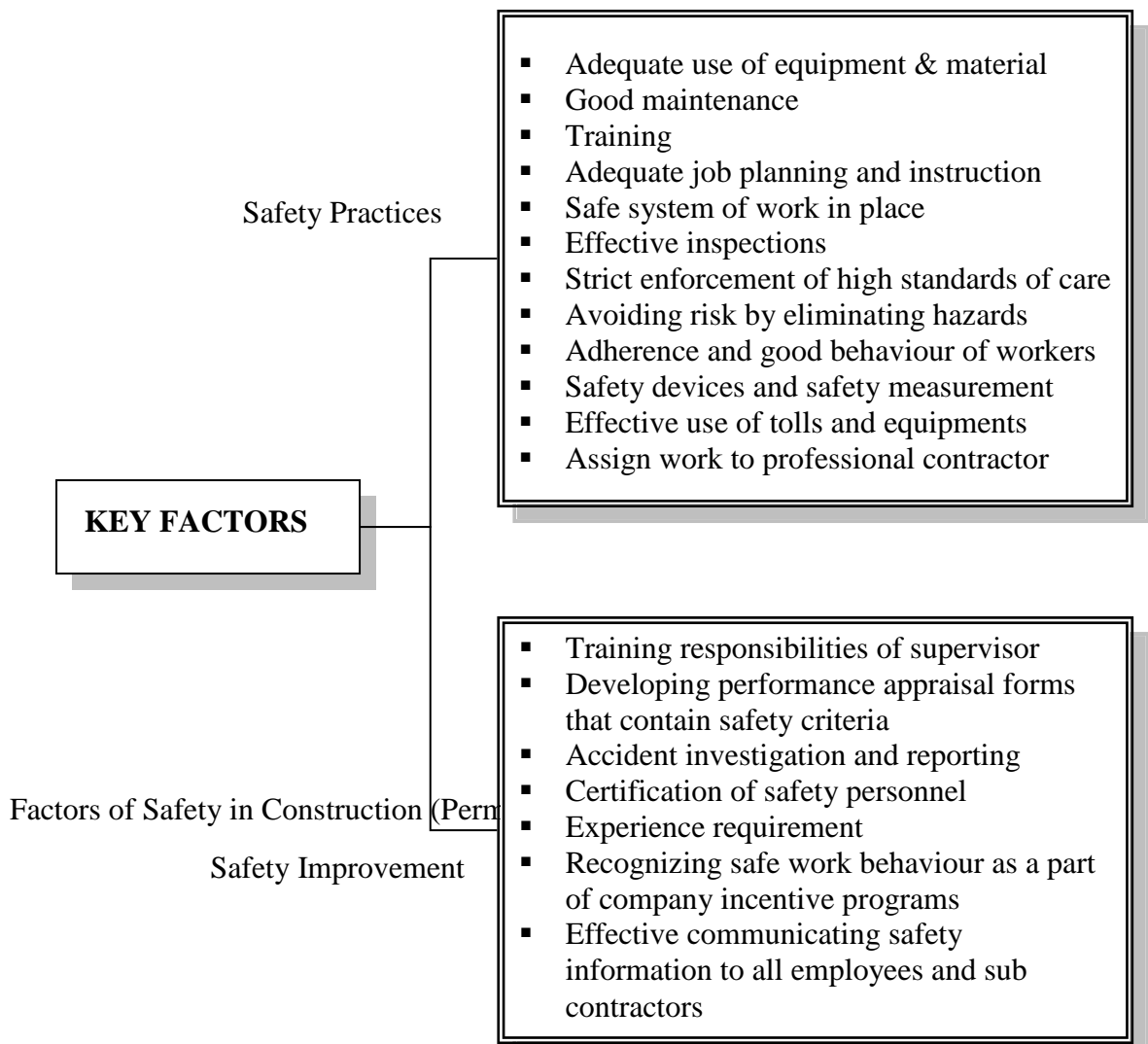
identified and noted during the course of the walk-through. Where hazards exist, identify the type, level of risk, and seriousness of potential for injury for each hazard. Review any hazards identified and consider the use of guards or engineering controls that will eliminate or minimize the hazards. For any remaining hazards, select PPE based on the degree of protection required for the hazard and the protection provided by the PPE.

## 2.13 DOCUMENTATION AND ACCIDENT PREVENTION

There are documents that may be maintained on the Project while the Project is active. Upon closure of the Project, the documents, depending on Contractor's internal policy, should be stored in Contractor's Records Management with other Project records and documents.

## 2.14 Key Factors of Safety in Construction

The key factors of safety in construction (safety practices and safety improvement) as defined by Permana in 2007 are shown in figure 2.5 below:





The term safety practice which comprises certain procedures in the safety management system is commonly applied in most developed countries. However, the safety practices in the construction industry practiced in most developed countries would not be appropriate to be applied totally without adjustment with the conditions within developing countries.

## **RESEARCH METHODOLOGY**

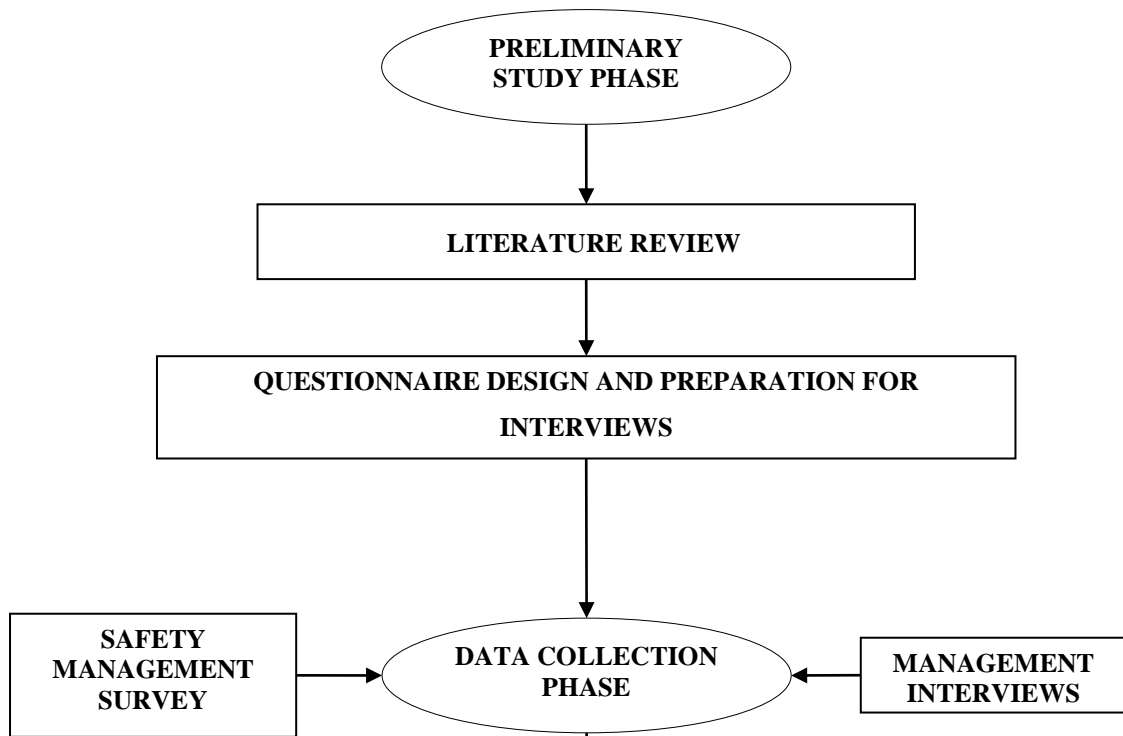
### **3.1 INTRODUCTION**

This chapter describes the research procedure and the method used to conduct the research related to its objectives that has been highlighted in Chapter 1. Details of data collection are also described in this chapter. The research design is disclosed first followed by background of data collection and detailed research process as well as research method. A questionnaire is developed and used for the data collection. This questionnaire is described in this chapter. Research method describes a relevant questionnaire, its implementation of data collection and the sample as well as analysis technique for data analysis.

### **3.2 RESEARCH DESIGN**

The research is designed to study safety management practices on construction sites in Pakistan. The research can be divided into four phases: preliminary study, data collection, data analysis and construction safety framework development. The detail of the phases is described in Figure 3.1:

In the preliminary study phase, literature from journals, books and internet search engines like Google, Wikipedia etc. has been searched in order to gather background data. Also a safety management system of a Gammon Construction Limited, Hong Kong based company, is reviewed as a part of literature review. A questionnaire (see Appendix II) and interview guide questions (see Appendix III) have been developed for conducting safety management survey and interviews, by which safety related information were obtained from the construction sites in Pakistan.



**Figure 3.1:** Research Methodology

In the data collection phase, a safety management survey and interviews were carried out. A questionnaire used for safety management survey was distributed by face to face to top management representatives of the company, project directors, project managers, safety managers, safety officers, site engineers. While safety management interviews were conducted by face to face meetings of the above mentioned company's top management representatives.

In the data analysis phase, the collected data was entered in the statistical analysis software package SPSS 17.0 and analyzed. Qualitative method is used for analysis of management interviews and quantitative method is used for analysis of safety management survey. For this purpose, literature is reviewed for learning of statistical tools and to interpret the results obtained from SPSS 17.0. Based on the results of data analysis, conclusions and recommendations are made.

In the last phase, efforts were made to develop a construction safety framework model for implementing safety on construction sites. For this purpose, literature review was carried out on existing safety framework in developed and developing countries. Based on this literature review and the results obtained from above phases, construction safety framework is proposed for implementation of safety on construction sites by local construction companies.

### **3.3 RESEARCH METHOD**

The analysis of management survey was conducted by Statistical Package for the Social Sciences (SPSS 17.0). Available Formal safety management systems and also incident and accidents investigation reports were studied of the construction project sites provided by safety representatives on construction sites. Safety management survey was designed and hard copies were distributed for feedback. The collected data from valid responses were entered in SPSS 17.0 for analysis. Detailed analysis and results will be reported later in the upcoming chapter.

Ten interviews were conducted with top management particularly with people responsible for construction safety in the company and the details of these interviews are given in chapter 4. The management interviews looked at issues like current safety practices in construction industry of Pakistan, situation of safety on company's different projects, whether management investigates injuries, site safety plan on company's project, training of workers and supervisors and sub-contractor safety implementation on sites. Interview results and analysis will be shown in the next chapter.

#### **3.3.1 Data Collection**

This section describes the background of data collection and gives a perspective view of the research process of how the research plan was executed. The data of this research was collected from the construction sites of Islamabad, Rawalpindi, Sindh, Khusab, Bagh, Sheikupura, Abbotabad and Peshawar.

The questionnaire developed after an extensive literature review, was pilot tested at the start of the data collection period. The people who supported and participated in the pilot study included the following management personnel on

three high rise projects in Islamabad are Deputy Project Director, Project Coordinator, safety managers and site engineers. Following 2 projects in Islamabad and 1 project from Rawalpindi were visited for pilot testing of questionnaire:

1. The Centaurus Project, Islamabad.
2. PTET Telecom Tower Project, Blue Area, Islamabad.
3. Fauji Fertilizer House Building Project, Saddar, Rawalpindi.

Safety related issues related to the construction projects had been discussed with the safety managers and questionnaire was modified according to the safety management practices which were observed at the sites. The details of the visited construction sites for safety management survey were included in Appendix IV.

After pilot testing and amendments made in the questionnaire, the questionnaire (see Appendix II) in English was submitted to the safety managers on the construction project sites by face to face meetings after coordinating with them on telephone to give some time for their feedback and evaluation. Some questionnaires were distributed via email for distant construction project sites like Peshawar, Shiekupura, Sindh and Khusab to safety managers and safety officers for their feedback.

### **3.3.2 Safety Management Survey**

To meet the research requirements of safety management survey, literature review was carried out and safety, health and environmental management system of a construction company in Hong Kong was studied to examine how the system was developed, implemented, monitored and audited. Planning for the research methodology was conducted by setting objectives, designing, reviewing, discussing and finalizing the questionnaire with the safety experts from the construction sites. Questionnaire was filled out from sixty construction sites. Collected data was entered in SPSS 17.0 during the analysis.

A safety management questionnaire was developed to survey the selected construction project sites. The information and data used for safety management was obtained from this survey. Choudhry et al. (2008) questionnaire was adopted which consists of 56 questions and eight aspects of site safety management. After pilot testing the questionnaire, some amendments are made. The questionnaire after

the amendments consists of 25 questions covering seven aspects of safety management.

A cover letter (see Appendix I) was prepared and presented along with the questionnaire to the respondents providing feedback. The respondents are required to answer either 'Yes' or 'No' to the given questions.

Seventy construction sites were selected for the survey. The survey was planned to be carried out over a period of eight weeks in which data collection and data collation was to be done. The list of surveyed construction project sites is given in Appendix IV.

### **3.3.3 Safety Management Interviews**

Management interviews were conducted in Islamabad, Rawalpindi and Bagh with the purpose of gaining a deeper knowledge of safety management practices and issues in construction sites. The interviews conducted with management lasting between 15 to 20 minutes included people responsible for construction safety i.e. Deputy Project Directors, Project Directors, Project Managers, Safety Managers, and Safety Officers. These people were selected from different project sites that have a expertise in safety related issues. The initial approach was made by telephone follow-up for an appointment, followed by a face-to-face interview. An interview guide was developed consisting of ten questions for these interviews and is listed in Appendix III. The in-depth interviews yielded rich data about the construction industry of Pakistan and its safety situation including operational safety management system. Data analysis and results are given in the next chapter.

### **3.3.4 Construction Safety Framework Development**

Literature review within this study was obtained from journals, books, data and previous research from people from different developed and developing countries. Mainly the focus is on the construction safety framework developed by previous research studies in developing countries like Singapore, Malaysia, Indonesia, Bhutan etc and successfully implemented on construction sites in these countries. After the extensive literature review and according to the findings of

safety management survey and safety management interviews, a framework for implementing safety on construction sites is proposed in chapter 4.

## ***CHAPTER 4***

### **DATA ANALYSIS AND RESULTS**

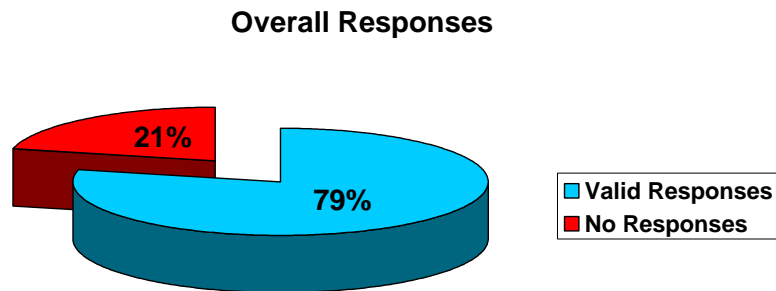
#### **4.1 INTRODUCTION**

This chapter describes the data-analysis procedures and results, along with tables and graphs, obtained from safety management survey and analysis and results of management interviews. Safety management survey results were quantitatively analyzed, while management interviews were qualitatively analyzed and are shown in the upcoming sections.

#### **4.2 SAFETY MANAGEMENT SURVEY RESULTS**

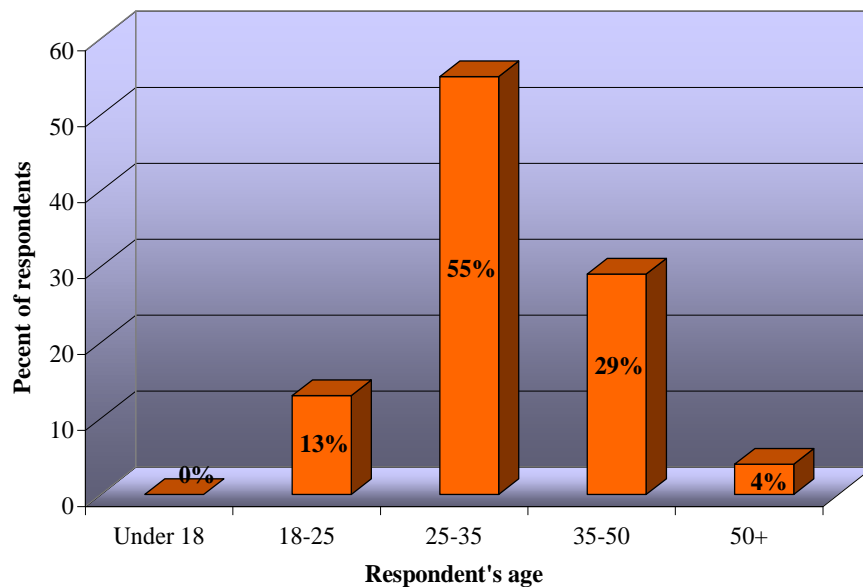
The safety management survey was conducted in seventy construction sites in different cities of Pakistan. The response rate was good (79%) with 55 valid

responses, 15 no responses (21 %), with a target of one questionnaire to be filled from one construction site. Figure 4.1 shows the overall response rate pie chart for survey:



**Figure 4.1:** Overall Responses Chart

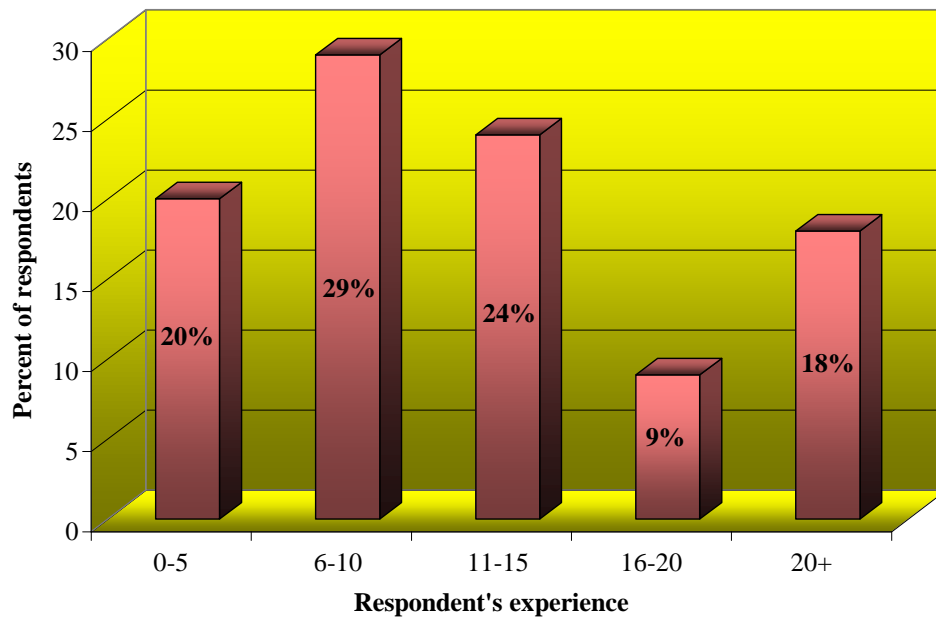
The age of respondents and experience in construction industry is shown in Appendix V. Following figure 4.2 shows the respondent's age distribution chart:



**Figure 4.2:** Respondent's Age Percentage Distribution Chart

Figure 4.3 shows the respondent's experience distribution chart. The graph shows that 29 % respondents have experience between 6-10 years in the construction industry.





**Figure 4.3:** Respondent's Experience Percentage Distribution Chart

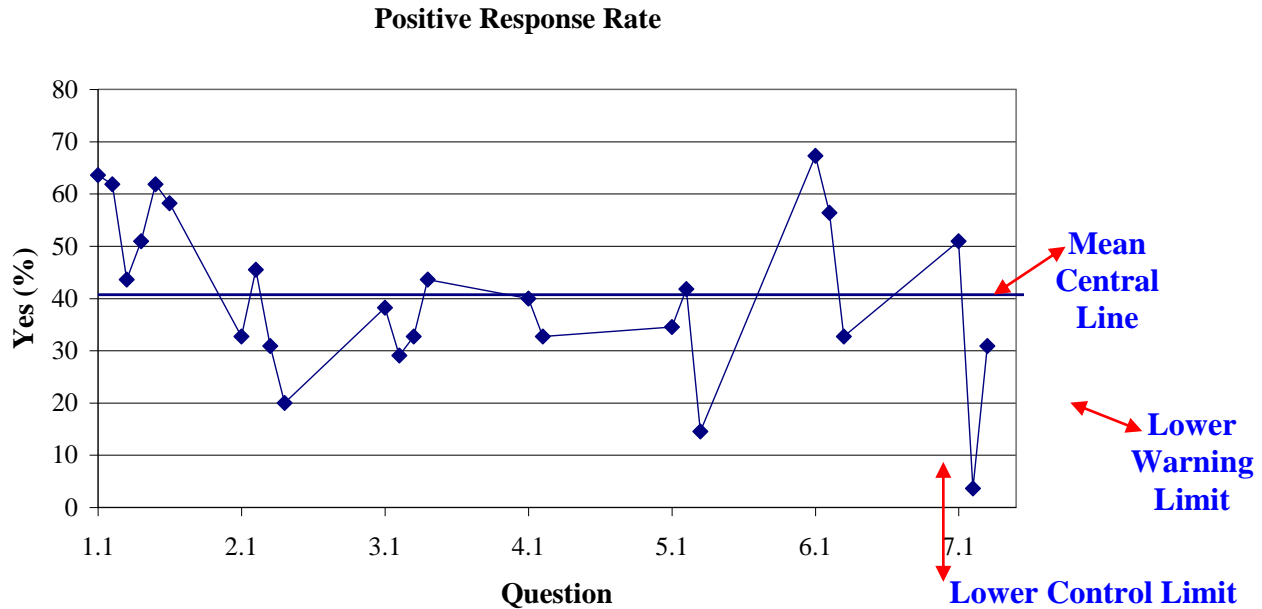
The collected data from 55 valid responses were entered into the Statistical Package for the Social Sciences (SPSS 17.0) for analysis of answers to each question. The answers to the 25 questions are summarized in Table 4.1. The respondents were required to tick “Yes” or “No” against the question. Positive responses in percentage terms (Yes %) from all respondents were calculated and are shown in Table 4.1. From all positive responses, a control chart is drawn as shown in Figure 4.1. From statistical analysis, the mean (40.72), standard deviation (15.87), minimum (3.6), and maximum (67.3) values were determined. The collected data entered into SPSS 17.0 and output files are included in Appendix VI. In the following table 4.1, numbers from 1.1 to 7.3 refer to question numbers in the questionnaire.

From the results shown in table 4.1, the following consideration of the seven aspects of safety management was investigated by the questionnaire survey. The keywords used for each question i.e from question # 1.1 to 7.3 are given in Appendix VI.

**Table 4.1:** Questionnaire Results

<b>Question</b>	<b>Yes</b>	<b>No</b>	<b>Yes (%)</b>
1.1	35	20	63.6
1.2	34	21	61.8
1.3	24	31	43.6
1.4	28	27	50.9
1.5	34	21	61.8
1.6	32	23	58.2
2.1	18	37	32.7
2.2	25	30	45.5
2.3	17	38	30.9
2.4	11	44	20
3.1	21	34	38.2
3.2	16	39	29.1
3.3	18	37	32.7
3.4	24	31	43.6

4.1	22	33	40
4.2	18	37	32.7
5.1	19	36	34.5
5.2	23	32	41.8
5.3	8	47	14.5
6.1	37	18	67.3
6.2	31	24	56.4
6.3	18	37	32.7
7.1	28	27	50.9
7.2	2	53	3.6
7.3	17	38	30.9

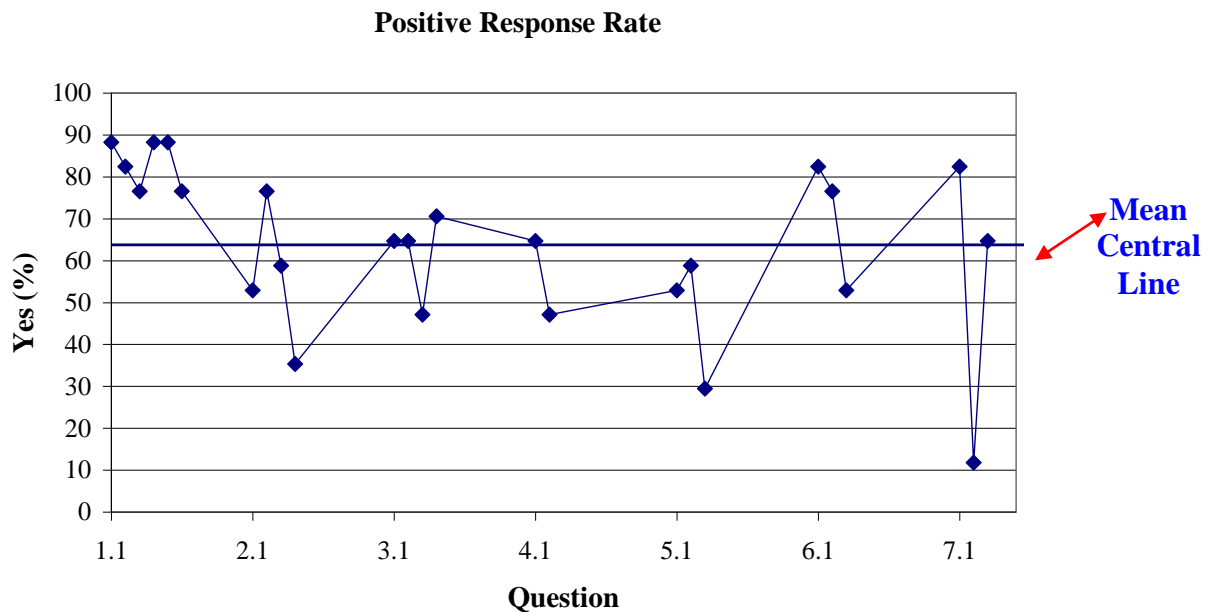


**Figure 4.4:** Control Chart for Positive Response Rate

The control chart given as output is the chart for the mean as shown in Figure 4.4. This chart, which is pretty much self-explanatory, shows that 40% of the construction companies have safety management system in practice at their

construction sites. According to Deming (1986), the two basic uses of control charts are; a) as a judgement tool; we look at a control chart to observe whether the process that made a particular batch of product was in statistical control. If yes, then we know, for the quality characteristic that was plotted on the chart, the distribution of this quality characteristic for individual items. b) as an operation (ongoing); a control chart can also be used to attain and maintain statistical control during production. Here the process has already been brought into statistical control / or nearly so, with only rare evidence of a special cause.

From the positive response rate of C-A Category companies sites (see Appendix IV), a control chart is drawn as shown in Figure 4.5. From statistical analysis, the mean (63.77), standard deviation (19.56), minimum (11.8), and maximum (88.2) values were determined. The collected data entered into SPSS 17.0 and output files are included in Appendix VI.



**Figure 4.5:** Control Chart for C-A Category Companies

From Figure 4.5, it is clear that 64% of the PEC recognized, C-A category (No Limit), construction companies are practicing safety management system on their construction sites, which shows that top construction companies are taking steps to implement workplace safety to avoid serious accidents from taking place

on the project sites. This condition can be made better by involvement of top management of the construction companies.

Now the questionnaire results are discussed in the following sections:

#### **4.2.1 Health and Safety Policy**

The survey results for the questions regarding safety policy are numbered from 1.1 to 1.6 as shown in questionnaire in appendix. The results for question # 1.1 shows the valid positive response rate of 63.6 %, which indicates that on most the construction sites visited, contractors give importance to the development and implementation of HSE policy. 61.8 % is the valid positive response rate for question # 1.2., showing that the HSE policy developed by construction companies for their projects clearly state that decisions on other priorities should give due regard to construction safety requirements. For question # 1.3, 43.6 % is the positive response rate for the surveyed construction sites; which shows that the policy developed by fewer companies meets the safety standards such as OSHA etc. The valid yes response rate for question # 1.4 of 50.9 % and no response rate of 49.1 %, giving us a clear picture that the at least on half (50 %) of the construction sites surveyed, the policy implemented set targets for health and safety performance including a commitment to progressive improvement. For the question # 1.5, the valid positive response rate is 61.8 %; which clearly indicates that policy identify top management key senior personnel for overall coordination and implementation of the policy for the execution of activities on construction sites. For question # 1.6, it is clear that 32 (58.2 %) out of 55 construction companies allocate financial budget to safety in their BOQ, including the provision of safety amount in their contract documents, mostly in highly funded projects like The Centaurus Project, PTET Tower, FFCL Tower etc.

#### **4.2.2 Safety Organization**

On each construction project, it is necessary to display charts on the notice boards indicating the responsible safety advisor for every section of the project (Choudhry, 2007). The valid response rate (32.7 %) for question 2.1 clearly tells us that out of 55 construction sites surveyed, only 18 have an organization chart showing the names and positions with responsibility lines for safety

performance management. For question # 2.2, the valid positive response rate is 45.5 %, which is above the mean figure (40.72); indicating that the individual health and safety responsibilities of all employees were clearly defined on most of the projects surveyed, by PEC recognised No Limit (CA Category) companies. The valid positive response rate for question # 2.3 was 30.9 %; the results shows that only 17 out of 55 construction companies working on the construction projects surveyed appointed competent officers and safety supervisors having qualification and degree in safety and also experience of working on local construction sites and abroad. While the score for question # 2.4 was 20 % which was below the mean figure (40.72). It reveals that it is the area where construction companies needs to pay more attention as most of the work is performed entirely by subcontractors. The subcontractors should prepare and submit the site specific safety plans for each of their construction activities.

#### **4.2.3 Safety Training**

The valid positive response rate for question # 3.1 was 38.2 %, which is below the mean figure (40.72); indicating that there is a need for a health and safety training plan by construction companies on their projects. It should be submitted along with the other documents at the time of bidding and should be a part of contract documents. Question # 3.2 valid positive response rate was 29.1 % , which shows that training of new employees were not given importance by construction companies working on construction sites i.e 39 out of 55. Top management involvement is required for training to be made compulsory to every new employee inducted in the company. The results for question # 3.3 were giving the valid response rate of 32.7 % which was far below the mean figure (40.72). It shows that there is still a need to incorporate safety training as a compulsory item within budget of the company's project. However the valid positive response rate was 43.6 % for question 3.4, which was above the mean figure (40.72); indicating that there is a trend present within construction companies to train their in service employees by introducing different courses related to their trades or to depute them to other places for training purposes. So from the results of questions 3.1, 3.2, 3.3 and 3.4, it is suggested that the construction companies have to take steps in safety

training of their staff , save their precious life and to be more competent to remain in this dynamic business of construction.

#### **4.2.4 Safety Inspections**

Results of questions 4.1 and 4.2 were showing valid positive response rates of 40 % and 32.7 % respectively. The result of question # 4.1 shows that safety officers and safety supervisors carry out safety inspections at regular intervals within a week or within a month. While result from question # 4.2 indicates that on fewer of the surveyed projects i.e 18 out of 55, safety performance is measured by conducting safety audits for project execution on a monthly or yearly basis. Safety audit is the best tool for measurement of safety performance on a construction project to check whether safety is implemented according to site safety plan or not and to improve it by having a record of previous safety performance.

#### **4.2.5 Safety Promotion**

Results for question # 5.1 indicate that on 19 out of 55 construction sites, safety bulletin boards are provided and located so that every employee will see them during working days. The valid positive response rate was 34.5 % which was below the mean (40.72); so safety bulletin boards easily understandable by workers, working on construction sites, have to be provided by construction companies working on different projects in local language or English language and by providing signs on boards so that those workers can easily understand the signs, who are illiterate. The results for question # 5.2 show the valid positive response rate of safety signs and posters prominently displayed on site was 41.8%, which was slightly above the mean value (40.72). Safety signs and posters should be prominently displayed on site, so that every employee working on the site can see them and work safely. It is good practice that company displays signs and posters near work areas to enhance precautionary measures (Choudhry, 2007). A valid positive response rate of 14.5 % for question # 5.3 indicates that there is a need for safety awards to be meted out on a regular basis with recognition given for good safety performance by individuals of the company working on a specific project. For promotion of safety on site, different schemes like Best Safe Site Competition,

Best Safe Foremen Competition, Best Safe Worker Competition etc. are needed to be organized.

#### **4.2.6 Personal Protection Program**

Results for question # 6.1 gives the valid positive response rate of 67.3 % i.e 37 out of 55 construction sites surveyed, had the requirements for the provision of personal protective equipment (PPE) been indicated in the contract agreement / safety plan. The results of question # 6.2, showing the valid positive response rate of 56.4 %. On construction sites surveyed, there was a increased trend to obtain a sufficient stock of carefully selected and appropriate Personal Protective Equipment either provided in BOQ or purchased by construction companies for their workers in their own expenses. The valid positive response rate for question # 6.3 was 32.7 %, which is below mean value of 40.72 %. There is a need for an effective system for the issuance, recording, and inspection of PPE and its replacement been established by the construction companies.

#### **4.2.7 Documentation and Accident Prevention**

Results of question # 7.1 shows that 28 (50.9%) out of 55 construction companies working on the projects surveyed had an arrangement to keep record of accidents occurring during execution of project activities. The valid positive response rate for question # 7.2 was 3.6 %, which was far below the mean figure (40.72). This shows clearly that there was no staff hired to keep the proper documentation of accidents occurring and updating of this record on the construction sites surveyed. The valid positive response rate was 30.9 % for question # 7.3, which was again below the mean value (40.72). It is the responsibility of the senior key personnel of the organization working a construction project to develop and implement a policy / plan for accident prevention on construction site during execution of construction activities. So the overall results from questions 7.1, 7.2 and 7.3 indicates the need on priority basis for construction companies to have proper documentation for all the activities executed on the project and to have a accident prevention plan to ensure safety on project site and to avoid any unforeseen event or accident.



### **4.3 SAFETY MANAGEMENT INTERVIEWS RESULTS**

All the interviewees were selected through the following steps:

- First of all, 15 potential interviewees were contacted, who either had high profile in their respective domains or likely had related experience and knowledge. The interviewees were contacted by telephone and the research was briefly introduced to them so that they could get an understanding of the research.
- Only 10 persons expressed their willingness to take part in the interview. A brief discussion was then carried out over phone with each interviewee to clarify any particular questions raised by them and to testify whether they had adequate knowledge for the perspective topic.
- An appointment was made with each interviewee to set the date of interview either at site office or in head office. Only two interviews i.e participants 01 and 09 were conducted at their company's head offices while the rest eight interviews were conducted at the site offices as shown in the following table 4.2:
- The interviews from the interviewees were only kept to the paper work generated through the interview by asking the questions, which were the combination of descriptive questions and to answer either in 'Yes' or 'No'

as given in Appendix III. The overall analysis was conducted after all the interviews were completed.

**Table 4.2:** Details of Interviewees

<b>Participant</b>	<b>Designation</b>	<b>Organization / Project</b>	<b>Location</b>
01	Deputy Project Director	National Construction Limited	Islamabad
02	Project Coordinator	Projacs, The Centaurus Project	Islamabad
03	Safety Officer	Projacs, The Centaurus Project	Islamabad
04	Safety Manager	Izhar Construction (Pvt) Ltd, PTET Tower	Blue Area, Islamabad
05	Safety Manager	Guarantee Engineers, FFCL Tower	Saddar, Rawalpindi
06	Safety Officer	Habib Rafiq (Pvt) Ltd, Construction of Pakistan Institute of Parliamentary Services	F-5, Islamabad
07	Safety Manager	Eco-west International (Pvt) Ltd, Construction of District	Bagh, AJK

		Complex	
08	Site Engineer	Camp Dresser & Mckee Inc.,	Muzzafarabad,
		Pakistan Earthquake Recovery	AJK
		and Reconstruction Project	
09	Project Director	Asher Engineers & Blue Area,	
		Contractors, Construction of	Islamabad
		Green Tower	
10	Project Manager	Matracon Pakistan (Pvt) Ltd,	F-5, Parliament
		Construction of AJK Lodges	Lodges, Islamabad

## Interview Results

Below are the results derived from the interviews.

*Q#1) Would you like to throw some light on the salient features of the Pakistani construction industry in the context of safety.*

Participant	Interviewees' Responses
01	“With an experience of 20+ years in the construction industry of Pakistan and also some experience from abroad, I think that a lot of improvement in the context of safety is required on construction sites in Pakistan. Usually safety is present on projects where the funding is high”
02	“Safety practices in the construction industry of Pakistan are improving since last 5-6 years and there should be proper safety standards developed by the regulatory authority”
03	“In Pakistan, awareness is required to be given to the practioners working on construction sites especially the workers who risk their lives by performing risky activities, which may also cost their lives”
04	“Safety subject is relatively new in construction industry of Pakistan”

- 05 “Safety Programs need to be developed by the government for improving safety in construction industry of Pakistan”
- 06 “Safety management system must be a part of every construction project in the construction industry of Pakistan”
- 07 “In my opinion, safety issues must be highlighted and must be given prime importance for execution of construction activities. Organizations must play their role to consider this sensitive issue of safety in their projects”
- 08 “The concept of safety is new in Pakistani construction industry. As far as my experience is concerned, safety practices ensure workers to work safe and sound and they are more productive working in safer conditions”

Participant	Interviewees’ Responses	Continued....
09	“Pakistani construction industry is far as behind compared to other developing countries in terms of safety implementation on construction sites. We can learn from their experiences and introduce safety on our project sites”	
10	“Safety implementation on sites is still a big issue in construction industry of Pakistan, which requires attention at top organization level”	

**Analysis:** From the above responses, it is seen that there is a concept of safety within top management of construction companies. They are also aware of the safety practices being followed in outside world and within Pakistan. Indeed, most of the participants have international exposure of working on different construction sites in developed and developing countries.

**Q#2) Please express your views on safety situation in general on construction projects of the company.**

Participant	Interviewees’ Responses
01	“Projects in hand of the company set different priority level as far as safety matters are concerned. Company provides Personal Protective Equipment to its workers like helmets, gloves and goggles at its own

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	expense to ensure that workers are working safely. If funding is provided by the client then the situation of safety gets better within the organization”
02	“Very good safety arrangements on construction projects were made by the company and appointed proper safety staff who is responsible for on site safety of different construction operations”
03	“Safety situation is very good as you can see no body is allowed to enter the construction site, if he or she does not wear proper personal protective equipment and also improper dressing. Safety inspections are carried out on daily basis”.
04	“Safety management system is recently included in every construction project of the company and importance is given to the safety of all employed personnel on sites”

<b>Participant</b>	<b>Interviewees’ Responses</b>	<b>Continued...</b>
05	“Safety situation is good on the construction projects of the company. Company employee proper qualified safety staff to handle the matters related to safety”	
06	“As one of the largest construction company of Pakistan, the company takes step to establish safety department and to deploy competent staff for all the projects in hand”	
07	“Company appointed well qualified staff for dealing the matters relating to safety on construction projects whether they are building projects or road projects. Also proper documentation is made to keep record of accidents and accident prevention policy”	
08	“As a multinational company, on every project the situation of safety is excellent as there is no compromise on safety and proper persons are hired who have expertise in safety implementation on sites”	
09	“Where safety provisions and funds are provided in the contract documents and BOQ, safety situation of the company is very good and qualified safety officers were hired”	
10	“Safety situation within the projects in hand of the company is	

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satisfactory and needs further improvement”

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**Analysis:** From the responses above, it is seen that the safety situation in general on construction projects of the company varies a great deal depending on the nature of the construction project. If the project in hand has enormous funding like a high rise building, then safety cost is also high. The result is that the contractor requires to develop and submit the site safety plan at the time of bidding and if contract is awarded then it has to implement the site safety plan. Also sufficient PPE can be purchased, maintained and replaced as funding is provided by the client. Whereas on the other hand, on a lower funded projects, contractors purchased limited stock of PPE on their own expense as no funding is provided by the client, for safety of their workers like helmets and safety shoes.

*Q#3) Please express your views on safety, health, and environmental management system of the company. How they were developed, implemented, monitored, audited, and reviewed continuously?*

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<b>Participant</b>	<b>Interviewees' Responses</b>
01	“There is no safety, health, and environmental management system of the company in place”
02	“Safety, health, and environmental management system was developed by the company and implemented on site. So far it is not audited and reviewed by the company. It is in its initial form”
03	“Proper documents of the safety, health and environmental management system were developed by the company and are kept in record in office documents. However they are not audited and reviewed continuously”
04	“HSE management system was developed by the company and it was kept documented in the company head office”
05	“Safety Policy, procedures and on site training documents were prepared and implemented by the field staff of the company and was submitted to the company head office. As it was recently prepared, no auditing and reviewing had done yet. However it is planned to review these documents and amendments are to be made”

- 06 “The company’s safety department had prepared HSE management system for the implementation of safety on its construction sites. The documents are available on construction sites. They are monitored, audited and reviewed continuously by the consultation of field staff”
- 07 “HSE management system was developed by the company and implemented on sites. However monitoring, auditing and reviewing is planned to be done on annual basis”
- 08 “Proper documentation was done by the company for all the safety related materials, handbooks and safety management system manuals for implementing safety on construction sites. They are monitored, audited and reviewed by the field staff”
- 09 “No HSE management system was developed by the organization”

<b>Participant</b>	<b>Interviewees’ Responses</b>	Continued....
10	“There was no safety, health and environmental management system developed and implemented for this project”	

**Analysis:** From the above responses, it is cleared that participants know about the document named as ‘safety, health and environmental management system’ developed by their respective companies and implemented on their construction projects.

***Q#4) To what extent is the management investigating recordable incidents?***

<b>Participant</b>	<b>Interviewees’ Responses</b>
01	“There is no investigation system of recordable incidents on the construction sites by the management”
02	“The field staff like safety officers are documenting and investigating the recordable incidents on site”
03	“Safety manager or safety officer investigates recordable incidents in the specified form and then send the copies to all the parties concerned on the project site”
04	“Recordable incidents are investigated on regular basis and report is prepared and submitted to the field personnel on construction site and also send copy of the report to the head office”
05	“Recordable incidents are investigated by the safety manager on site

	and proper record of these incidents is also kept and updated as well”
06	“Safety staff deployed by the company on site is responsible for carrying out investigations of recordable incidents and documentation of these incidents is also done”
07	“Investigation of recordable incidents is carried out on regular basis by the safety manager on the project site”
08	“All the incidents occurring on site are investigated and recorded by the safety officer in charge on project site”
09	No comment
10	“No investigation is done as such”

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**Analysis:** From the responses above, it is clear that reputable companies have adopted themselves to the latest technologies and also started to give importance to safety related issues on their projects. These companies appointed competent field safety staff, who are investigating and documenting the recordable incidents on their construction sites in proper format and templates.

***Q#5) On each project, who is responsible to prepare the site safety plan? How is being updated?***

<b>Participant</b>	<b>Interviewees’ Responses</b>
01	No Comment
02	“Usually site safety plan is prepared by the contractor’s safety representative and is updated in coordination with consultant’s safety representative based on the safety performance on site”
03	“As a safety officer from consultant side, generally site safety plan is prepared by contractor executing activities on site and is seldom updated”
04	“Site safety plan is prepared by the safety manager on site and is not updated yet”
05	“It was prepared by the company in head office and submitted at the time of submission of contract documents. It is not updated until now”



06	“Site safety plan is prepared and updated from time to time by the safety officer in charge on the project site and as demanded by the consultant or client”
07	“It is prepared by the safety department personal at the company’s head office and submitted along with the contract documents and is not updated as the project is recently started”
08	“It is usually prepared and updated by the safety department of the company”
09	No Comment
10	No Comment

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**Analysis:** The aim of this question is to identify the importance of site safety plan on construction sites. From the above responses we can see that site safety plan is provided by the contractor as demanded by the client as part of the contract documents. The updating of site safety plan is not in practice by the companies, which requires attention by the management.

***Q#6) Please express your views on education and training of workers and supervisors.***

<b>Participant</b>	<b>Interviewees’ Responses</b>
01	No Comment
02	“Training of workers and supervisors on site is done by the company’s policy and they are also educated by having proper training sessions of their trades”
03	“Education and training of workers are done frequently”
04	“Safety training of workers and supervisors are in place on site before the execution of work”
05	“Regular safety talks and training sessions are made on day to day basis to workers in order to perform their operations safely and to prevent any injuries occurring to them”
06	“Education and training of workers about the safety on site is carried out at regular intervals by the safety staff”
07	“Safety training is given to the labour working on site to perform their task

- safe and sound and in efficient manner”
- 08 “Safety related training is given by safety manager on site to the workers and supervisors and especially the importance is given to the wearing of personal protective equipment”
- 09 “It is very important to train the workers and supervisors about safety related issues on site and to perform their work quite safely”
- 10 No Comment

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**Analysis:** From the above responses, it is clear enough that the construction companies are taking steps to educate and train their workers and supervisors working on site to improve safety conditions on sites.

**Q#7) *Is the policy explained to new employees as part of their training and orientation prior to the commencement of work?***

Participant	Interviewees' Responses
01	“No”
02	“Yes”
03	“Yes”
04	“Yes”
05	“No”
06	“Yes”
07	“No”
08	“Yes”
09	“No”
10	“No”

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**Analysis:** From the responses above we can see that most of the top companies in Pakistan have the policy explained to new employees as part of their training and orientation prior to the commencement of work to ensure that their workers are safe from all kinds of injuries and ultimately fatalities.

**Q#8) *Does any process exist on construction sites that operatives should learn from incidents to avoid resulting serious accidents?***

Participant	Interviewees' Responses
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01	“No”
02	“No”
03	“No”
04	“No”
05	“No”
06	“No”
07	“No”
08	“No”
09	“No”
10	“No”

**Analysis:** From the above responses it is clear that there is a need to introduce the process by which operatives can learn from incidents to avoid serious accidents by the top management of the company by carrying out the case studies from different companies from different countries and by establishing Research and Development section in their companies.

**Q#9) A short question is, “are plants and equipment used on site suitable for the jobs and those using these were trained?”**

Participant	Interviewees’ Responses
01	“Yes”
02	“Yes”
03	“Yes”
04	“Yes”
05	“Yes”
06	“Yes”
07	“Yes”
08	“Yes”
09	“Yes”
10	“Yes”

**Analysis:** The above responses show us that all participants give positive response that “plants and equipment used on site suitable for the jobs and those

using these were trained”. Mostly the operators operating on plants and equipments on site are experienced and have passed the trade test from the respective department. They have on site experience on local construction sites as well as from abroad like Gulf, KSA etc.

***Q#10) How is the safety of subcontractors’ workers managed on-site? Do they practice safety management systems? How they use and follow safety standard as well as procedures on-site?***

<b>Participant</b>	<b>Interviewees’ Responses</b>
01	No Comment
02	“All safety on site is managed by the main contractor. Meetings are regularly held with sub contractors and important issues on safety are discussed”

<b>Participant</b>	<b>Interviewees’ Responses</b>	Continued....
03	“There is no such practice in place as they are concerned to perform their specified work and can’t afford to spend on safety as they consider it as a additional cost to their work”	
04	“No, they don’t have any safety management systems. Safety manager on site appointed by the main contractor is responsible for the implementation of safety on site and also to ensure safety of sub contractor’s workers”	
05	“As such no such concept exists on sites of safety implementation by the subcontractors”	
06	“Usually prime contractor is responsible for implementing safety on construction sites as sub contractors have limited resources and funding. So they don’t have any safety management systems. They performed their work as sub contracted and generally follow the safety instructions as given by the main contractor’s representative”	
07	“Sub contractor’s workers safety is ensured by the main contractor’s representative on site i.e safety manager. As far as safety management systems are concerned, there is no such thing exists”	
08	“Company is responsible for ensuring sub contractor’s workers safety on site and to properly educate them about the safety related	

	procedures and guidelines to execute their work safely”
09	No Comment
10	No Comment

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**Analysis:** From the above responses we can see that ‘sub contractor’s workers safety on site and guidelines for them to implement safety as far as their work is concerned is very important matter, that needs attention by all the companies as most of the works on a construction project are executed by these specialty contractors. It the responsibility of the safety officer in charge on site to educate its own company workers as well as the workers of the sub contractor as most of the dangerous works are performed by them and also they are involved in great number of injuries on site. According to the research findings of Choudhry (2007), unstable job nature in the subcontracting system is creating problems in implementing site safety measures. On-site subcontractor’s workers do not seem to be involved in the site safety process. He postulated that communication of safety related information is an important issue between the project management team and the site workforce.

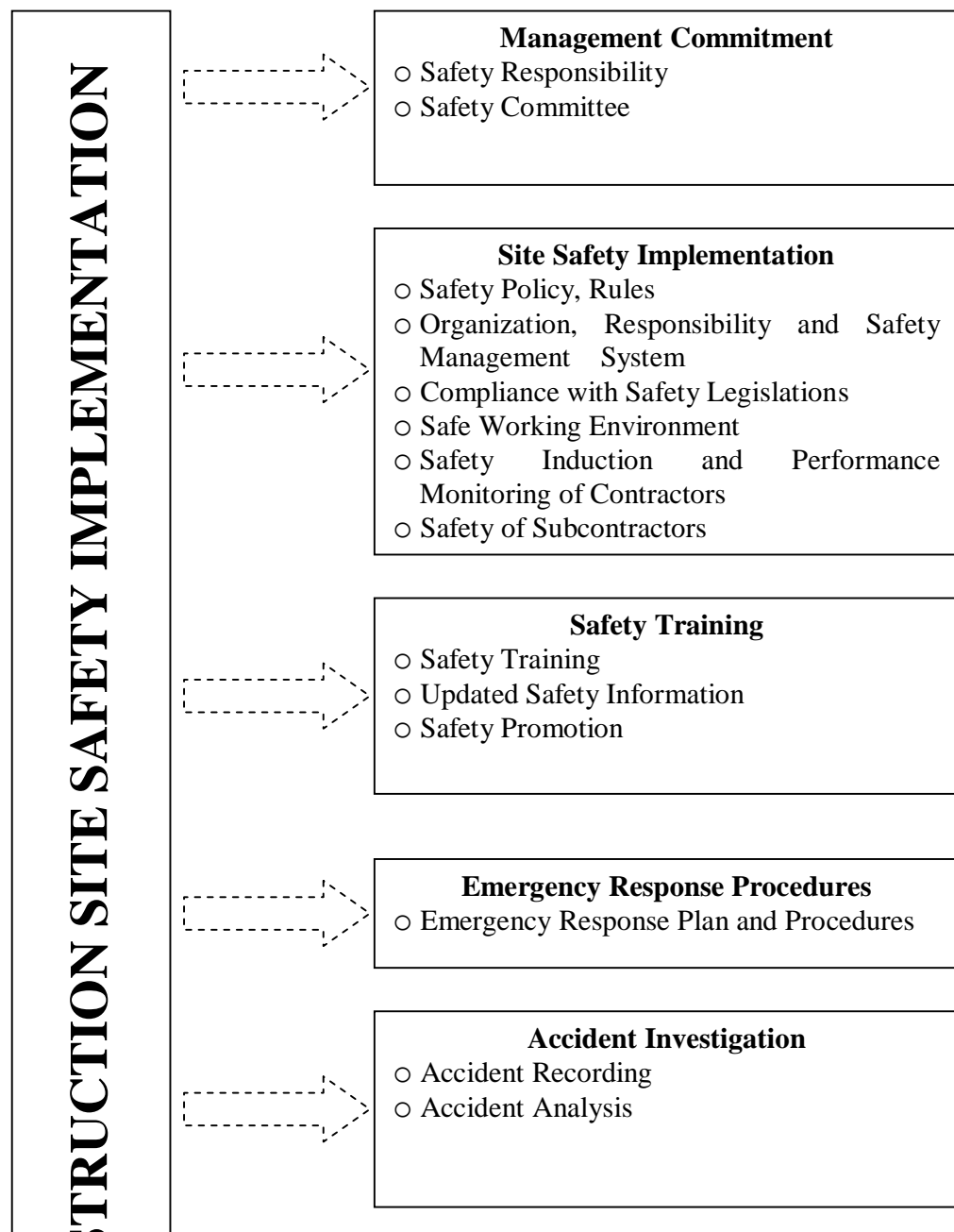
#### **4.4 CONSTRUCTION SITE SAFETY IMPLEMENTATION FRAMEWORK**

In general, safety on construction sites is linked with historical, economical, psychological, technical, procedural, organizational and work environment issues. The development of safety systems, safety practice and procedures; monitoring of safety compliance, establishment of safety committees at site level, communication of safety policies to site personnel, participation of safety officers, consultation between site staff and safety officers also affect safety performance. For improving safety at project level include reducing the turnover of project management teams, devoting more time to site safety issues, increasing the number of formal safety meetings with supervisors and specialty contractors, increasing informal site safety inspections, increasing fines to workers with poor safety performances, etc. Safety systems, written safety policies and measurable safety targets, safety committees at company level, communication of safety policies to the various concerned parties are also said to be essential to construction safety, while safety awards or incentive schemes, safety training schemes, safety committees and level of subcontracting are also recommended for consideration

(Ng et al 2004). Figure 4.6 below shows the construction site safety implementation framework developed in this study. The construction site safety implementation framework consists of six components which are discussed below:

#### 4.4.1 Management Commitment

The first safety best practice identified, and one which is essential to any good safety program, is a management commitment to safety as “Management Support is Key to Safety Commitment”.



**Figure 4.6:** Construction Site Safety Implementation Framework

No company can have a successful safety program if the management of that company is not committed to the concept of a safe workplace. Every company has an obligation to ensure, as much as possible, the safety of its employees. Management's commitment to safety can manifest itself in many different ways.

#### 4.4.1.1 Safety Responsibility

Employers have legal obligations to ensure a safe and healthy workplace. While accidents can happen anywhere, there are some special danger zones. About one third of industrial accidents occur around forklift trucks, wheelbarrows and other handling and lifting areas. The most serious accidents usually occur near metal and woodworking machines and saws, or around transmission machinery like gears, pulleys, and flywheels. Falls on stairs, ladders, walkways and scaffolds are the third most common cause of industrial accidents. Hand tools like chisels and screwdrivers and electrical equipment (extension cords, electric droplights, and so on) are other major causes of accidents. In addition to unsafe conditions, three other work-related factors contribute to accidents: the job itself, the work schedule, and the psychological climate of the workplace. So it is the responsibility of the management to appoint qualified safety field staff, who can prevent the accidents from occurring on construction site.

#### 4.4.1.2 Safety Committee

It can be defined as “a committee set up to examine the health and safety policy of a particular company”. A safety committee has to be formed to assist with the planning and implementation of the Safety Management System on the construction site.

The first requirement for productive safety committee meetings lies in the hands of management. A senior manager should always attend and attend on time. This demonstrates management commitment to the process and to improving safety generally. An important aspect of committee meetings are the Minutes. The minutes are brief but indicate that all the agenda items have been covered.

Table 4.3 provides brief information about the committees: employees, size and representation. This summary is intended to provide basic facts. The legislation needs to be approved for the workplace to have the information about the size of the committee members.

**Table 4.3 :** Requirements for Health and Safety Committees

No. of Employees	Size of Committee	Representation
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20 or more employees	At least 2	At least half to represent employees
when there are 20 or more employees or when "required by order"	Not less than 4	At least one half must be worker representatives
As directed by the Client	At least 3 and not more than 12	At least two employees and one employer or at least half employees
when 10 employees or more	At least 2 and not more than 12	At least half to represent employees
20 or more employees as designated by Client	At least 4 and not more than 12	At least half to represent employees
20 or more employees, or when ordered by Client, or where a designated substance is in use (no minimum number of employees)	At least 2 (fewer than 50 employees); At least 4 (50 or more employees)	At least half to represent employees
20 or more employees	At least 4	At least half to represent employees
20 or more employees	As agreed upon by employees and employer	Equal Representation
20 or more employees	As agreed upon by employees and employer	At least half to represent employees
10 or more employees	At least 2 and not more than 12	At least half to represent employees
20 or more employees	At least 4 and not more than 12	At least half to represent employees
As directed by Chief Safety Officer	Not Specified	Equal Representation

#### **4.4.2 Safety Implementation**

The implementation process has five steps, as follows:

1. Securing management commitment, support and leadership
2. Assessing the safety implementation needs
3. Developing and selecting the components of safety management system.
4. Implementing the safety management system on construction site.
5. Evaluating the safety management system and planning for further activities

##### **4.4.2.1 Safety Policy**

To implement health & safety policy the construction company have to:

- Appoint and name a health and safety officer who in association with the safety manager will be responsible for health and safety.
- Endeavour to eliminate environmental hazards and encourage the reporting of hazards by supervisors and site staff.
- Look into conditions and practices reported to be unsafe and investigate all accidents that are reported.
- Publish Safety Rules for workplace and carry out periodic safety inspections as appropriate.
- Ensure that all employees are aware of correct safety in the workplace and where appropriate arrange training.
- Ensure that safety instructions are given to site staff where appropriate.
- Make every effort to ensure that appropriate protective clothing is worn by site staff where necessary.
- Maintain adequate accident reporting, follow-up procedures and recording.
- Make adequate provision for fire prevention, fire fighting and fire evacuation procedures including practices in consultation with the local Fire Service.
- Ensure that there are fire evacuation notices and signs indicating primary and secondary routes and assembly points.
- Ensure that there is a master evacuation/assembly chart in the main entrance of the construction site.
- Operate a 'preventative maintenance' system.
- Include within the annual financial estimates provision to assist with implementation of the policy.
- Prominently display a copy of this document for the benefit of construction site employees.
- Ensure that medical facilities are readily available and that qualified first aid personnel and/or appointed persons are nominated.

- Systematically review all training needs, safety and welfare and, where appropriate, to ensure that this safety policy be modified or supplemented by further statements relating to the work of particular departments or groups of employees

#### **4.4.2.2 Safety Rules**

Before using equipment and machines or attempt practical work in a workshop, basic understanding of safety rules must be developed within the operators. These rules will help keep them safe in the workshop.

#### **4.4.2.3 Safety Organization**

How is the organization structured, where are responsibilities and accountabilities defined, who reports to whom and who is responsible for what. Management has to play its part for properly organizing and managing their responsibilities and accountabilities.

#### **4.4.2.4 Safety Responsibility**

A construction safety officer (CSO) is responsible for making sure that people working in the construction industry adhere to certain rules and regulations regarding safety. CSOs are trained in managing skills and safety principles and are required to have a field experience in the industry. The specific duties of a construction safety officer vary depending on the type of job and the tools or machinery used.

#### **4.4.2.5 Safety Management System**

There is an implied moral obligation placed on an employer to ensure that work activities and the place of work to be safe, there are legislative requirements defined in just about every jurisdiction on how this is to be achieved and there is a substantial body of research which shows that effective safety management (which is the reduction of risk in the workplace) can reduce the financial exposure of an organization by reducing direct and indirect costs associated with accident and incidents.

#### **4.4.2.6 Compliance with Safety Legislations**

If during the execution of a contract, a contractor or subcontractor is in breach of any OHS requirements, all work with regards to that activity have to be suspended. The contractor shall be alerted to the matter in writing only if work was suspended. Work cannot recommence until the adequate risk controls are in place to avoid risk of injury.

#### **4.4.2.7 Safe Working Environment**

The basic remedy idea is to identify and eliminate the unsafe conditions. OSHA standards address these mechanical and physical accident-causing conditions. HR and the firm's top managers should play central role in and accept responsibility for identifying unsafe conditions. However, as the employers front line managers, supervisors play a crucial role in this process too.

#### **4.4.2.8 Safety Induction and performance Monitoring**

From the generic information about working at the construction site, all contractors are required to attend a site induction involving the workplaces in which they will be working at. Site inductions are arranged and delivered by either the main contractor, or where appropriate the contract manager shall arrange and deliver the site induction. Special inductions may be required or high risk areas.

Other contractor employees or subcontractors which are employed after the initial site induction are to be inducted by the main contractor. Records of this training are to be kept using the contractors own induction form. Records are to be forwarded to the contract manager or safety inspector at the end of each month.

#### **4.4.2.9 Selection of Subcontractors**

The selection of any sub-contractors is probably best left to the contractor. Clients must, however, satisfy themselves that a contractor has an effective procedure for appraising the competence of a sub-contractor. When selecting a suitable sub-contractor, a contractor may use some or all of the criteria that a client may use in selecting a suitable contractor. Again, the degree of competence required will depend on the work to be done.

### **4.4.3 Safety Training**

Contractors are required to ensure that all foremen and their workers including gangers, drivers and plant operators working on site shall have attended and successfully completed a general safety induction training course recognised by regulatory authority.

#### **4.4.3.1 Induction training in construction safety**

Induction training ensures that persons engaged to undertake construction work have a basic knowledge of the preventative measures devised from a risk assessment so as to prevent or minimize the possibility of injury on construction sites.

#### **4.4.3.2 Updated Safety Information**

A safety officer on a construction site have to identify all possible risks that workers might be exposed to and implementing changes to protect them from those risks. Safety officer sometimes feels like there no end to the mischief that they might be able to do, especially in a plant with machines running, forklifts driving, trucks offloading, etc. So it is important to have an updated information about the safety conditions and performance on a construction site which keeps on changing from day to day.

#### **4.4.3.3 Safety Promotion**

On a construction site, safety officers and supervisors can develop an advertising campaign to promote their safety program. Safety promotion methods may include safety posters and stickers, safety contests, safety suggestions recognition and rewards, and recognition organization. Top company management needs to give incentives to front-line supervisors, superintendents and to introduce project safety incentives to motivate its staff and improve the safety performance on the site.

### **4.4.4 Emergency Response Procedures**

Emergency procedures are plans for handling emergencies that may occur on the construction site, including, but not limited to, injuries resulting from falls, fires, explosions and releases of hazardous materials.

In the construction industry a variety of emergencies may occur. The accidents range from grazed skin to significant events that may require the evacuation of entire suburbs and perhaps loss of life. Some examples of workplace emergencies include:

- fire
- gas leaks
- electrocution
- chemical spills
- collapse/malfunction of plant
- collapse of structures
- fire/other emergency in nearby site
- implied threat to site, e.g. bomb threat
- natural disasters, e.g. earthquake.

To ensure safety and well being of workers on construction site, it is important to prepare carefully for emergencies. In the ever changing construction environment, this is particularly important. Construction sites are continuously faced with changes in the physical layout, changes in emergency devices available and in harmful exposures. Careful pre-planning of emergency procedures, prior to the start of a project and during changes in different construction phases, must be done and all crew members must be aware of these procedures.

#### **4.4.4.1 Emergency Response Plan and Procedures**

The thing to think during an emergency is how to evacuate or escape, especially if most familiar route is not accessible. Knowing the emergency plan and being aware of surrounding conditions can mean the difference between quick action and the wrong action. Safety and the survival of all crew members depends on taking the right action.

Identify the emergencies that are likely to occur in your location or line of work. Take each identified emergency and develop company procedures that all employees may follow during an emergency situation. Emergency procedures can

be well documented and bound in a binder or book. Every construction work site and supervisor should have a copy of the emergency procedures.

#### **4.4.5 Accident Investigation**

An incident usually refers to an unexpected event that did not cause injury or damage this time but had the potential. "Near miss" or "dangerous occurrence" are also terms for an event that could have caused harm but did not.

##### **4.4.5.1 Accident Recording**

Accident recording is the process by which organizations investigate an accident and then code, store and analyze the information from the report form for insurance claims and risk management purposes.

A designated responsible person is required to record the following:

- fatal and other major accidents;
- accidents causing employees more than three days incapacity for work;
- work-related diseases;
- gas accidents; and
- any dangerous occurrence.

##### **4.4.5.2 Accident Analysis**

All accidents, near misses and outbreaks of disease should be analyzed as a matter of routine. The findings of such analysis should then be used to improve workplace safety standards and make appropriate recommendations to prevent a repeat of the incident. Accident investigations determine how and why these failures occur. By using the information gained through analyzed, a similar, or perhaps more disastrous, accident may be prevented.

As little time as possible should be lost between the moment of an accident or near miss and the beginning of the investigation. In this way, one is most likely to be able to observe the conditions as they were at the time, prevent disturbance of evidence, and identify witnesses. The tools that members of the investigating team may need (pencil, paper, camera, film, camera flash, tape measure, etc.) should be immediately available so that no time is wasted.

#### **4.4.6 Safety Review**

Post-construction field reviews are made to evaluate safety features of completed projects and identify any site conditions that may negatively affect safety in an effort to implement the necessary changes to improve safety. Upon completion of the project reviews, inspection reports were analyzed to determine if there are common inconsistencies with safety features and performance. The noted safety deficiencies and associated recommendations may be used to develop design guidelines for context sensitive design projects as a tool to aid designers in designing as well as to train construction personnel to identify and correct common mistakes. Based on post-construction safety review, findings and conclusions are made from the recent construction project and recommendations are made for future projects to avoid the mistakes made in previous projects.

##### **4.4.6.1 Safety Hazard Review**

Workplaces with fall hazards range from construction sites, in which workers may be a few stories above the ground with fall hazards. A combination of head and fall protection may be required in either type of work area. For the worker several stories above the ground, a fall harness is a prerequisite, in addition to a hard hat. Areas with small fall hazards, however, likely do not require harnesses, but some form of head protection, is necessary.

Constant exposure to noise weakens a person's hearing over time, and workplaces with loud equipment and tools consistently in use can be considered such a hazard. Workers in these instances need safety supplies, such as muffs or ear plugs, for hearing protection. Ear plugs or muffs, however, should not be powerful enough that all sounds are blocked out. Instead, these safety supplies should reduce background noise and allow you to hear those around you at the same.

##### **4.4.6.2 Site Safety Policy Review**

The Safety Policy developed at the start of the each construction project needs to be reviewed by the top management which supports six fundamental means of maximum employee involvement:

1. Management commitment to safety.
2. Weekly tool box safety meetings at all jobsites.



3. Effective job safety training for all categories of employees.
4. Job hazard analysis provided to all employees.
5. Audio and/or visual safety presentations given at jobsites by responsible person.
6. Various incentive awards for exemplary safety performance.

The responsible persons will have to meet to evaluate all areas of safety and make recommendations to the company chief executive officer.

#### **4.4.6.3 Safety Audit**

Safety auditing is a structured and detailed approach to reducing and controlling the seriousness of accidents before it's occur. The main purposes of safety audit includes to evaluate management, the workforce and the physical plant itself for the novel purpose of accident prevention and containment efforts.

The audit serves to inform the organization how well it is doing with regard to safety performance. The construction job site safety audit can be a critical tool for keeping projects on time and under budget. On going attention to safety and loss control is the ounce of prevention that's worth a pound of cure. On a regular basis, identifying and then correcting or removing work site hazards, a job site safety audit efficiently minimizes accidents and injuries. With hazards identified on a timely basis, some can be taken care of right away while others may require scheduling.

## **DISCUSSION**

### **5.1 INTRODUCTION**

Qualitative and quantitative results of safety management in construction are discussed in this chapter. Results of safety management survey are discussed for construction industry application. Management interviews are also discussed which revealed many aspects of managing safety on construction projects. Finally, the construction safety framework developed is discussed and comparison is made with the previous construction safety framework.

### **5.2 DISCUSSION ON RESULTS FOR THE SAFETY MANAGEMENT SURVEY**

The detailed data analysis and results on the management survey were presented in the previous chapter. In this section, the results are further discussed with respect to safety management to consider construction industry application. The Company's policy clearly states that safety, health and well-being of employees and environmental protection is to be the number priority for the construction firms. The construction company have o keep the documents that reveal that the responsibility for the site safety lies firmly with the project management team. The safety team needs to be on a construction project to provide advice on actions according to contractual and statutory requirements, to ensure safety management in the best interest of all workers, and to achieve the company target of a zero-accident working environment. The construction companies in Pakistan may integrate safety management systems into their project management systems. Most of the respondents agree that implementation of safety, health and environmental management systems are the best way to ensure safety on-site. Therein, implementation of the site safety plan is all-important to ensure safe operation of construction sites (Choudhry, 2007).

Safety management as well as best safety practices of local construction companies were investigated through safety management survey. In some reputed construction companies like Descon Engineering Limited, Izhar Construction (Pvt)

Limited, Habib Rafiq (Pvt) Limited, Eco-West International (Pvt) limited, Guarantee Engineers etc., safety issues gained vital importance and the companies top management was implementing safety, health and environmental management system to reduce injuries, eliminate illness, and to provide a safe work environment for their workforce on their construction sites.

Safety management survey determined the status of safety on the construction sites. The analysis provided useful information on seven aspects of construction safety including: health and safety policy; safety organization; safety training; safety inspections; safety promotion; personal protection program and documentation and accident prevention. Statistical analysis indicated that there was a need to introduce the concept of site-specific safety plan to be submitted by the main contractors and sub-contractors executing construction activities on sites. Documentation and accident prevention at the construction sites needs top management attention of the contractors. Supervisors have to attend safety training sessions organized by the organization at sites or in the offices. Safety inspections are targeted to improve the unsafe condition and unsafe behaviors. Inspections are to be documented into the safety checklists which are available online developed by OSHA. Financial budget needs to be allocated to the safety in the BOQ which may vary from 2% to 5% of the total project cost.

### **5.3 DISCUSSION ON MANAGEMENT INTERVIEWS**

In this section, the results of management interviews are discussed along with their application to the construction industry. It is observed through interviews that safety management systems are not well developed and operational in the construction industry. At the government level, legal requirements are not in place in the form of laws and regulations for safety and health. Worker safety awareness program on the construction sites needs to be introduced by the clients, consultants and contractors to improve safety conditions on construction sites. Work instructions in writing are to be developed based on the company policy for the project as required during the execution of the construction activities to avoid any unpleasant event from occurring. Clients have to take initiative to ask local contractors to submit safety, health and environmental management systems at the time of bid submission for the project. There must be a partnership between the

government, clients, consultants, contractors and the workers for ensuring safe operations in construction site environments more than ever to increase productivity and maximize profits (Choudhry, 2007).

Qualitative analysis provides useful information on the significance for managing safety on construction sites by the top management of the construction firms. Interviews revealed the useful information on the general safety condition in the construction companies; developing, implementing, monitoring, auditing and reviewing of safety, health and environmental management system within the companies; the investigation of recordable incidents by the management; preparation and updating of site safety plan on each project by the contractors representatives; education and training of workers and supervisors; explanation of company policy to new employees as part of their training and orientation prior to the commencement of work; existence of the process on construction sites that provide information to the operatives to learn from the previous incidents for avoiding serious accidents resulting from such incidents; suitability of plants and equipments for the site jobs and training of operatives using these plants and equipments; and the management of sub-contractor's workers safety on-site and use of safety standards and procedures on-site. Management interviews analysis revealed that a contractor needs to implement a safety, health and environmental management system on construction sites to help reducing risk at job site for improving safety culture on-site.

#### **5.4 DISCUSSION ON CONSTRUCTION SAFETY FRAMEWORK**

A detailed description of developed construction safety framework for implementing safety on construction sites has been presented in the previous chapter (see section 4.4). In this section, comparison is made between the developed construction safety framework with the previous available safety frameworks. An extensive literature review was carried out to look for the construction safety framework for implementation of safety on construction sites and best frameworks were selected which gave information about implementing safety on construction sites. In combination with literature review, results from safety management survey and management interviews were utilized to develop the

safety implementation framework on sites which is suitable for local construction firms. Ng et al. (2004) framework for evaluating the safety performance of construction contractors is selected. In table 5.1, a comparison is made between the construction site safety implementation framework factors and Ng et al. (2004) construction safety factors in project level. Construction safety framework developed in this study is suitable for implementation of safety on construction sites while the compared safety framework previously developed by Ng et al. was for evaluation of safety performance by construction contractors. The context of the frameworks differs in terms of implementation and evaluation of safety on construction sites.

**Table 5.1:** Comparison of Safety Implementation Framework

	<b>Construction site safety implementation framework factors of this research</b>	<b>Ng et al. construction safety factors in project level</b>
1	Administrative and management commitment includes responsibility and safety committee	1 Project management commitment includes safety responsibility and safety committee
2	Safety Implementation includes safety policy, rules, organization, responsibility and safety management system; compliance with safety legislations; safe working environment; safety induction and performance monitoring for contractors; selection of subcontractors	2 Implementation includes safety inspection; safe system of work; plant and equipment; safe working environment; safety officer and supervisor.
3	Safety information, training and promotion includes safety training; updated safety information; safety promotion	3 Information, training and promotion includes safety training; updated safety information; safety promotion

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4	Emergency procedures includes emergency plan and procedures.	4	Emergency procedures includes emergency plan and procedures.
5	Accident recording, reporting and investigating includes accident recording and reporting; accident investigation and analysis.	5	Recording, reporting and investigation includes accident recording and reporting; accident investigation and analysis.
6	Safety review includes safety hazard review; site safety policy review; safety audit	6	Safety review includes safety hazard review; site safety policy review; safety audit

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Safety factors in project level was proposed by Ng et al. (2004) for evaluation of safety performance by construction factors but these factors differ from the safety framework developed in this research in the context of implementation of safety on construction sites. Each factor in the current study is taken into account in respect of safety implementation on construction sites by contractors while Ng et al. in his research discussed the safety evaluation methods and factors affecting safety performance of contractors. In the previous chapter (see section 4.4), the factors for implementation of safety on construction sites describes a clear picture as how an effective safety system can be establish by the construction company to implement safety on its construction projects. First the administrative commitment is necessary for implementation of safety, which is the considered as the first step. Similarly for the evaluation of safety performance by contractors, project management commitment is essential without which it is impossible. For implementation and evaluation of safety on construction site, safety policy, rules, organization, safety management system, safe working environment, selection of sub-contractors on merits are few factors that are to be taken into account. Safety information, training and promotion, emergency plans and procedures, and accident recording, reporting and investigation are the factors which further stimulates the implementation process for safety on construction sites, also considered by Ng et al (2004) evaluation of safety performance of contractors on construction sites.

## **CONCLUSIONS AND RECOMMENDATIONS**

### **6.1 INTRODUCTION**

In this chapter, research conclusions and recommendations are presented. Based on the study results, the conclusions are drawn and recommendations are made.

### **6.2 REVIEW OF RESEARCH OBJECTIVES**

The two primary objectives of this research effort were :

1. Study the safety management system required for safely managing operations on construction sites.
2. Develop a safety framework for implementing safety on construction sites.

These objectives are discussed as how they are achieved. The first primary research objective has been met by studying safety management system for implementing safety on construction sites of different companies. Detail of safety management system was included in Chapter 2. The significance of safety management system for construction sites safety implementation was discussed in detail and a detailed survey on safety management system was conducted using a questionnaire covering seven important aspects of safety management system. Management level safety interviews were conducted to find out the trends of safety management in the construction industry.

The second primary objective has been met by developing a construction site safety implementation framework through the findings of safety management system questionnaire survey, management safety interviews and past research. Six parameters required for site safety implementation identified in the developed framework are management commitment, site safety implementation requirements, safety training, emergency response procedures, accident investigation and safety review. The detailed information about the six parameters were discussed in chapter 4.

### 6.3 CONCLUSIONS

Safety management survey explored seven aspects of construction site safety including (1) health and safety policy; (2) safety organization; (3) safety training; (4) safety inspections; (5) safety promotion; (6) personal protection program and (7) documentation and accident prevention. Conclusions made from the statistical analysis of safety management survey are shown as below:

- The construction company's top management needs to consider the development and implementation of safety, health and environmental management systems.
- Safety organizational chart needs to be displayed on site.
- Competent safety staff be appointed responsible for implementation of safety practices on site.
- The concept of submission of specific safety plan by the subcontractor needs to be introduced in the construction industry.
- Health and safety training plan, training to new employees and financial budget to safety are the issues that needs attention by management of the company.
- Safety inspections need to be made at regular intervals from the client.
- Safety performance needs to be checked at regular intervals at management level by means of conducting safety audits.
- Safety bulletins needs to be provided and different awards schemes need to be introduced to motivate and increase the safety performance level of workers at project site.
- The documentation of safety record and accident prevention policy/plan also requires top management attention.

Based on the qualitative analysis of safety management interviews conducted from the interviewees as shown in Table 4.2, following conclusions are made:

- Trends of safety in construction industry of Pakistan had started improving from last 5 years. Previously the concept of safety by the



staff during construction rarely seen on sites however people do care of safety at that time as well but not given the name.

- Safety is there where quality work is present and proper funds are provided for the project safety provisions. Due to funding problems, it is impossible to include safety in BOQ and to give importance to safety issues.
- The conditions in the construction industry of Pakistan are changing like EIA report is necessary for every project from the environmental point of view.
- In Pakistan, as most of the contractors have no awareness of any safety policy/program and has no education in this matter, that's why implementation of the same is difficult.
- Although the Safety clauses inducted in the contract but implementation and monitoring from client is not adequate.
- There is no proper policy been made in construction industry in Pakistan because of the necessity of safety is not justified from higher authorities at national level.
- Safety related literature and handbooks are mostly kept at the head offices of the construction companies and only oral trainings are given to the workers at the construction sites.

#### **6.4 RECOMMENDATIONS**

- Provision of funds needs be allocated/included in the contract, so that contractor can implement the safety more efficiently.
- On construction sites in Pakistan, it is the responsibility of the client to give positive response to the consultant's instructions conveyed through letters and memos and take measures against the contractor's violations of safety policy on site.
- Follow up of Safety Measures at site have minimized the accidents to the lowest level.

- On the government level, it is imperative to establish a Government Agency to supervise and control the implementation of safety practices in construction industry of Pakistan. Such Agency have bigger authority to take stern measures and give sanctions to contractor companies violating the rules, has never been established in Pakistan. The controlling agency should be organized under the Ministry of Manpower in order to ensure the implementation of safety control of both government and private construction projects. This controlling agency should be given the authority to put penalties and sanctions upon contracting companies for its disobedience to safety practices.

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## **Appendix I: Cover Letter of Safety Management Questionnaire**

**To:** \_\_\_\_\_

**Subject:** **SAFETY MANAGEMENT RESEARCH QUESTIONNAIRE**

Respected Sir,

Department of Construction Engineering and Management at School of Civil and Environmental Engineering (NUST) Islamabad is conducting a Research Survey on Safety Management in the construction industry of Pakistan.

The construction industry is one of the most important sectors in any nation's development. The volume of construction is an indicator of a nation's progress and economic prosperity. What is happening to the construction industry may be a matter of national concern. This research is important in the construction sector for its future improvement.

We are interested to find out how you feel about safety practices and principles in your construction site environments. We are conducting confidential surveys. To help with task, we would like you to complete the attached questionnaire – confidentiality is assured. The questionnaire is relatively simple to complete and ask about your attitudes to safety issues; as well as any suggestion you might have to ensure safe working condition on construction sites.

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,

**WAQAS AHMED**

Post Graduate Student – Construction Engineering & Management

**DR.RAFIQ MUHAMMAD CHOUDHRY (Ph D)**

Associate Professor & Head  
Department of Construction Engineering & Management  
National Institute of Engineering  
School of Civil & Environmental Engineering  
Sector H-12, NUST, Islamabad.

## Appendix II: Safety Management Questionnaire

### General Information

<b>a. Personal Details: (Details will be kept confidential)</b>	
Name (Optional):	
Age in years:	Under 18    18-25    25-35    35-50    50+
Gender:	1. Male                  2. Female
Name of Project:	
Position:	
Organization:	
Address:	
Working Experience in Construction Industry:	0-5    6-10    11-15    16-20    20+
Education Obtained:	

<b>b. Contact Details: (Details will be kept confidential)</b>	
Telephone (Optional):	
Email (Optional):	

## Safety Management System

Please complete the questionnaire by ticking / filling either “Yes” or “No” against each question for which the confidentiality is assured.

Statement	Yes	No
<b>1.0 Health and Safety Policy</b>		
1.1 Has your company developed Health, Safety & Environmental policy?	<input type="checkbox"/>	<input type="checkbox"/>
1.2 Does the policy clearly state that decisions on other priorities should give due regard to construction safety requirements?	<input type="checkbox"/>	<input type="checkbox"/>
1.3 Does the policy commit the organization to full compliance with all relevant health and safety standards?	<input type="checkbox"/>	<input type="checkbox"/>
1.4 Does the policy set targets for health and safety performance including a commitment to progressive improvement?	<input type="checkbox"/>	<input type="checkbox"/>
1.5 Does the policy identify key senior personnel for overall coordination and implementation of the policy?	<input type="checkbox"/>	<input type="checkbox"/>
1.6 Does your company allocate any financial budget to safety?	<input type="checkbox"/>	<input type="checkbox"/>
<b>2.0 Safety Organization</b>		
2.1 Is there an organization chart showing the names and positions with responsibility lines for safety performance management?	<input type="checkbox"/>	<input type="checkbox"/>
2.2 Has the individual health and safety responsibilities of all employees been clearly defined?	<input type="checkbox"/>	<input type="checkbox"/>
2.3 Have sufficient competent safety officers and safety supervisors been appointed and engaged for the site?	<input type="checkbox"/>	<input type="checkbox"/>
2.4 Are subcontractors required to submit site-specific safety plans?	<input type="checkbox"/>	<input type="checkbox"/>
<b>3.0 Safety Training</b>		
3.1 Is there a health and safety training plan?	<input type="checkbox"/>	<input type="checkbox"/>
3.2 Is any training given to new employees?	<input type="checkbox"/>	<input type="checkbox"/>
3.3 Is safety training a compulsory item within the budget?	<input type="checkbox"/>	<input type="checkbox"/>
3.4 Are trainings given to in service employees?	<input type="checkbox"/>	<input type="checkbox"/>

Continued....



<b>Statement</b>	<b>Yes</b>	<b>No</b>
<b>4.0 Safety Inspections</b>		
4.1 Do safety officers and safety supervisors carry out safety inspections at regular intervals?	<input type="checkbox"/>	<input type="checkbox"/>
4.2 Does your company conduct safety audits for project execution?	<input type="checkbox"/>	<input type="checkbox"/>
<b>5.0 Safety Promotion</b>		
5.1 Are safety bulletin boards provided and located so that every employee will see them during working days?	<input type="checkbox"/>	<input type="checkbox"/>
5.2 Are safety signs and posters prominently displayed on site?	<input type="checkbox"/>	<input type="checkbox"/>
5.3 Are safety awards meted out on a regular basis with recognition given for good safety performance by individuals?	<input type="checkbox"/>	<input type="checkbox"/>
<b>6.0 Personal Protection Program</b>		
(Safety helmet, safety shoes, safety goggles, safety gloves, ear muffs)		
6.1 Has the requirements for the provision of personal protective equipment (PPE) been indicated in the contract agreement / safety plan?	<input type="checkbox"/>	<input type="checkbox"/>
6.2 Has a sufficient stock of carefully selected and appropriate PPE been obtained?	<input type="checkbox"/>	<input type="checkbox"/>
6.3 Has an effective system for the issuance, recording, and inspection of PPE and its replacement been established?	<input type="checkbox"/>	<input type="checkbox"/>
<b>7.0 Documentation and Accident Prevention</b>		
7.1 Has any arrangement made by your company to keep record of accidents occurring during execution of project activities?	<input type="checkbox"/>	<input type="checkbox"/>
7.2 Is there any staff hired to keep the proper documentation of accidents occurring and updating of this record?	<input type="checkbox"/>	<input type="checkbox"/>
7.3 Is any policy / plan developed for accident prevention on construction site?	<input type="checkbox"/>	<input type="checkbox"/>

**Thanks for your co-operation**

### **Appendix III: Descriptive questions for interview**

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<b>Sr.#</b>	<b>Interview Questions</b>
1.	Would you like to throw some light on the salient features of the Pakistani construction industry in the context of safety?
2.	Please express your views on safety situation in general on construction projects of the company.
3.	Please express your views on safety, health, and environmental management system of the company. How they were developed, implemented, monitored, audited, and reviewed continuously?
4.	To what extent is the management investigating recordable incidents?
5.	On each project, who is responsible to prepare the site safety plan? How is being updated?
6.	Please express your views on education and training of workers and supervisors.
7.	Is the policy explained to new employees as part of their training and orientation prior to the commencement of work?
8.	Does any process exist on construction sites that operatives should learn from incidents to avoid resulting serious accidents?
9.	A short question is, “are plants and equipment used on site suitable for the jobs and those using these were trained?”
10.	How is the safety of subcontractors’ workers managed on-site? Do they practice safety management systems? How they use and follow safety standard as well as procedures on-site?

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## Appendix IV: List of Construction Sites for Safety Management

### Survey

Sites	Construction Company Name	Construction Site Name	Location
01	Descon Engineering Ltd	Engro Chemicals Pakistan Ltd (Expansion project)	Daharki, Sindh
02	PROJACS	The Centaurus Project	Islamabad
03	Descon Engineering Ltd	Nestle Milk Receiving Unit	Shekupura
04	Camp Dresser & Mckee Inc.	Pakistan Earthquake Recovery and Reconstruction Project	Muzzafarabad, AJK
05	Izhar Construction (Pvt) Ltd	PTET Telecom Tower Project	Blue Area, Islamabad
06	Paragon Constructors (Pvt) Ltd	Construction of Technical Block	Khushab
07	Habib Rafiq (Pvt) Ltd	Construction of Pakistan Institute of Parliamentary Services	F-5, Islamabad.
08	Matracon Pakistan (Pvt) Ltd	Construction of AJK Lodges Project	Parliament Lodges, Islamabad
09	Builder Associates (Pvt) Ltd	Construction of PT-Tele House	Mauve Area, G-10, Islamabad
10	Contech International	Strategic Ops Building	Naval Complex, Rawalpindi
11	Camp Dresser & Mckee Inc.	Infrastructure Support & Capacity development Program	Lahore
12	Bridgestone Construction Company	Canyon Views	DHA Phase II, Extension, near Rawat Tool Plaza, Islamabad Highway.
13	Sinaco Engineers (Pvt) Ltd	Construction of 3 Cold Stores and Tetra Pack Extension Project	Engro Foods, 8 km Pakpattan road, Sahiwal
14	National Foundation for Resource Development	ASKARI-XIV	Rawalpindi

<b>Sites</b>	<b>Construction Company Name</b>	<b>Construction Site Name</b>	<b>Location</b>
15	AGA Associates	Construction of Quaid-e-Azam International Hospital	Golra More, Rawalpindi
16	Tameer Associates	Construction of NUST Headquarters	NUST, H-12, Islamabad
17	AGA Associates	Construction of Zainab Hostels	NUST, H-12, Islamabad
18	Guarantee Engineers	Construction of Fauji Fertilizer House Building	The Mall, saddar, Rawalpindi
19	Capital Builders	Extension of Army Burnhal College	Abbottabad
20	Quality (Pvt) Ltd	Construction of Transit Accommodation	Rawalpindi
21	Asher Engineers & Contractors	Construction of Green Tower	Blue Area, Islamabad
22	Khyber Grace (Pvt) Ltd	Construction of Labour Complex WWF	Taxila
23	Aarcon	Construction of Park Lane Apartments	Faizabad, Rawalpindi
24	L.A.C (Pvt) Ltd	Construction of Azad Jammu and Kashmir Council Building	F-5, Islamabad.
25	Eden Housing Ltd	Eden Lane Villas-II	Eden Towers, Gulberg Lahore
26	Interconstruct (Pvt) Ltd	Construction of FGEHF Apartments	Package-IV, G-11/4, Islamabad
27	KKP (Pvt) Ltd	Construction of FGEHF Apartments	Package-III, G-11/4, Islamabad
28	Abdul Majeed & Company	Construction of FGEHF Apartments	Package-II, V, G-11/3-4, Islamabad
29	Iksa Construction Company	Construction of Ghakkar Plaza	The Mall, saddar, Rawalpindi
30	Shahzaman (Pvt) Ltd	Construction of FGEHF Apartments	Package-I, G-11/3, Islamabad
31	M/S Interglobe	Construction of Oil Storage Tanks	APL RBT, Caltex Road New Lalazar, Rawalpindi

<b>Sites</b>	<b>Construction Company Name</b>	<b>Construction Site Name</b>	<b>Location</b>
32	Kestral SPD (Pvt) Ltd	Jallozai Team Accomodation	Jallozai, Peshawar
33	Izhar Construction (Pvt) Ltd	Construction of Ghazali-V,VI Hostels	NUST, H-12, Islamabad
34	Eco-west International (Pvt) Ltd	Construction of District Complex	Bagh, AJK
35	Bahria Town (Pvt) Ltd	DBH JV	Rawat Industrial Estate, Rawalpindi
36	Haris & Co	Kadawari-Incinerator Relocation Project	Sindh
37	Descon Engineering Ltd	Fauji Cement Project	Near Brahma Bahtar Interchange, Taxila
38	Interhom (Pvt) Ltd	Construction of New Pakistan Secretariat Building	G-5, Islamabad
39	Habib Rafiq (Pvt.) Limited	Construction of Stock Exchange Tower	Islamabad
40	Build fast Countrywide (Pvt) Ltd	Construction of NIIT Building	Nust, H-12, Islamabad
41	Shalimar Construction Co (Pvt) Ltd	Construction of CCE & MS Building	Nust, H-12, Islamabad
42	Izhar (Pvt) Ltd	Construction of Attock Refinery Building	Morgah, Rawalpindi.
43	Universal Corporation (Pvt) Ltd	Construction of National Monument of Pakistan	Islamabad
44	Army Housing Directorate	Construction of 54 Houses Block	DHA, Lahore
45	Guarantee Engineers	Construction of FPCCI Building	G-8, Islamabad
46	Army Housing Directorate	Construction of housing calony of 400 houses	Askari XIV, Rawalpindi
47	National Construction Limited	Construction of NUST Institute of Management Sciences	Nust, H-12, Islamabad
48	National Construction Limited	Construction of Academic Block I, CIIT	CIIT, Chak-Shehzad, Islamabad.
49	Builders Associates (Pvt) Ltd	Construction of Cultural Complex	Near Shakarparian, Islamabad

<b>Sites</b>	<b>Construction Company Name</b>	<b>Construction Site Name</b>	<b>Location</b>
50	Guarantee Engineers	Construction of Immigration Tower	G-8, Islamabad
51	Universal Corporation (Pvt) Ltd	Construction of Worker's Welfare Fund (WWF) Secretariat	Mauve Area, G-10, Islamabad
52	MoinSons (Pvt) Ltd	Construction of State Life Tower	Islamabad
53	Uni-Build Associates (Pvt) Ltd	Construction of Rawalpindi Education Board	Morgah, Rawalpindi.
54	H.A Associates	Construction of International Cricket Stadium	Near 6th Road, Rawalpindi
55	Builders Associates (Pvt) Ltd	Construction of EOBI House	Mauve Area, G-10, Islamabad

### Appendix V: List of Respondent's Ages and Experiences

Respondent	Age	Experience	Position
1	25-35	6-10 yrs	Senior HSE Engineer
2	25-35	6-10 yrs	HSE Officer
3	25-35	6-10 yrs	In charge HSE
4	25-35	11-15 yrs	Assistant Resident Engineer
5	18-25	0-5 yrs	Safety Inspector
6	25-35	0-5 yrs	Construction Manager
7	25-35	6-10 yrs	Safety Officer
8	25-35	11-15 yrs	Project Manager
9	35-50	16-20 yrs	Project Manager
10	35-50	20+ yrs	Project Manager
11	25-35	6-10 yrs	Design Manager
12	18-25	0-5 yrs	QA/QC Engineer
13	25-35	6-10 yrs	Safety Officer
14	18-25	0-5 yrs	Project Engineer
15	25-35	11-15 yrs	Project Manager
16	18-25	0-5 yrs	Site Engineer
17	25-35	0-5 yrs	Site Engineer
18	25-35	0-5 yrs	Site Engineer/QC
19	25-35	6-10 yrs	Project Manager
20	25-35	11-15 yrs	Project Manager
21	25-35	6-10 yrs	Project Director
22	25-35	6-10 yrs	Project Manager
23	35-50	20+ yrs	Project Manager

Continued....

<b>Respondent</b>	<b>Age</b>	<b>Experience</b>	<b>Position</b>
24	35-50	20+ yrs	Deputy Project Manager
25	18-25	0-5 yrs	Area Engineer
26	50+	20+ yrs	Managing Director
27	25-35	6-10 yrs	Project Manager
28	35-50	20+ yrs	Project Manager
29	35-50	20+ yrs	Project Manager
30	25-35	11-15 yrs	Project Manager
31	18-25	0-5 yrs	Site Engineer
32	18-25	0-5 yrs	Site Engineer
33	25-35	11-15 yrs	Project Manager
34	25-35	6-10 yrs	Safety Officer
35	50+	20+ yrs	Manager Security and Safety
36	25-35	0-5 yrs	Planning Engineer
37	35-50	11-15 yrs	Safety Officer
38	25-35	6-10 yrs	Planning Engineer
39	35-50	16-20 yrs	Senior Engineer
40	25-35	6-10 yrs	Project Manager
41	25-35	6-10 yrs	Project Manager
42	25-35	11-15 yrs	Project Manager
43	35-50	20+ yrs	Project Manager
44	35-50	11-15 yrs	Project Manager
45	35-50	11-15 yrs	Construction Manager
46	25-35	6-10 yrs	Deputy Assistant director
47	35-50	20+ yrs	Deputy Project Director

Continued....



<b>Respondent</b>	<b>Age</b>	<b>Experience</b>	<b>Position</b>
48	25-35	11-15 yrs	Project Manager
49	35-50	16-20 yrs	Project Manager
50	35-50	20+ yrs	Deputy Project Director
51	35-50	16-20 yrs	Executive Director Engineering
52	25-35	6-10 yrs	Planning Engineer
53	25-35	11-15 yrs	Project Manager
54	25-35	11-15 yrs	Project Manager
55	35-50	16-20 yrs	Project Manager

## Appendix VI: Data in SPSS and results

### Keywords for questionnaire items

QUESTION #	KEYWORDS
1.1	POLICY
1.2	DECISIONS
1.3	COMPLIANCE
1.4	TARGETS
1.5	PERSONNEL
1.6	BUDGET
2.1	CHART
2.2	RESPONSIBILITY
2.3	STAFF
2.4	SUBCONTRACTORS
3.1	TRAINING
3.2	NEW STAFF
3.3	COMPULSORY
3.4	IN SERVICE
4.1	INSPECTIONS
4.2	AUDITS
5.1	BOARDS
5.2	SIGNS
5.3	AWARDS
6.1	PPE
6.2	STOCK
6.3	ISSUANCE
7.1	RECORD
7.2	DOCUMENTATION
7.3	PREVENTION

### Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
HSE Policy	55	0	1	.64	.485
Construction Safety Requirements decisions	55	0	1	.62	.490
Policy Compliance with Safety Standards	55	0	1	.44	.501
Targets for Health and Safety	55	0	1	.51	.505
Key Senior Personnel Identification	55	0	1	.62	.490
Allocation of financial budget to Safety	55	0	1	.58	.498
Organization Chart	55	0	1	.33	.474
Health and safety Responsibilities	55	0	1	.45	.503
Sufficient Competent Safety Staff	55	0	1	.31	.466
Subcontractors site specific safety plans	55	0	1	.20	.404
Health and Safety Training Plan	55	0	1	.38	.490
Training of new employees	55	0	1	.29	.458
Safety Training compulsory in Budget	55	0	1	.33	.474
Training of in service employees	55	0	1	.44	.501
Inspections by Safety Officers	55	0	1	.40	.494
Safety Audits for Project Execution	55	0	1	.33	.474
Safety Bulletin Boards	55	0	1	.35	.480
Safety Signs and Posters	55	0	1	.42	.498
Safety Awards	55	0	1	.15	.356
Provision of PPE in CA/Safety Plan	55	0	1	.67	.474

Continued....

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	N	Minimum	Maximum	Mean	Std. Deviation
Sufficient PPE Stock obtained	55	0	1	.56	.501
Effective System for issuance, recording, inspection and replacement	55	0	1	.33	.474
Accident records	55	0	1	.51	.505
Staff for accident documentation	55	0	1	.04	.189
Accident Prevention Policy/Plan	55	0	1	.31	.466
Valid N (listwise)	55				

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