INVESTING IN SAFETY IN BUILDING CONSTRUCTION PROJECTS IN ISLAMABAD AND RAWALPINDI

By

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DEDICATED

TO

MY PARENTS

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(Emad Faruqui)

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ABSTRACT

Construction industry is one of the most hazardous industries where workers are more prone to accidents. These accidents can be reduced by improving the safety performance of construction industry through investing in safety to reap long term financial benefits. Investing in safety at the construction projects can be realized through the involvement of the top management of the construction companies. It ultimately leads the companies to superior safety performance by evaluating their weaknesses and incorporating the best safety practices. This study presents identification of the weaknesses in current health and safety management practices and various aspects of health and safety management systems that need financial investments by the construction companies, operating in the Islamabad / Rawalpindi. The study instrument is a questionnaire based survey comprising of different aspects of safety management system practices and the associated financial resources spent to implement and monitor the safety systems. The questionnaire was pilot tested to make it suitable for construction projects in Islamabad / Rawalpindi area. This questionnaire was used to collect data from 71 building construction projects located in Islamabad / Rawalpindi area. Various statistical tests were performed on the collected data. Analyses of the data were carried out by using SPSS – 17.0.

Results demonstrate that the health and safety management system in place at the construction project sites in the Islamabad / Rawalpindi region are not up to standards. Major findings of this study include: 1) non-existence of health and safety managers / personnel to implement and monitor health and safety; 2) implementation of health and safety was considered as a formality rather than an obligation or responsibility; 3) more emphasis on productivity by stakeholders rather than on working safely; 4) clients aversion to provide any budget for health and safety implementation and monitoring; 5) contractors considering that training of workers and staff is not beneficial for their business; 6) contractors' reluctance to invest in health and safety management and considering it a cost rather than an investment; and 7) workers' unawareness of their rights. Further results indicate that the most neglected safety practices requiring special emphasis are: a) investing in hiring of health and safety managers / personnel to implement safety management system; b) investing in training the on-site staff and sub-contractors; c) investing in refresher safety training courses; d) monitoring and controlling job specific risks. Study of building construction projects indicates that the factor of "*safety training*" has the lowest financial investments followed by "*safety meetings*" and "*worker's involvement*". Study concludes that investing in safety training and personnel staffing is obligatory for implementing and monitoring of a health and safety management system. This study may be useful for contractors, consultants, and clients to improve health and safety on building construction projects.

CHAPTER 1

INRODUCTION

Safety Management Plan implementation is crucial for the physical wellbeing of the workers, who are the responsibility of the construction company, and for long term financial benefits. Implementation and monitoring of the Safety Management system of a Construction Company is crucial for the fact that worker safety should be the top priority for the management of the company because accidents/incidents cause long term financial losses to the firm, along with that, it makes the firm look awful in the construction business.

Financial benefits and costs due to safety go hand-in-hand. Having a construction firm's employees trained to be cautious and able to recognize the potential hazards at the construction site can go a long way to having financial gains in the long run. The true cost of injuries and occurrences can indirectly affect the profits of the construction company. Injuries, accidents and incidents are like ticking bombs waiting to go off. Once they occur, they take a toll on the construction company. Apart from profits, the occurrences of accidents/incidents can take a toll on the time, productivity, quality and environment of a project. To minimize these unforeseen occurrences, the management has to play an important role in implementing and enforcing the construction company's Construction Safety Management plan. The enforcement and formulation of Safety Management plan of a construction company takes money. This thesis proposal will shed light on the cost of implementation of safety management plan at a construction site for various construction companies of Pakistan. The construction industry of Pakistan is now coming to terms with the fact that safety is an integral part of works at the construction site. Hence, formulation of a construction safety plan and having a safety policy is a must for the image of the company to compete in the national and international market.

1.1 BACKGROUND

Contractors and workers agree that money is what drives health and safety conditions in construction (Scott P. Schneider). The Pakistani Construction Industry has always been of economic and social significance to the country. Share of construction sector has increased from 6.7 percent in 2009-10 to7.0 percent in 2010-11 (Pakistan Economic Survey 2011-12). The following pie-chart figure gives a breakdown of the major labor employment share in Pakistan.

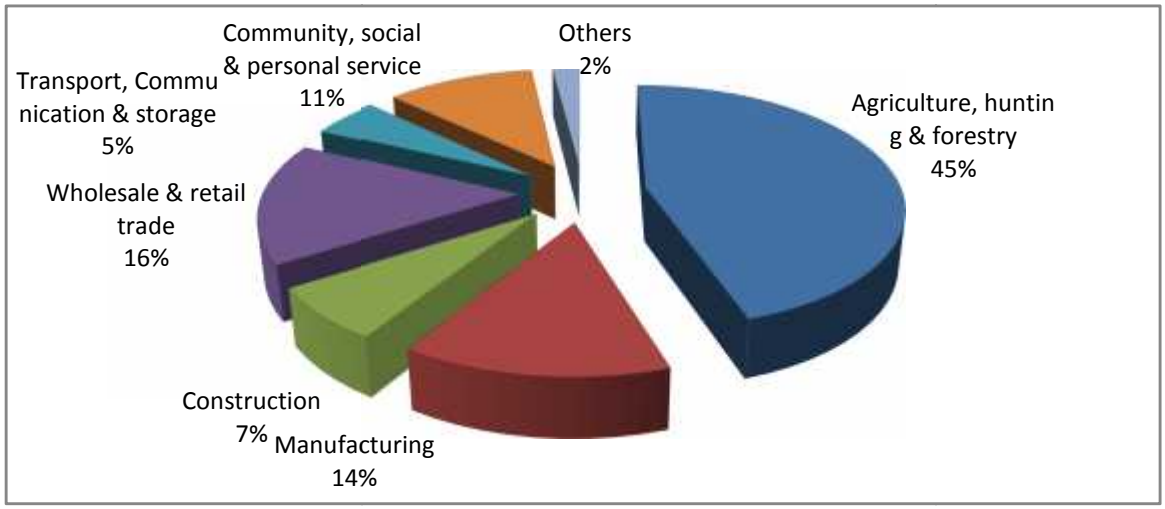

Figure 1: Major labor employment share breakdown in Pakistan.

Source: Pakistan Economic Survey 2011-12

Lack of expertise and resources in the construction management of projects are the main obstacles that are hindering the growth of the Pakistani construction industry. A rigid attitude and behavior of the top management toward quality, safety and risk management, plus emphasis on employees' commitment toward project performance rather than short term profits can prove profitable if planned and managed in the long term. Coupled with better education and training to drive the improvement process, and tendency to cure the cause of the problem rather than the symptom can be a wondrous solution towards the betterment of the Pakistani construction industry. To promote coordination, teamwork, productivity and industry performance, the clients' understanding towards their significance has to be realized by the construction industry's professionals first. Furthermore, extensive awareness and training programs have to be initiated on a national scale to counter the underlying problems. (*Farooqui, Ahmed and Lodi et al, 2008*)

Major causes of accidents are primarily related to the exclusive nature of the construction industry, human performance, complicated working conditions, and pitiable

safety management, which cause unsafe work routines, equipment and practices (Abdelhamid and Everett, 2000). Stress has to be placed, both developing and developed countries, on training and the deployment of comprehensive safety programs (Koehn et al., 1995). In developed countries, innovation in modern technology, on one hand, has played a positive role towards industry productivity, but on the other hand, has created a daunting task of keeping the work environment safe. Obviously, the industry profitability and the industry productivity are dented due to the construction accidents and the related damages caused to the employees, property, equipment and employees' morale. Hence, in the developed countries have responded to this inevitable danger by incorporating safety and training in their daily lives and have made it an integral part of it, on and off the job sites. In the U.S.A., for instance, the *Experience Modification Rating* (EMR) is used in relation to the workers' compensation rates and are a function of the loss of a contractor, and each labor hour is influenced through those workers compensation rates. A safe contractor even though has higher overheads and can lose the construction project bid, but can also be competitively beneficial through exceptional safe experience. On the other hand, an unsafe contractor can be liable to pay huge penalties in terms of insurance. Safety, therefore, and its effects of not having it implemented and monitored at site and considering it as an integral part of works is now a key factor in determining how profitable a construction firm is in such countries. Employers in developed countries are reluctant to hire or permit to bid contractors with unacceptable EMRs. Hence, incorporation of safety for the contractors has become a matter of survival in the cut throat construction industry of the developed countries. Thus, the contractors are forced to implement and monitor safety as their business strategy, which has led to the improvements in global construction safety records (Farooqui, Arif, Rafeeqi et al., 2008).

Pakistan still has not responded to the technological improvements. Even though there might be some technological transfers evident, it still has not resulted in safer working conditions. On the other hand, a larger chunk of construction work is being carried out manually by manpower has in fact increased number of site accidents. In Pakistan, roughly 6-7% labor is directly attached with the construction industry. A few major reasons for safety non-performance have been identified through informal assessments which include: lagging mechanization and industrialization of construction sector; lack of professionalism in the field of construction and project management techniques which has led to unsafe project sites and have also resulted in construction delays, cost overruns, poor productivity and poor product and process quality; failure to adopt safety provisions as a major industry objective;

failure to connect business survival and construction company's' reputation with insurance mechanisms and further business incentive have failed to prioritize the issue of safety in the Pakistani construction industry; and unfavorable and adversarial business environment and relationships in the industry have led to issues such as controversies, conflicts, claims and litigation amongst the stakeholders, therefore diverting the focus away from issues like safety (Farooqui, Arif, Rafeeqi et al., 2008).

The two studies previously conducted were 'Developing a model for integrating safety, quality, and productivity in building projects in the Gaza strip' at The Islamic University of Gaza August, 2007, and 'Estimating Indirect Costs of Injuries to Construction Workers by James R. Van de Voorde at University of Washington, 1991. Safety, as said earlier, has become an integral part of works at any construction site. Once the workers feel safe they can concentrate on getting the job complete. Safety is therefore indirectly linked to the three main performance measuring indicators; time, cost, and quality. As discussed by Moheeb Abed Abu Alqumboz, 2007, safety has a major impact on quality of workmanship and productivity of workers at site. As far as the relationship of cost of safety is concerned, Moheeb Abed Abu Alqumboz concluded that "Safety expenditures are very much less than losses due to accidents", and as being a contributing factor, it has been ranked in the first position with regard to its importance in sustaining safety and cost of project including resources. Results have also indicated that the lowest factor "Occupational safety increases project cost" is ranked very low.

The following diagram explains how safety is an integral part of the on-site proceedings.

Figure 2: Success factors of a construction project

Source: International Journal of Project Management (17, 6), 337-342, 1999

Figure 3: Key Performance Indicators (KPIs) for project success

The Figure 3 shows the Key Performance Indicators (KIPs) to evaluate project success.

According to Albert P.C. Chan, Ada P.L. Chan, (2004), there has been a paradigm shift in evaluating the success of projects. Key performance measures "such as safety are attracting increasing attention" Chan. A. P. C., Chan., A. P. L. et. al. 2004. Now Cost, Time and Quality are not the only key performance indicators that decide on the success of a construction project. There are other key performance indicators (KPIs) that have a psychological impact on the key stakeholders at the construction project. Then there is the aspect of Health and Safety at the project. If the contractor is not addressing the health and safety issues at site, an accident / incident is bound to happen. It is a ticking bomb waiting to go off. Due to the lurking hazards at site, the overall project success plummets.

During the survey for this study, the projects that incurred fatal losses had become 'sick'. The works had to be stopped till the investigation was complete and parties, that had incurred the loss, had not been financially compensated. In some cases, the police also had to be satisfied. On the other hand, the client and supervision consultants were also taken aboard for the evaluation of safety measures. Till all parties were not satisfied, the work did not proceed. Due to the negligence of the contractor, the moral of the workers plummeted. Hence, the quality of the works suffered together with the cost implications that the contractor had to bear. Due to the fatal accident episode, the project's commercial value was not the same either. Apart from the tangible effects of not implementing and monitoring health and safety at site, the contractor had to face reputational losses. Credibility of a construction company is a major aspect of conducting business in the construction industry world over.

1.2 PROBLEM STATEMENT

The problem in Pakistan related to implementation of safety is that there is no concept of upholding a safety culture. Ultimately, the company has to bear the financial burden of injuries incurred by the workers at a site. It may be due to the fact that “direct cost” incurred seems bearable, but it’s the “indirect costs” that take up the majority of the “true cost of injuries” in an accident situation and is not quantified in terms of lost time, productivity and product damage. An evaluation and documentation of the “cost of implementation of safety” is needed to spot a trend that develops at construction sites in Pakistan. Furthermore, a comprehensive study is required involving several construction projects for a conclusion, but due to the nature of data, its availability is kept discreet and is not public record. In this study, a list of major expenditures on the implementation of safety was first recognized to quantify the rupee amount that the construction firms spend to have a safer and healthier work environment at their construction projects. Due to time constraints, and data unavailability a limited number of construction projects were selected and studied.

1.3 RESEARCH AIMS & OBJECTIVES

The key objectives of the research proposal are as follows:

1. To study the health and safety performance of the building construction project sites;
2. To analyze the effects of implementation of safety at the building construction projects sites;
3. To measure the “investment in safety” at building construction projects;

1.4 RESEARCH SIGNIFICANCE

This research study shall be valuable for academicians, clients, consultants, contractors and practitioners. The identification and documentation of cost associated with the implementing and up-holding a safety culture at the construction sites will prove to be of utmost value to the contractors, clients and consultants, thereafter, transferring the benefits of safety to the end user as well. This research is significant to illustrate the fact to the client, contractor and consultant that investing in safety to develop a safety culture produces wonders for all stakeholders to the construction project.

1.5 METHODOLOGY

This chapter details the methodology utilized to undertake the above aims and objectives through site visits. The field survey pays special attention to the extent of formal health and safety management systems employed in the organizations and the main reasons that started off the development of these systems; and, costs of observance and their benefits, including average amounts spent per employee and per construction site, together with the nature of expenditure by size of the construction firm. The results summarize the findings of the 63 site visits, again focusing on costs of fulfillment of in-house health and safety rules, key expenditures, profit of compliance, and factors inspiring the development of formal health and safety systems. A general discussion and recommendations follow this.

1.6 SCOPE OF THESIS

The research thesis is focused on the construction industry of Pakistan. Several construction sites were picked and the cost spent to take actions to uphold the health and safety of workers at the construction site were studied. This study was primarily targeted to study the following aspects of Health and Safety at various construction sites.

1. Nature of the hazards
2. The barriers for not implementing health and safety management systems at the construction sites by the construction firms.
3. Reasons of developing a formal Health and Safety Management system by the construction firm.
4. The cost of developing and implementing Health and Safety Management program by the construction firm at the construction sites.
5. To analyze if the implementation of Health and Safety program had any effect on the workers at the construction site.
6. The extent of Health and Safety program implemented at the construction site by the construction firms and its subsequent costs.

1.7 ORGANIZATION OF THESIS

Chapter 1 provides a background and problem statement that developed the need of this research. Study objectives, its significance and scope are also presented.

Chapter 2 provides the in depth explanations for the Safety policy, and safety program, hazard analysis and safety training at the construction site, personal protective equipment (PPE), workers compensation, construction safety in developed countries, costs caused by accidents.

- Direct Costs
- Indirect Costs
- Other Costs

To link the scope of the thesis with the laws of economics, the concept of *Economies of scale* is discussed in detail along with the governing mathematical equations, and how the *economies of scale* impact the associated costs of investing in health and safety to implement and monitor it at the construction projects.

Chapter 3 is concerned with the research methodology employed in the study. The process of survey design, selecting a study sample, sample size, development of a questionnaire, and method of data gathering and conducting full scale survey is presented for quantitative phase of the study.

Chapter 4 describes the quantitative data analysis and results. The chapter is devoted to the testing of study intentions that arise from the research objectives. The purpose of tests are used to determine hazards of particular concern at the construction sites, statistics of having a formal health and safety management systems, a discussion on what prompts employers to implement health and safety systems at the construction project sites, how well kept is the record for the accidents/ill-health, a brief discussion on whether the size of the project matter in keeping the accident/ill-health records or not. The following are some of the topics discussed on the costs spent on the various aspects of the health and management system in order to implement and monitor health and safety at the construction sites.

- Average cost incurred at the construction sites.
- Cost of manual handling incurred at the project sites.
- The cost incurred for the up-keep of signage at the project sites.
- How the expenditure varies on the different components of the health and safety management system.

To further deduce how the implementation and monitoring of a formal health and safety systems has on the over-all culture and attitude of the workers at the construction site, information on the following were also taken.

- Does the size of the construction firm matter on how pro-safety the workers are at the construction site?
- Over-all changes in the attitude of the workers and staff members.
- The types of frustrations and barriers faced to effectively implement and monitor H&S at the construction site.
- Discussion on the various benefits versus costs of implementation of H&S system.
- Discussion on source of advice and information

Chapter 5 includes the conclusions and recommendations. The conclusions include the discussion of observations based on the collected data through field survey. The recommendations include as to how the improvements can be made to mitigate the problems that are observed.

1.8 RESEARCH TIMELINE

This study was conducted from November 2012 to September 2013. The research timetable was demonstrated in Figure 4.

TASK	Nov. '12	Dec. '12	Jan.	Feb.	Mar.	Apr.	May.	Jun	Jul	Aug.	Sep.
Develop Research Proposal											
Pre-project Meeting											
Preparation with GEC Members											
Literature Review											
Development of Survey											
Data Collection											
Data Analysis											
Drafting Thesis											
Thesis Presentation											
Thesis Finalization											

Figure 4: Thesis timetable

1.9 SUMMARY

Brief summary of the research is introduced in this chapter. Starting by reviewing the past literature that developed a need of this research is highlighted. Significance and important aims & objectives are presented. Scope with outline of the thesis chapters is also discussed.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter is devoted to the literature survey and is divided into sections. The first section of this chapter will look into the different aspects of a Safety Management system for a construction firm and its main salient features. Second section will tackle the aspects involved in the implementation of a construction health and safety program at the construction sites by the construction firms. The third section will look into the last line of defense of a health and safety program, which is the personal protective equipment (PPE). Ultimately, the last section will be of the costs of accidents.

All the above sections have a certain rupee amount associated with it and contractors have to pay attention to these costs since they take a toll on the profits of the construction firms. To cater for these costs the bid preparer has to have a certain intuition as to how to mitigate these costs. According to PPRA bidding rules, "The contractor is responsible for the safety of all its activities including protection of the environment on and off the site. Compensation of all damage done intentionally or unintentionally on or off the site by the contractor's labor shall be paid by him".

In Pakistan, in order to win bids contractors must keep their costs down. Labor is a major part of the costs. The winning tender is therefore likely to be the one that does not provide safety equipment, welfare facilities and a safe working environment. In this context a low price for the client is secured at the expense of the health and safety of the workforce.

In USA, many large owners and government agencies are now making safety a precondition of working on their projects (e.g., safety personnel to be employed at the construction site, and procurement of personal protective equipment for the company personnel). Roelofs (1996) suggested that putting health and safety requirements into contract specifications, beginning with federally-funded or state-funded work (e.g., highway and bridge work) may be the best solution to compensate for the failure of market incentives to counteract occupational hazards and diseases. This is because it builds the costs of safety into the contract as a *bill of quantities'* item and provides a level playing field for contractors, since all have to fulfill the contractual obligations. AIHA of USA has published a guide to include health and safety in contract documents (AIHA, May 2005). The recently passed

highway bill in the USA(SAFETEA-LU) includes a requirement that safety be a specific pay item in highway contracts to make sure that contractors do not skimp on safety at the bid stage.

As a first step in examining the costs and benefits of the 1989 Health and Safety Act in Ireland, a review of the international research on costs and benefits of Health and Safety legislation was conducted. The research concludes that the benefits of regulation are difficult to measure and usually underestimated while costs are often clearer. Moreover, the benefits of Health and Safety legislation vary considerably with the approach taken and depend on the nature of the regulatory intervention. The research suggests that success is not just down to a particular regulation but the principles underpinning the whole regulatory framework and how this is perceived by employers. Regulation may have an 'invisible' effect by simply putting Health and Safety legislation on the agenda of employers and cultivating self-regulation in the long-term.

2.2 SAFETY POLICY, AND SAFETY PROGRAM

A health and safety policy is a workplace guideline meant to protect the well-being of employees and customers. Health and safety policies must be clearly posted or otherwise available to employees. Employees must be provided with any additional safety-related training required for certain jobs. Employers must monitor the effectiveness of their policies and make necessary adjustments (Hinze, J. W., *Construction Safety*, 1997)

There is a significant distinction between large, medium and small sized contractors in Pakistan. Most large contracting firms have a safety policy and a safety program on paper, but the employers are generally unaware of its existence and significance. In contrast to the general attitude towards health and safety, some large construction firms do pay particular attention to health and safety procedures. They provide training for their workers at site and maintain a health and safety department at site and at the head office. For majority of contractors in Pakistan, maximizing profits and short term cost savings is the primary objective. Unsafe condition prevail at many construction sites all over Pakistan where hard working laborers are left at the mercy of numerous hazards (Farooqui, Arif, Rafeeqi, 2008).

The main constraint of having a safety program applicable becomes evident when the company top management doesn't commit to applying safety program. In this case, it will be hard to convince employees and workers to act safely on workplace. Another constraint might be that worker may disregard company rules and safety program because some

workers believe that accident occurs due to fate and not due to their own or companies' wrong safety behavior (Abu Alqumboz, 2008). Results shown by Abu Alqumboz et.al 2008 also show how much important the role of top management in implementing safety and health policy in a manner that also improves quality.

"Safety and Health Policy" group was ranked in the third position in a study by Abu Alqumboz et.al 2008. Safety and health policy can be established properly if good safety training and a good safety organization exist. Safety and health policy are essential in setting regulation, laws, and provisions of safety on jobsite. In good quality management point of view, a proper written policy should exist to control and organize the regulatory part of project management.

If contractors were able to estimate the indirect costs of a work related injury and to monitor these costs as they do for most major project cost items, they would quickly see the direct monetary effect these accidents have on project costs. Such a focus can only help in convincing contractors, as well as their foremen and superintends, that accidents have significant costs and that a strong pro-active safety program will not only protect workers but increase the contractor's profit margin. Contractors manage project direct costs in great detail, yet they continue to ignore the true costs of accidents, allowing them to be hidden, resulting in greater lost profits.

After the increase of attention paid to safety issues in USA, it is very common that companies have their own safety programs. Enshassi (2003) in his research concluded that although an effective safety program can prevent or reduce injuries, not all contracting organizations implement safety programs. The traditional safety management programs do not always improve the results of safety because they are centered exclusively on the technical requirements and on obtaining short-term results (Cited by Weinstein in Herrero et al, 2001).

During tendering process, one firm makes an allowance for safety and health requirements and the other does not and subsequently has financial advantage and will win the tender because owners did not consider pre-qualification of contractors on safety and health (McWilliams et al, 2001, Enshassi, 2003).

The law in developed economies of the world requires employers of construction workers to provide a safe working environment for their employees. Those companies that continue to do the minimum required with respect to safety will probably not survive. Small companies where the owner, superintendent, foreman and lead carpenter are all one in the same person, can likely do fine by following proper safety regulations and maintaining

positive job control. Extremely large companies consistently have best safety records, very small firms are less safe, and medium size firms typically have the worst injury rates (BLS 1993, Hinze 1995). When the size of a company is such that thousands of workers are employed and several management layers exist, along with several departments and perhaps regional offices; a firm ordinarily has formalized policies and procedures. A firm's safety department is a subset of this formalized system of operation. Moreover, safety departments for large firms will generally be staffed with more dedicated safety positions and have access to more resources. A combination of these and many other elements result in more effective safety programs for very large firms. Hence, it follows that small companies with future plans of growth or existing large companies that desire to be successful at preventing injuries must have an aggressive, dynamic and formally structured safety program (Eich, 1996).

2.3 HAZARD ANALYSIS AND SAFETY TRAINING.

A construction project can be made safe right from its inception by training the designers to design with safety in mind. Hinze and Gambatese (1996) rounded-up diverse list of “best practices” for the designers to keep safety in-mind during the design phase of the project and minimize construction hazards at the job sites. Hinze (1997) proposed that the contract stipulations may include the following prerequisites:

- Submission of a project-specific health and safety plan
- Job hazard analysis
- Safety meetings with supervisory personnel on a regular basis
- A project specific safety coordinator/manager
- Making reporting of accidents, safety inspections, and safety meetings mandatory
- Listing of subcontractors in the safety program
- Compliance of safety guidelines in line with the owner’s
- Establishing an effective worker orientation program.

It is common that construction industry is known for being a hazardous amongst other industries. Hinze (1997) stated that construction industry is one of those industries with the highest rate of injury and fatality. All employees are required to attend safety training from manager to worker. Safety training gives employees opportunity to identify hazards and the best practices to avoid such hazards at workplace.

In USA, OSHA's general PPE requirements mandate that employers conduct a hazard assessment of their workplaces to determine what hazards are present that require the use of PPE, provide workers with appropriate PPE, and require them to use and maintain it in sanitary and reliable condition. Project quality measures require that a professional assessment of hazardous to be conducted in order to manage the use of PPE.

For the development of a safety culture and a safe attitude towards on-site jobs, it is the project owners who have to realize that safety is not to be taken lightly. Hence, awareness programs have to be developed and implemented. It is also recommendable that official and unofficial education and training programs have to be made available and mandatory for career development (Farooqui, Arif, Rafeeqi, 2008). It is absolutely essential that emphasis must be placed on safety training and education, and then utilization of that knowledge at the job-sites (Kohen et. al., 1995).

At many construction sites, it was observed that no orientation safety meetings, daily or weekly safety meetings were held to induce the concept of safety in workers. Hazards were not pointed out before hand. Hence, the employees had to learn through experience and their own mistakes. The non-existence of medical facilities, inadequate water supply for cleaning and drinking purposes, substandard sanitation and housing made it ever so difficult for the workers to develop an attitude towards safety. These conditions were more prevalent on construction projects that were in remote areas (Farooqui, Arif, Rafeeqi et.al. 2008). It was recommended by Farooqui, Arif and Rafeeqi (2008) to arrange for the official and unofficial safety meetings to educate the workers of their right to work in a safe environment. Furthermore, it was recommended that the top management of the construction companies must be made morally responsible for the inadequate arrangements for safety. This would catalyze the process of bringing about a change in safety culture of the Pakistan construction industry. Contractors should integrate safety training programs with other practices according to their budget. They should encourage their project managers to develop safety incorporated project plans and schedules.

2.4 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Protective clothing, helmets, goggles, or other garment or equipment designed to protect the wearer's body from injury is called Personal Protective Equipment (PPE). The hazards addressed by protective equipment include physical, electrical, heat, chemicals, biohazards, and airborne particulate matter. The PPE is used to minimize the person's

exposure to various physical dangers at the project sites when there is an unfeasibility or ineffectiveness of engineering and administrative controls to moderate the risks involved to acceptable levels. It should further be noted that PPE is employed to minimize the dangers not to eliminate them.

MacCollum (1995) ranked the methods used for reducing safety risks according to their priority and effectiveness, including the following:

- The project should be designed to eliminate or minimize the vulnerability of employees at site;
- Hazards should be guarded such that they are constantly monitored;
- Warnings should be given;
- Special procedures and trainings should be made available; and
- Deployment of personal protective equipment.

This result shows the importance of PPE in decreasing injuries at workplace. It is usual that such personal protective equipments when used properly will stand as a barrier to hazard and risk. The use of PPE is requires to reduce employee exposure to hazards when engineering and administrative controls are not feasible or effective in reducing these exposure to acceptable levels. If PPE is to be used, a PPE program should be implemented. This program should address the hazards present; the selection, maintenance, and use of PPE; the training of employees; and monitoring of the program to ensure its ongoing effectiveness (Abu Alqumbo, 2008).

Furthermore to Abu Alqumbo's research to related construction safety to quality and productivity "Lack of top management commitment to providing PPE leads to lack of attention of workers and engineers to safety". In USA, OSHA's general PPE requirements mandate that employers conduct a hazard assessment of their workplaces to determine what hazards are present that require the use of PPE, provide workers with appropriate PPE, and require them to use and maintain it in sanitary and reliable condition. Project quality measures require that a professional assessment of hazardous to be conducted in order to manage the use of PPE. "Personal Protective Equipment (PPE)" group was ranked in the seventh position. According to his results "PPE helps decreasing injuries because it stands as a barrier to hazards at workplace. PPE should be selected and maintained based on feasible PPE program which should primarily address the importance of top management commitment to providing such tools to workers and employees. This commitment is

importance to increasing the awareness of workplace workers and employees of using PPE for their personal safety".

Does the project safety budget come from centrally managed dollars or is it part of the project expenses? A superintendent whom is at ease about requesting additional funds from the home office to cover safety related items, works for a company whose policy creates an opportunity for a safer climate than a superintendent trying the project on budget and wondering if additional personal protective gear should be purchased on the jobsite budget. It was expected that such an arrangement would have an adverse effect on safety since the project supervisor would have the added economic burden of personal protection while still staying within budget for the project. Perhaps, for large companies, getting funding approval from headquarters is a hindrance and a jobsite safety budget is more convenient than dealing with some other level of management for the procurement of safety items (Eich, 1996).

It was expected that such an arrangement would have an adverse effect on safety since the project supervisor would have the added economic burden of personal protection while still staying within budget for the project. Perhaps, for large companies, getting funding approval from headquarters is a hindrance and a jobsite safety budget is more convenient than dealing with some other level of management for the procurement of safety items.

Under Factory Act 1934, the owner will have to pay only Rs.500 in penalty over negligence in the protection of workers. Workers undertake a risk while at work and the following problem areas are common:

1. Accidents due to cave-ins while excavations often occur.
2. Due to the unavailability of protective gloves and boots, cements burns are common during concreting activities.
3. Due to weak scaffolding and the unavailability of safety belts, workers fall from heights.
4. Workers sustain injuries due to absence of personal protection equipment.
5. There is inadequate housekeeping.

2.5 WORKERS COMPENSATION

Workers do not file for compensation due to several reasons. For one, they have to wait for several days before they receive the claim, and in some cases the claim is not even entertained despite the pain and suffering. If the workers file a claim, there are not get paid

for the time that they worked. Workers do not want to be labeled as complainers. They would much rather work quietly and be paid for their work without raising an eyebrow. This means there is also a potential of them being blacklisted in the company or worst be kicked out of the company. Then they have to face the period of unemployment.

2.6 CONSTRUCTION SAFETY IN DEVELOPING COUNTRIES

According to Koehn (1995), the labor component of the available resources is higher in the developing countries of the world than in the developed countries. Nevertheless, construction safety is given a top priority in those countries. Sohail (1999) in his study stated that “construction industry is economically important as it typically contributes 10 per cent of a developing country's GNP. Only 5-10% of workers in developing countries and 20-50% of workers in industrial countries (with a few exceptions) are estimated to have access to adequate occupational health services” (Hogstedt and Pieris, 2000).

Despite recent efforts to improve safety in the construction industry, statistics show that the accident and injury rate in construction is still significantly higher than most other industries (Elzarka et al, 1999). These poor figures of safety in developing countries were obvious in statement of Jaselkis et al (2002) that “greater effort is required to control a construction project in a developing country especially in the areas of quality and safety”. For example in Hong Kong, Safety is one of the most difficult issues facing the construction industry there, where the accident rate in construction is reported as highest when compared to other industries. (Ahmed et al, 2002)

In his research, Koehn et al (1995) emphasized that “preventing occupational injuries and illness should be a primary concern of all employers”. He also stated that “safety of both project personnel and construction workers cannot be guaranteed by legislation alone, nor should safety be the sole responsibility of the employer, the contractor”.

Employees must be involved. Construction safety in developing countries has some features as follows (Koehn et al, 1995):

– The employees in large construction firms are not aware of the existence of the safety policy on paper. Hence, they are not informed of their rights working in hazardous conditions;

- Majority of contractors aim for profits and short term financial benefits. Therefore, it becomes increasingly difficult to manage safety at the construction sites;
- Injuries generally not recorded are a big source of mismanagement of safety at the job sites;
- Workers generally do not pay attention to their work environment and accept the dangers as being part of their jobs. Hence, neglect the hazards and do not report injuries;
- Before the commencement of the works at site, the owners and consultants do convey their due concerns for the safety of the workers, but as the work progresses, the interest in safety at the job sites declines and it is more about the speedy completion of works;
- Compensation is generally paid in the event of the death of a worker;
- To enforce compliance with the rules and regulations enacted by the foregoing legislation, work sites are periodically inspected by government officials. Unfortunately, inspections are not regularly conducted.

According to Farooqui, Arif, and Rafeeqi et. al., 2008, the top three safety non-performance practices at building construction work sites are:

1. Ear plugs not worn while working with noisy machines;
2. Ankle-high or close toed shoes not worn;
3. Face or dust repellant masks not worn in dusty working conditions.

Most workers do not wear the protective gear either because they are unaware of the importance to their health and safety or they consider them a hindrance to their productivity. Moreover, the site management seems very disinterested in keeping up with the safety rules and regulations of the company. This shows that the health and safety situations need total revamping. Safety is given a less priority on the list of items even during the execution phase of the project which is not a healthy style of work.

2.7 INVESTMENT / COSTS DUE TO ACCIDENTS

Accidents are a major cause of delays and cost over-runs and hence lead to substantial financial losses to the contractor (HSE, 2006). These implications make the project ‘sick’ and demoralize the on-site staff and workers. It also affects the society and can cause significant social unrest. These adverse effects on workers “such as social costs are difficult to express in

monetary terms and economic costs (e.g. loss of output, insurance cost)" (Haslam *et al*. 2004; Booth *et al.* 2005). Coble and Blatter, (1999) suggested that the prevention of accident may lead to reduction in cost overruns caused by accidents and ultimately lead to long term financial benefits. This poses a significant challenge for the contractors since they have to prevent accidents and counter for the situations that may give rise to such fatal accidents and near-misses (Lanoie & Tavenas, 1996).

Table 1 gives a concise description of what are the 'direct' accidents costs of accidents and what are the 'indirect' associated costs of accidents, as shown by Ferret and Hughes (2007), HSE (2006). Table 1 further gives a brief overview of effects of costs due to accidents and the affected stake holders.

Table 1: Various Direct/Indirect cost of injuries

Direct costs	Indirect Costs
Insurance premium	Hiring costs of temporary labor
Litigation cost	Lost time of employees due to accidents
Medical expenses	Cleaning/waste disposal
Material damaged	Loss of work
Compensation claim	Sick pay
Accident investigation	Overtime costs
Loss of life	
Permanent disability	
Agony and anxiety	

Source: Ferret and Hughes (2007); HSE (2006)

2.7.1 Direct Cost of Accidents

Direct cost is the actual costs that can be quantified and monitored due to injuries and fatalities (HSE, 2004; Tang et al. 2004). These costs are expenditures due to accidents occurring that include insurance costs; impairment to the buildings and equipments or vehicles; medical care expenditures; investigation costs; costs regarding legal matters pertaining to the event; casualty; eternal disability; illness of workers; production losses; pains as well as discomfort associated with accidents (Everrett et al. 1996; Tang et al. 2004; Oxenburg and Marlow, 2005; HSE, 2006; Ferret and Hughes, 2007).

An estimation of the direct cost to employers due to accidents at construction projects has been provided by Fellows et al. (2002) and was calculated as £433.22 per employee per annum as shown in Table 2.

Table 2: Estimate of the direct cost to employers of accidents

Predicted accident rates	Category	Actual number	Loss	Value (£)
1	Reported accident. Loss to Company: 200% of wage rate	33	33 × 20 days = 660 days lost per 1,000 workers at 200% = 1,320 days at £70per day	92,400
10	Minor accidents	330	330 × 2 hours = 660 hours lost per 1,000 workers = 73 days at 200% = 146 days at £70 per day	10,220
33	Property damage Insurance costs	990	990 x £300 20p per £100 wages for 1,000 workers 0.2 x 16,800 x 1000 100	297,000 33,600
Total cost per 1,000employees **Cost per employee (per annum)**				433,220 433.22

Source: Fellow et al. (2002)

2.7.2 Indirect Costs of Accidents

Costs that are not covered by insurance and are less tangible that are a resultant of accidents is called “Indirect Costs” (Ferret and Hughes et. al. 2007). These costs are incurred while dealing with the accident and consequently affect the productivity at the job site. These indirect costs involved are given in Table 1 and make up a substantial amount of money that affects the profit margins of the construction companies. Not to mention the production losses, due to which the work that should have been completed during the lost days cannot be accounted for (cf. Lindqvist and Lindholm, 2001; Fellow *et al.* 2002; Ferret and Hughes, 2007). According to Fellow *et al.* (2002) indirect costs are up to four times higher than direct costs of accidents. Indeed, Ferret and Hughes (2007) estimate that indirect costs are up to 36 times higher than direct costs of accidents.

Given that most construction companies operate and compete on very small profit margins (Lindqvist and Lindholm, 2001), such costs are likely to affect their financial health. Each time an accident occurs, the total cost of the injury or illness and additional expenses, such as insurance premiums, must be subtracted from profits in real income (Lanoie and Tevanes, 1996).

2.7.3 Other Costs of Accidents

It is important to recognize that accidents affect not only the employer but all the key stakeholders of the construction industry. At first, the affected maybe the employees involved in the accident, but their death, injury or illness is linked to their families as well.

The Figure 3 draws attention to the prime stakeholders affected; accidents in the construction industry also have great consequences for co-workers and the society as a whole.

Figure 5: Principal stakeholders affected in an accident

Source: Ikpe, 2009

The Table 3 gives a concise summary of the effects of costs due to accidents incurred by stake holders. Regardless of all, the construction companies are the major stakeholders that encounter financial and reputational losses.

Table 3: The effects of an accident on the stake holders of the construction site

Stakeholders	Non-tangible	Tangible
Worker	Pain and suffering, moral and psychological suffering (especially in the case of death and permanent disability)	Loss of salary, reduction of professional capacity; loss of time (medical treatment); site compliance of health and safety issues.
Family and friends of the affected worker	Moral and psychological suffering, medical and family burden	Financial loss; extra costs; loss of time to take care of the injured worker.
Co-workers	Bad feeling, worry or panic (in case of serious or frequent accidents).	Loss of time, increase of workload; training of temporary staff
Employer	Bad reputation; litigation cost; insurance cost; compensation cost.	Decrease in production, damages to machinery; equipment, and material; quality losses; recruitment and training of new staff; increase of production costs, increase of insurance premium; administrative costs; litigation costs and absenteeism.
Society	Reduction of the human labor potential; reduction of the quality of life.	Loss of production, increase of social costs, medical treatment and rehabilitation costs, decrease of standard of living.

Ferret and Hughes (2007)

2.8 COST SAVINGS BY SAFETY

Past literature review on this topic reveals that investing in safety and health will help control a company's expenditures and overhead costs during all phases of the construction project. There is a problem with this statement, because the construction company only plans for the short term and does not consider long term financial benefits. The construction companies only consider the implementation of safety as a formality and not an obligation to society or a responsibility. If these companies embrace health and safety to be a core value, their profitability and return on investments relating to injury prevention, along with creation of a safe work environment can be immense, monetarily and culturally.

Safety should always be viewed in a positive manner and not in terms of fatalities or injuries or even a bad incident. Companies should believe in zero accident and incidents policy and work hard to attain these goals. For this to happen, the health and safety management system should be well thought-out. This is where the problem lies. The safety professionals cannot justify the expenditure on safety based on hunches or probabilities. The construction company looks at safety in terms of expenses versus revenue and focus on tangible elements of business and not the possibilities or hazards that lurk at the constructions sites that the works have to face day-in and day-out.

Employing safety professionals and personnel is just not enough to implement and monitor safety. To change the work environment and make safety a part of the companies' culture, they have to invest funds and improve coordination of work activities. Hence, managerial personnel are needed to identify unsafe conditions rather than changing work habits of the workers.

Results of past studies indicate that greater attention should be given to indirect costs of workers injuries. Studies show that lower accident rate reduction is directly correlated to the increased safety investments and increased safety investments lead to increase profitability. The implementation of safety and health programs will not have a huge impact on the company in the beginning stages of implementation, but given time, it will certainly pay for itself and make the company profit in years to come.

The following figures show how the safety investment is related to the accident rates and actual profits. Graphs reproduced from A.J. Joseph, "Safety costs money and can save money" in Singh, Hinze and Coble (editors), Implementation of Health and Safety on Construction Sites, 1999.

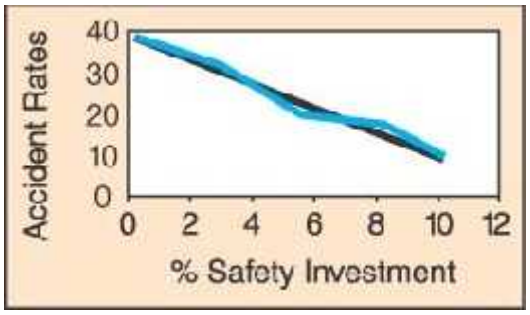

Figure 6: Correlation of Accident Rates and Safety Investments

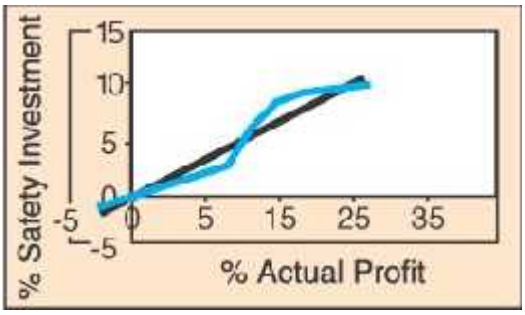

Figure 7: Correlation of Safety Investment and Actual Profits

2.9 ECONOMIES OF SCALE CONCEPT

In this section, we will discuss how the age old concept of ‘economies of scale’ is tied to the findings and results of this particular research. We will firstly discuss the basic concept of economies of scale and try and explain what it encompasses. Secondly, how the ‘economies of scale’ is used in the construction industry and will try to relate the concept with the industry. Thirdly, how the concept of ‘economies of scale’ is in relation to the findings and results of this particular research. This relation will validate the scenarios and research findings and how the concepts of economics and finances of the industry can be tied to the implementation and monitoring of H&S system at the construction sites. The age old concept of ‘economies of scale’ is tried and tested and can be used to explain how the cost of health and safety implementation and monitoring behaves in the Islamabad/Rawalpindi area at the various building constructing sites. It is worth mentioning that the cost figures are mere estimates and are expected to have noticeable variances.

Economies of scale refer to economic efficiencies that result from carrying out a process (such as production or sales) on a larger and larger scale. The resulting economic efficiencies are usually measured in terms of the unit costs incurred as the volume of the relevant operation increases. "Scale economies can be present in nearly every function of a business, including manufacturing, purchasing, research and development, marketing, service network, sales force utilization, and distribution," wrote Michael E. Porter, author of *Competitive Strategy*. "Scale economies may relate to an entirely functional area, as in the case of a sales force, or they may stem from particular operations or activities that are part of a functional area."

Many small business operations are of insufficient size to utilize economies of scale to major strategic advantage, though there are instances in which even smaller businesses can use such economic efficiencies to gain an edge over startup competitors. Indeed, John Pearson and Joel Wisner noted in *Industrial Management* that "since company productivity is generally defined as a ratio of output to input (for example, revenues divided by costs) management strategies for improving productivity have usually included some form of cost-reduction effort," of which economies of scale is often an essential element. In other words, even the smallest company can make itself healthier by improving its economy of scale. In competitive terms, however, small businesses often find that economies of scale are most visible as a weapon utilized by their larger competitors as a barrier to market entry.

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The utilization of economies of scale cannot be realized for many small businesses due to their inefficient operations. This concept cannot be used to a major strategic advantage over larger operators. On the other hand, scale economies can be exploited in some aspects of operations of small businesses to gain a competitive edge over large businesses. The smallest company can make itself healthier by improving its economy of scale. In competitive terms, but economies of scale are most visible as a weapon utilized by their larger competitors as a barrier to market entry.

Howard J. Weiss and Mark E. Gershon, authors of *Production and Operations Management,* separated economies of scale into two types—construction and operations. "The construction economy of scale is that construction costs are not directly proportional to the building size. The operating economy of scale, meanwhile, is based on the idea that for any given facility size, there is an optimal operating efficiency that reduces the cost per unit. Considering the situation that two plants will require a replication of capital, whereas one large plant may not. This is the operating economy of scale.

2.10 ECONOMIES OF SCALE IN THE CONSTRUCTION INDUSTRY

2.10.1 Effects of Scale on Construction Cost

Inspection of cost estimates are usually based on a single variable representing the capacity or some physical measure of the design such as production volumes of processing plants. For the sake of this study, this variable represents the cost of construction of building. Costs do not always vary linearly with respect to different facility sizes. Typically, scale economies or diseconomies exist. Economies of scale exist if the average cost per unit of capacity declines. On the other hand, diseconomies of scale exist if average costs increase with increasing size. The concept of economies or diseconomies of scale is established after

gathering empirical data of various facilities. If economies of scale exist, the advantage of lowering the costs per unit of capacity can be taken to gain a competitive edge over others in the market.

Let x be a variable representing the capacity, and y be the resulting construction cost. Then, a linear cost relationship can be expressed in the form:

$$y = a + bx$$

Equation 1: Linear relationship equation

In Equation 1 '*a*' and '*b*' are positive constants to be determined on the basis of previously collected data. Note that in Equation 1, a fixed cost of $y = a$ at $x = 0$ is implied as shown in Figure 8. If two values of x are known, for example c and d, as shown in Figure 8, then the cost of a particular design can be obtained through linear interpolation.

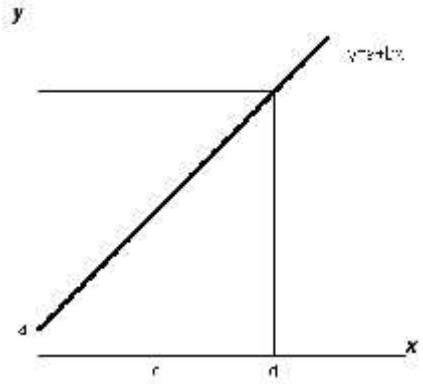


Figure 8: Linear cost relationship with Economies of Scale

A nonlinear cost relationship between the Construction Cost x and H&S cost y can often be represented in the form:

$$y = ax^b$$

Equation 2: Non-linear cost relationship between H&S cost and construction cost.

where '*a*' and '*b*' are positive constants to be determined on the basis of collected data. Increasing economies of scale exist for $0 < b < 1$, and decreasing economies of scale exist for $b>1$. This concept is represented in Figure 9. After taking the natural log of both sides of the Equation 2, a linear relationship can be obtained as given in Equation 3.

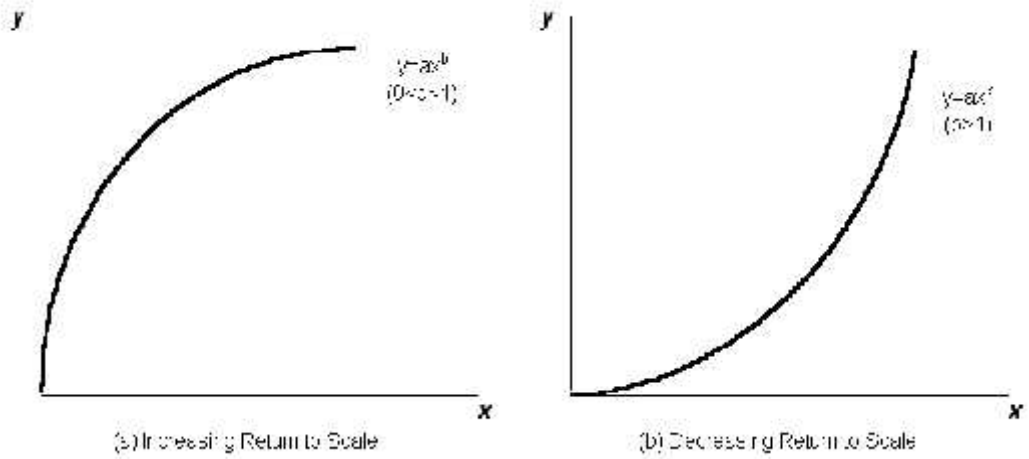


Figure 9: Non-linear cost relationship with increasing / decreasing Economies of Scale.

$$\ln y \quad \ln a + b \ln x$$

Equation 3: After applying the exponential rule to Eq. 2.

A statistical system to relate a dependent variable *Y* to one or more independent variables *X* is called linear regression. If the linearity does not exist, then it is possible to transform either the independent variable or dependent variable in the regression model to develop a stronger relationship that is robust and a better representation of the empirical data collected through field survey. Therefore the following transformation technique was used to improve linearity, since the data collected was recognized to be a power function of the following sort.

In comparison of the equation 1 and Equation 3, following conclusions can be made: 1) *y = ln(y);* 2) *m = b*; 3) *x = ln(x);* 4) *c = ln(a)*

2.11 ECONOMIES OF SCALE IN HEALTH AND SAFETY

The existence of significant economy of scale underlies many of the difficulties encountered by public and private decision-makers in improving the level of occupational health and safety. It has already been noted that there are a number of market imperfections and other economic problems which are preventing Pakistan from generating an adequate stock of properly trained health and safety manpower. These problems, with regard to both the development and the utilization of the necessary expertise, are partly attributable to economies of scale. Training of safety and health professionals is most cheaply undertaken in large numbers, yet few firms could utilize a sufficient number of professionals to realize economies of scale in training. Thus, few firms develop the in-house capacity to train health

and safety professionals .This task is left by default to government, universities, and research institutes. Yet these institutes often lack sufficient financial resources, with the result that they are also unable to capitalize on economies of scale in training. A major national commitment to improve occupational health and safety would be likely to generate sufficient demand for skilled health and safety professionals to reduce significantly the long-run average cost for their training, since educational institutions could then take advantage of economies of scale in this regard. Ashford N. A., "*Crisis in the Workplace: Occupational Disease and Injury*" (1976).

Serious problems also exist with regard to economies of scale in man-power utilization. Retention of an in-house health and safety staff often involves a substantial fixed cost which must be spread over a large volume of production in order to meet the criterion of economic feasibility. Often, the complementary nature of services provided means that the average cost of man-power services falls as firm size increases. For example, the acquisition of an adequate health and safety library may be no more expensive for a large firm employing several health and safety professionals than far a small firm with a full-time staff of one.

Problems presented by economies of scale may be even more serious with regard to the process of technological change. Equipment and processes designed to improve workplace health and safety are presently expensive, in part, because so few firms have been in the market for such "esoteric" items. If a large number of firms began to demand such equipment and processes, it is likely that significant economies of scale could be realized in their production, thereby lowering their long-run average cost. A wider market for less hazardous equipment and processes would induce suppliers to adopt the techniques of mass production. These firms, and the firms that wish to utilize the less hazardous equipment and processes, would also begin to increase the share of their research and development budget allocation to inventive and innovative activity with respect to improved occupational health and safety, with the result that the long-run average cost of reducing workplace hazards would quite likely fall even further. Ashford N. A., "*Crisis in the Workplace: Occupational Disease and Injury*" (1976)

Presently, the existence of what economists call "indivisibilities" limits the institution of safety and health practices and controls. For example, it makes little sense to insulate acoustically a single machine or process that is surrounded by many other noisy machines. Thus, firms are often faced with the choice between total inaction and the considerable expense involved implementing acoustical redesign throughout the entire plant. Such

indivisibilities are pervasive in occupational health and safety, and have heretofore provided a serious impending to investment in the reduction of workplace hazard.

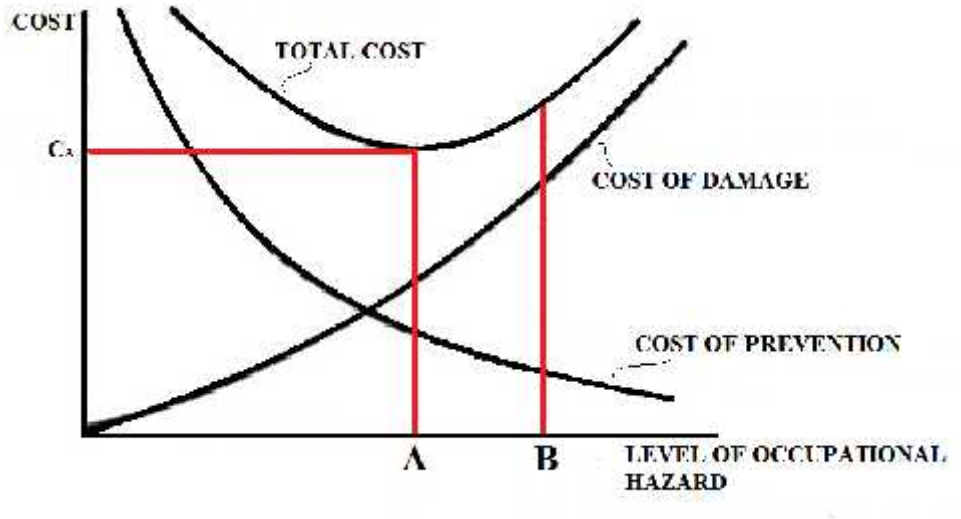


Figure 10: General trend of the costs of various aspects of H&S at a construction site

Source: Ashford N. A., "Crisis in the Workplace: Occupational Disease and Injury" (1976)

Figure 10 shows the trends for the "cost of damage", the "cost of prevention" together with the "total cost", which is simply the sum of "cost of damage" and the "cost of prevention". Point *A* is the minimum level of occupational hazard. Hence to achieve '*A*', an optimum cost to be spent should be C_A. If the level of occupational hazard increases or decreases, the total cost is bound to increase as well. Hence, the delicate balance is quite difficult to achieve but nonetheless, the level of minimum accidents and injuries should be the goal at every construction project site.

Nevertheless, it remains the case that the bulk of the costs associated with occupational injury and illness do not presently befall the firm, directly or indirectly; and herein lies the primarily explanation for the failure of the market mechanism to provide a socially tolerable level of workplace health and safety. Most of the costs of occupational illness and injury are directly borne by working people and their families. Workers, who become injured or ill as a result of their job, and their dependents, suffer a considerable loss of income and fringe benefits such as groups medical and life insurance, and a general diminution of economic security and well-being.

Large companies, i.e. P.E.C Category C-A, C-B and C-1, compensate in full for any injuries or sickness experienced at the job site. Construction firms of lower P.E.C contractor category do not pay for the injuries of the workers. Hence, the right to sue has to establish to make all contractors pay for any injuries and illnesses experienced by the workers at the construction project sites.

2.12 BARRIERS OF INVESTING IN CONSTRUCTION SAFETY

Previous studies focused on improving project safety performance by implementing and monitoring safety management systems, assessing the effectiveness of safety management systems, defining the stakeholder's responsibility insafety management, determining the cost of accidents / incidents related to construction works, etc (El-Mashaleh et al 2009; Abudayyeh et al 2006; Leopold and Lenard 1987). Managers and society primarily looked for the reduction of accidents and incidents at the construction sites, the economic benefits were ignored altogether and safety management was labeled as an expense, or a dead – investment. Firstly, the initial high costs of starting up a health and safety department for the construction companies was the biggest hurdle to comply or even consider health and safety management systems at sites. These costs included direct and indirect costs of training, negative impacts on productivity and performance of workers and extra administrative costs borne by the prime contractors and sub-contractors. Hence, there was a clear need to show how safety performance can be improved through investing in health and safety management system (Loosemore and Andonakis 2007). Secondly, the beneficiaries of a sound health and safety management system were not clear. It was deduced that benefits are not just one sided but in fact are multifarious. The benefits of health and safety management system can be realized on project level, company level, client level and consultant level. This made the identification and measurement of benefits difficult. Thirdly, "many benefits of investing in safety were intangible, such as workers' and customers' satisfaction, improvement of productivity, and company's image and reputation. These intangible benefits were very difficult to measure in monetary terms" (Muñiz 2009). Finally, most construction companies did not calculate accident / incident costs due to management's lack of knowledge and understanding of the compensation mechanisms involved (Gavious et al 2009). These barriers and frustrations obstruct people from having a clear understanding of the economic significance of safety management, which was the problem that needs to be solved (Sun et. al.2010).

2.13 SUMMARY

In this chapter we discussed the various aspects of a basic health and safety management system and the subsequent costs involved in order to implement and monitor the system at the project site; safety policy, a safety program, hazard analysis, safety training, personal protective equipment (PPE). A brief introduction to the various costs involved in the implementation and monitoring of a health and safety system is later discussed to breakdown the costs being considered for the documentation, data analysis, and final interpretation and depiction of the collected data.

A detailed introduction of health and safety policy is discussed in this chapter. The chapter also mentions the salient features of a sound Health and Safety policy for strict implementation and monitoring of a health and safety management system. The numerous aspects of a hazard analysis and safety training program are as follows:

- Submission of a project-specific safety plan
- Job hazard analysis
- Supervisory level safety meetings on regular basis
- A safety coordinator specific to the project site
- Obligatory reporting of accidents, and incidents.
- Regular safety inspections, and safety meetings
- Including subcontractors in the safety program
- Complying with the owner's safety guidelines
- Establishing an effective worker orientation program.

In this chapter past literature review regarding the cost savings in safety and the correlations of investments in safety versus accident rates and profitability is discussed and how the construction companies can keep the accident rates low and profits high while keeping safety as their core value of business in the construction industry. Furthermore, the concept of economies of scale is discussed. The concept is discussed with the intention to link the research to the laws of economics. The governing mathematical equations and their transformations were also discussed.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

The purpose of this chapter is to present and discuss the methodology adopted for this research study to attain the aims and objectives explained earlier in Chapter 1. Survey method is chosen as a research strategy based on research questions followed with an extensive elaboration of the survey design processes. There is a further explanation of collection of data through field survey and data analysis strategy.

3.2 RESEARCH DESIGN

A research strategy identifies the layout and design of the research and how the researcher will carry out the study to attain the goals of the research (Sanderset.al. 2003). This particular step comprises of sampling and questionnaire development, data collection sources and consideration of research limitations. The research strategy is selected on the basis of the aims and objectives that the researcher is striving for. There are three approaches that are considered acceptable for the research in construction management. They are: quantitative methods, qualitative methods, and a combination of both commonly known as 'mixed mode approaches'. The quantitative research technique uses deductive approach and is associated with collection of data and its analysis using statistical analysis routines. Contrary to the previously mentioned method, the inductive method is used to draw results from interviews and observations rather than using statistical procedures (Amjad 2004 – 2005). From 1983-1996, Construction, Engineering and Management (CEM) journals research papers showed that quantitative methods were dominated and used by fifty seven percent (57%) of the researchers. Only eight percent (8%) utilized qualitative research methods and thirteen percent (13%) used mixed methodology (Loose more et.al. 1996). Wing et. al. (1998) claimed the fact that quantitative approach in construction engineering and management is more practical. While on the other hand, Association of Research for Construction Management (ARCOM) reveal the fact the in the period of 1991 – 2001, qualitative and mixed mode research approaches have increased somewhat. Seymore and Rooke (1995) and Seymore et. al. (1997) support the use of qualitative research approach. Easeterby – Smith et.al. (1991) trust the fact that most research studies in management are

based on mixed approach. Raftery et.al.(1997), despite the criticisms, believed in the use of mixed research approach.

Root et.al. (1997) argued that the choice between quantitative or qualitative methods is highly dependent on the research aim/objectives. Based on the above, the aim of this research is to explore the health and safety associated costs on building projects by evaluating the extent to which the health and safety measures are implemented at the construction project sites in the Islamabad/Rawalpindi area. For this purpose, data is required from different individual building construction project sites. Quantitative approach is used for this research and survey method is selected for data collection.

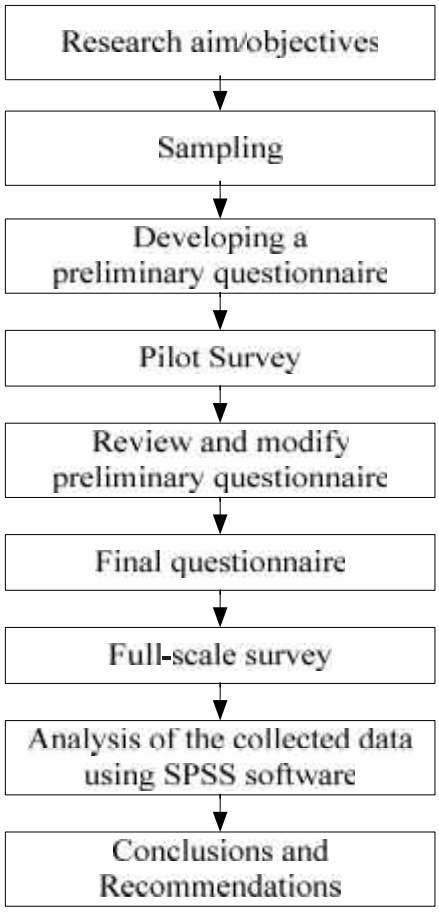


Figure 11: Research methodology flow chart

The research has been done on the steps shown in the Figure 11. To carry out the study questionnaire was developed. Pilot study was taken in to consideration and carried out for purpose of the questionnaire validation and refinement. Having done a feasibility survey, interview based survey was conducted by visiting building projects to obtain the contractor's feedback. Finally, statistical analysis of the collected data has been carried out to explore the tangible facts.

3.3 THE SURVEY DESIGN PROCESS

Survey is defined as “data collected from number of cases/projects through systematic measurement and then analyzed to yield the results (Marsh 1982). Trochim (1997) and Bryman (2004) argued that in applied social research, surveys are mostly carried out by questionnaire and interview surveys. Bryman (2004) referred surveys as cross-sectional studies and explained that the data collected from the surveys are generally quantitative in nature and can be used to correlate two or more variables. Trochim (1997) suggests that several issues should be kept in mind when a survey is chosen as a research strategy: a) population, b) sampling and c) question issues. The survey design selected for this research is shown in the Figure 8 (adopted from Shuwei 2009).

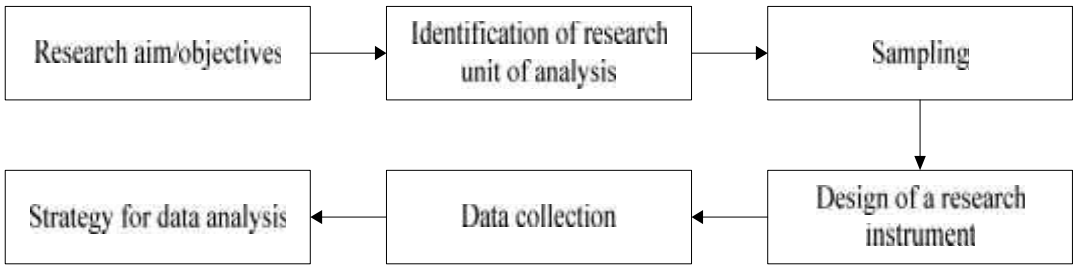


Figure 12: Research survey design process

3.3.1 Research Plan

The identification of unit of analysis is the central part of the survey design process and concerned with the data to be collected (Shuwei 2009). De Vaus (2002) has highlighted the importance of unit of analysis and argued that it is directly associated with the aim/objectives of the research. The purpose of this research is to evaluate health and safety performance of the contractors on building projects in the Islamabad/Rawalpindi area based on current status of health and safety management systems implemented by the construction firms operating the Islamabad/Rawalpindi area and the associated costs incurred at the construction projects. Each building project has been taken as a one case project. On each project, the safety performance of the contractors and the project performance in terms of health and safety associated costs were evaluated. Contractors are invited to provide their feedback about the health and safety performance and its implementation costs of their on-site staff and employed manpower on daily wages on each single building project. Sampling has been done to identify the building projects based on the number of C – 2, C – 1, C – B

and C – A contractors registered with the Pakistan Engineering Council (PEC) and the number of recently completed projects.

3.3.2 Sampling

Fellows and Liu (2003) defined the purpose of sampling as "collection of data and carry out of the research components provided that the sample selected is a good representation of the study population. Trochim (1997) argued that the process of sampling moves from study population to the sampling frame from which the research sample is selected. Study population and sampling frame have been explained by Saunders et.al. (2003) as "*population is a full set of cases from which a sample is drawn and sampling frame refers to a complete list of all the cases in the population".* It is important that the list of the cases should be clear, current and accurate (Shuwei 2009). If list is not available, the researcher can develop and complete the sampling frame (De Vaus 2002). On the basis of the sampling frame, sample is selected from the study population (Shuwei 2009). Two types of sampling techniques widely used: probability and non-probability sampling. In probability sampling, the sample can be selected which is a true representative of a population. On the other hand, De Vaus (2002) argued that when sampling frame is not available or the population study is widely dispersed, non-probability sampling is suggested. Channels (1985) argued that if the data is to collect from a small and accessible population, it is advisable to use all the cases in the population rather than to draw a sample. Johnson and Christensen (2004) also advocated that if the researcher is quite confident that he knows the total population, the complete population can be taken in the study. In this research, the study population is building projects (public and private) based on the traditional method of procurement on-going or recently completed from period of 2010 to 2012 in Islamabad and Rawalpindi region. It is also worth mentioning that feedback has been taken for construction projects in their construction phase as the contractors are fully and formally involved at this stage. A list of seventy one (71) building projects was developed and all of these were accessible to the researcher. Thirty – one (31) projects were not completed and construction work on thirty – five (35) projects were complete, while two (5) respondents refused to provide any/partial information required for complete survey. All the contractors working on these building projects were registered in Pakistan Engineering Council (PEC). Therefore, it was decided to survey all of them rather than draw a sample size from this study population. For complete building projects list, see Appendix I.

3.3.3 Design Plan

Based on the research aim/objectives i.e. to identify the "Cost of Safety" at construction site and workers' safety during the construction phase of the project only in the Rawalpindi/Islamabad area, a questionnaire was developed for full scale survey based on thorough past review of a literature, researcher experience on the building projects and after conducting a pilot survey. Measurement scale selection, attitude measurement and ranges of response category were taken in to consideration for the design of the questionnaire.

It was established that little had been done to review the Management of Health and Safety at building construction works, particularly the costs involved. Estimated costs incurred due to injuries/fatalities, Manual Handling Operations, and Signage were selected, as they would provide a comparison across the construction project sites in the Islamabad/Rawalpindi area and as they are likely to be applicable to our stance on workers' Health and Safety.

Selection of measurement scale

Measurement scale is generally divided in to four different levels, namely nominal, ordinal, interval and ratio (Reaves 1992 and Trochim 1997). In this research, a measurement scale to depict a range of costs incurred for different aspects of health and safety implementation at the construction project site was devised. Furthermore, a scale of three choices was given, to depict a general attitude observed at the construction projects sites regarding the construction health and safety implementation. Contractor's perception on health and safety implementation was to be measured, an estimated breakdown of the associated costs were then taken as feedback to estimate the total costs of safety at the construction project.

Attitude measurement

Oppenheim (1992) argued that people's perception about some specific issue goes from low, through neutral to a degree of high level. Attitude measurement is suitable for measuring individuals' perception or feelings, called an attitude scale by Bell (2005). De Vaus (2002) and Saunders et.al. (2003) have named attitude scale as numeric rating scale and semantic differential rating scale. There are four commonly used methods of attitude scaling

in social research: the Bogardus, Thurstone, Likert and Guttmann (cumulative) scales (Oppenheim 1992; Trochim 1997 and De Vaus 2002). Among them, Likert scale is widely used as it provides better reliability and less laborious (Oppenheim 1992 and De Vaus 2002). To depict a general perception on the aspect of health and safety implementation at the building project sites, the Semantic Differential Scale was used and measured the perception of the respondents.

Ranges of response category

For the questionnaire design, possible ranges of response category are available. These include 2-category response, 3-category response, 4-5-category response, 6-7-category response, 9-category response and even 10-11-category response (Alwin 1997). According to De Vaus (2002), widely used response categories are 2, 5, 7 and 10. Kelly (1999) argued that points in excess of seven fails to provide sufficient information. Several researchers have recommended 7-point scale (Alwin 1997 and De Vaus 2002); however, the fine distinctions can confuse and requires precision with greater accuracy (Shuwei 2009). Therefore, to obtain data of greatest precision, accuracy, and better breakdown of the costs involved, 7 point scale was adopted for the survey questionnaire to obtain costs for different aspects of health and safety at the construction project sites. Table 4 shows how the cost categories were broken down to cater for better data collection to achieve the aims/objectives.

Table 4: Cost categories for H&S implementation and monitoring

Aspect of Health and Safety for implementation and monitoring
Safety specialist
Risk assessments
New equipment
PPE
Training
Monitoring
Signage

Further explanation of the above given categories of the Health & safety aspects, most frequently observed at the building construction sites in the Islamabad/Rawalpindi area, are given ahead in the thesis write-up.

Table 5 shows how the different intangible effects of health and safety management system affected the onsite staff, the performance/ productivity of the workers, and other benefits. Responses were collected to observe the perception of the contractor on the aspect of health and safety at their construction project sites.

Table 5: Effects of implementation and monitoring of H&S at site

Effects of H&S implementation	Increased	No effect	Decreased
Reimbursement claims	❑	❑	❑
Insurance premiums	❑	❑	❑
No. of staff employed	❑	❑	❑
Product damage/ waste	❑	❑	❑
Performance / Productivity of employees	❑	❑	❑
Nonattendance due to sickness	❑	❑	❑
Staff self-confidence	❑	❑	❑
Staff yield	❑	❑	❑
Time lost due to accidents	❑	❑	❑

Pilot study

The purpose of a pilot survey, also known as feasibility survey, is to test a questionnaire for its reliability, consistency and validity (Thompson 2010). De Vaus (2002) argued that while conducting a pilot survey, the emphasis should take on checking whether any problem exists with the questionnaire items, how long it will take to fill in and whether respondents are interested in filling the questionnaire. Another important issue is how many pilot surveys should be carried out. Shuwei (2009) believed that the number of pilot studies depends on research aim/objectives, size of the research study and available resources (time and money). For this purpose, a pilot survey has been carried out to test the questionnaire items as well as the whole questionnaire. A sample of fifteen (15) projects from the study population was selected. The questionnaires were delivered by hand to ensure maximum feedback. The responses provided by the respondents were helpful in refining and improving the questionnaire for conducting full scale survey. Also the results of the pilot surveys were also incorporated in the data analysis as well. As suggested by Saunders et.al. (2003), the questionnaire was also thoroughly discussed with colleagues and friends to pick any error and obtain the face validity of a questionnaire. After that, the questionnaire was refined and ready for carrying out a full scale survey. In the next section, questionnaire layout is presented.

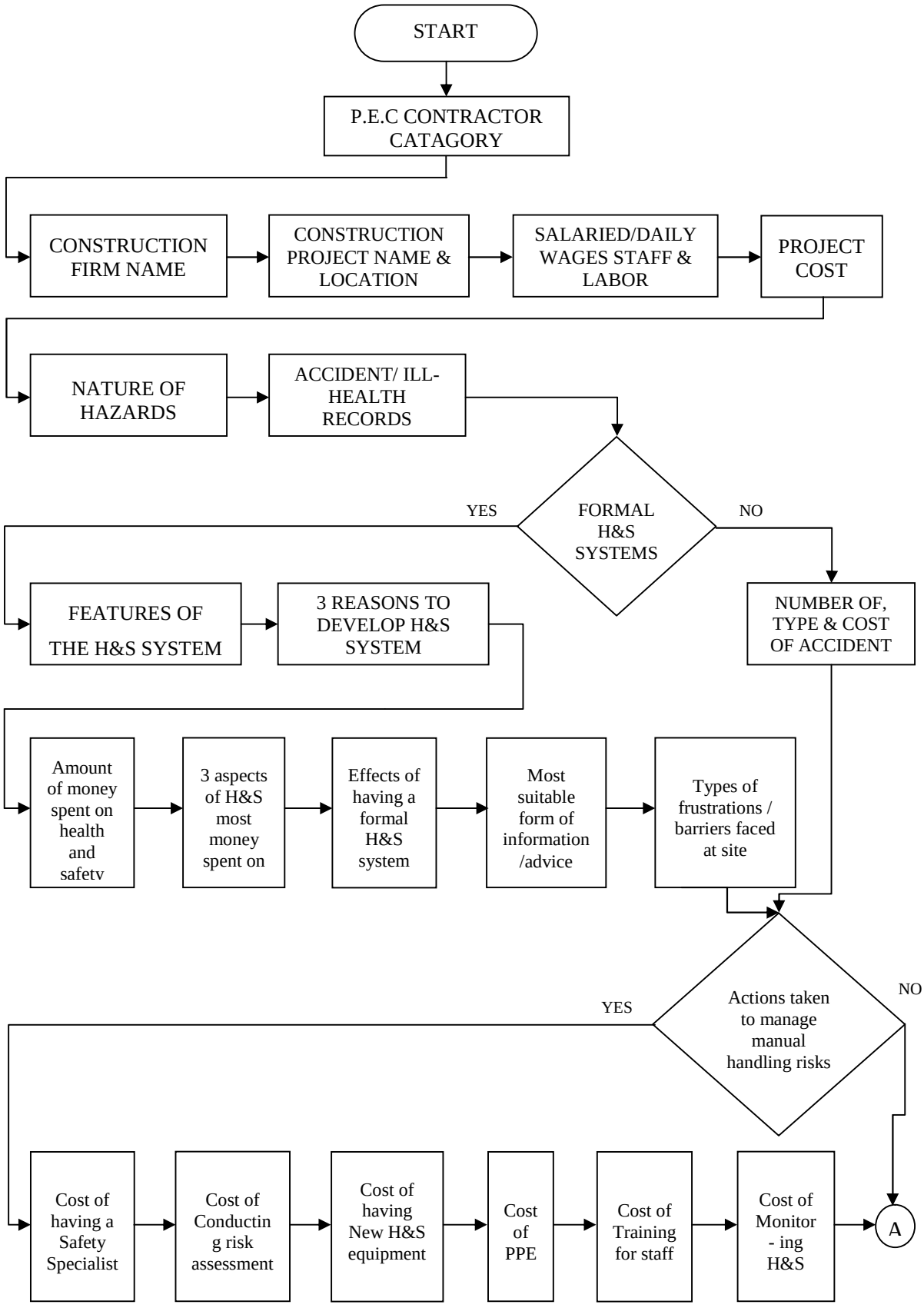
Layout of a questionnaire

Shuwei (2009) suggested that the survey questionnaire should be clear, precise and attractive for the respondents to fill in and return it. In this research, the questionnaire was developed in easy and understandable form and also keeping in view the context of Pakistani construction industry environment. The questionnaire was attached with a covering letter (please see Appendix II and III), describing the main purpose of the study and ensuring the respondents that the information provided by them will be kept confidential and used for academic purposes only. The questionnaire starts with the respondent's general information. The questions included: PEC Contractor category, contractor's name, project name, number of salaried employees, manpower on daily wages, and project cost. The main body of the questionnaire was divided in to six parts. All the questions included were formulated as closed-ended and a note was provided to the respondents on how to fill the questionnaire. In the first part, the respondents were asked to provide their feedback about the overall nature of the health and safety hazards faced at the construction project sites. Second section includes the different health and safety management procedures followed at the construction sites. Third section of a questionnaire was concerned with contractor's accident and ill-health records at the construction sites. Forth section instructs to give a feedback on the estimated costs involved to implement the health and safety procedures at the construction sites and the three (3) biggest expenses incurred to uphold a better and positive work environment at the building construction project sites followed by the general attitude and behavioral changes observed at the construction sites. The fifth section includes the costs involved to uphold health and safety for the manual handing activities which include the following:

I. Working at heights (Formwork, Steel Fixing, and Concrete Pouring);
II. Working at ground level (Formwork, Steel Fixing, and Concrete Pouring);
III. Working below ground level (Formwork, Steel Fixing, and Concrete Pouring).

The sixth section involved perception on providing an important aspect of safety, 'signage'. Firstly, the overall estimated cost of providing signs at the construction sites was asked, together with a brief discussion on how signs are perceived by the workers at the construction project site. Based on past literature, academic books, and pilot surveys, breakdown of the costs involved in consideration of Health & Safety at the building construction site were indentified and used for a better understanding of the psyche of the employer together with the perception of the workers at the building construction sites, which are identified in the Section 3.3.3.

Figure 9 depicts how the respondents worked their way through the survey.



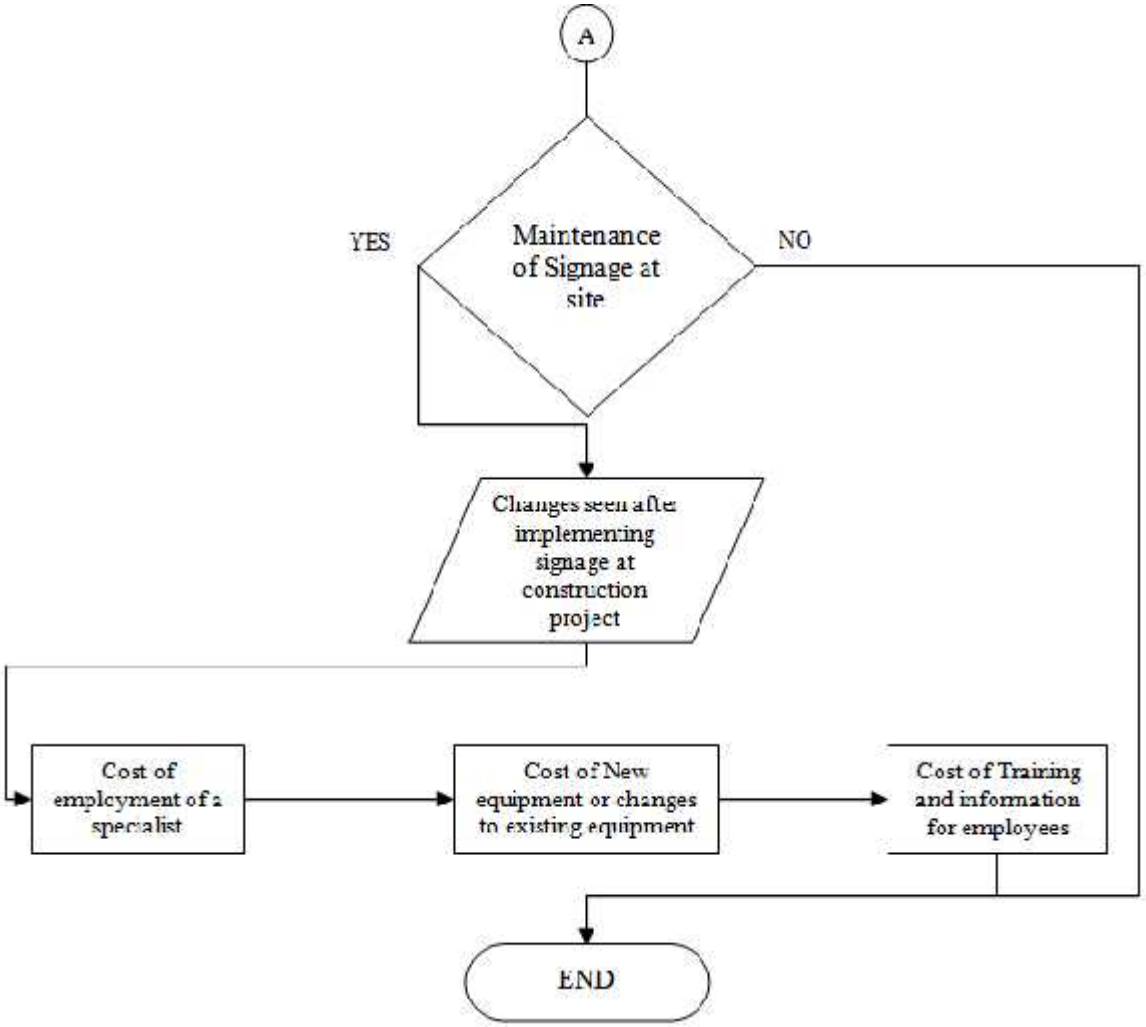


Figure 13: Flow chart of thesis survey

3.3.4 Data Collection

Full scale survey

Since all the building projects were accessible to the researcher, it was decided to deliver questionnaires to the respondents personally. Bell (2005) argued that delivering questionnaires to respondents by hand have distinct advantages: respondents can get a better understanding of the research purpose, questionnaires can be filled through face to face communication, any difficulty in the questionnaires can be sorted out easily and high response rate can be obtained. Therefore, building project sites in Islamabad and Rawalpindi region were visited and delivered questionnaires to the contractor's representatives personally. Out of seventy one (71), sixty three (63) valid responses were collected. Five (5) respondents refused to provide feedback because of confidential nature of the information. It

is worth mentioned that sixty three (63) responses collected are more than the sample size if calculated as given below (Wison 2010).

$$n - \frac{N}{1 + \left(N \times (e^2)\right)}$$

Equation.4: Calculating the sample size

Where,

n = Sample Size

N = Population Size = 72

e = Precision = 5 percent = 0.05

Putting values in Equation.1;

$$n = \frac{72}{1 + \left(72 \times (0.05^2)\right)}$$

$$n = 61.01 \approx 61\ projects$$

3.3.5 Strategy for Data Analysis

The information collected was ranked according to their frequency. The most frequent responses were ranked highest and the least frequent responses were ranked the lowest.

The least satisfactory factors and their indicators are presented using simple bar charts using Microsoft ® Excel Sheets, while the regression analyses was carried out using SPSS – 17.0. No ranking scale was used to deduce the importance of factors connected to the subject matter. The responses were purely to identify the various factors connected to the "Cost of Safety at the Construction Project in the Islamabad/Rawalpindi area". All the analysis and results are presented in Chapter Four.

3.3.6 Data Analysis

The results are presented, categorized by building construction project size. Mostly the results are presented as a percentage of the total respondents or respondents that answered a particular question. The costs relating to size are presented as investments per construction project and investments per employee. Caution should be given to interpreting the investments towards safety per construction project site as some construction projects have a greater percentage. The results are therefore discussed more in terms of the variations in the

nature of the investments across the construction projects rather than actual expenditure towards safety.

3.4 SUMMARY

The purpose of this chapter was to discuss the methodology used for this study in order to achieve research aim and objectives that were introduced in Chapter 1. Based on research questions, survey method is chosen as a research strategy with whole survey design process is extensively elaborated. The construction of a questionnaire, collection of data through field survey and data analysis strategy was also presented.

CHAPTER 4

DATA ANALYSIS AND RESULTS

4.1 INTRODUCTION

Two of the most widely used software for simple data complication and analysis; Microsoft ® Excel and SPSS 17.0 were used; since manual calculations cannot make an error-free analysis from a large amount of data (Gaur & Gaur 2009).

4.2 DATA ANALYSIS AND FINDINGS

4.2.1 Make up of Responses

The response rate has been quite good since sixty – three (63) out of the seventy – two (72) of the construction projects' employers responded positively due to personal site visits. Almost sixty – nine percent (69%) of the employers at the construction sites responded vigilantly. The face-to-face conversation made the feedback of the employers easier, hence, responding more confidently.

4.2.2 Hazards of Particular Concern

Tables 6 through 9 represent the hazards recognized by the employers at the construction project sites that are of potential concern for the workers at the construction project site. Table 6 shows the hazards related to the machinery and vehicles.

Table 6: Recognized machine hazards at sites

S. No.	Machine Hazards
1	Vehicle/Transportation
2	Whole body vibration
3	Ejection of material
4	Moving parts of machinery
5	Pressure Systems
6	Hand/Arm Vibration

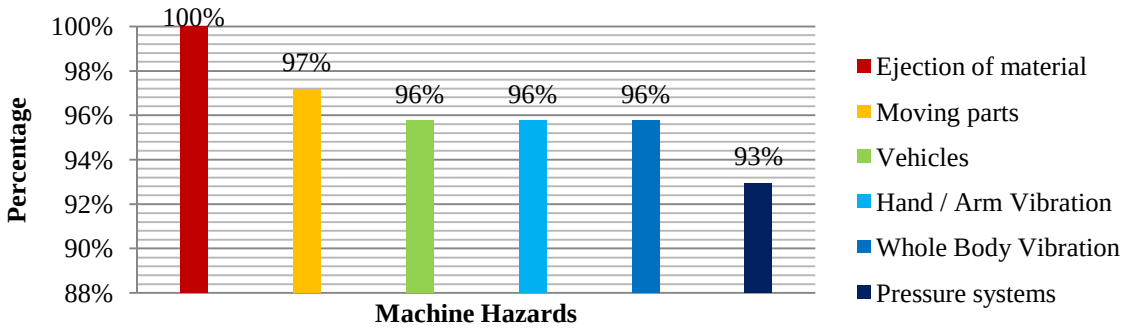


Figure 14: Recognized machine hazards

Table 7 shows the labor-intensive hazards faced at the construction project sites. Figure 11 shows the percentage responses observed for each labor-intensive hazard.

Table 7: Labor-intensive hazards

S.No.	Labor-intensive Hazards
1	Electricity
2	Manual Handling
3	Noise
4	Slipping/Tripping
5	Confined Spaces
6	Work at height

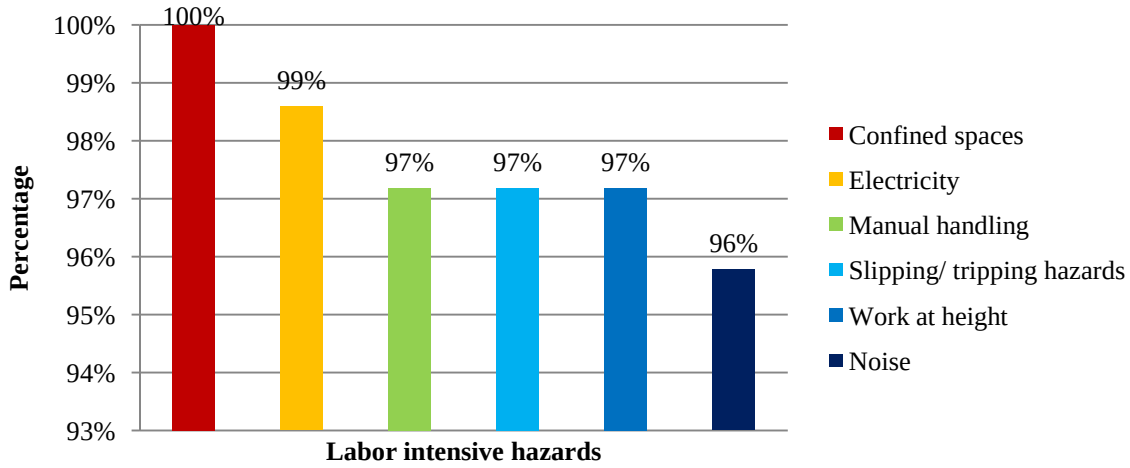


Figure 15: Labor-intensive hazards

Table 8 shows the environmental hazards, ranked to be the third highest in terms of concern for the employers at the construction projects. Figure 12 shows the percent responses for each of the environmental hazard.

Table 8: Environmental Hazards

Environmental Hazards			
1	Fumes	**4**	Chemicals
2	Fire	**5**	Extreme temperatures
3	Dust	**6**	Falling temperatures

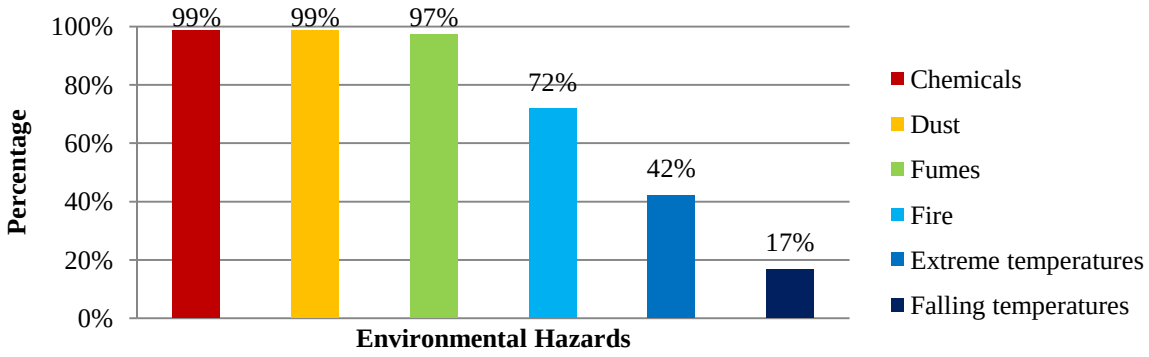


Figure 16: Environmental Hazards

Table 9 shows the occupational hazards recognized to be of lowest concern for the employers. Figure 13 shows the percent responses for the *other occupational hazards*.

Table 9: Other Occupational Hazards

S. No.	Other Occupational Hazards
1	Poor lighting
2	Psychosocial hazards

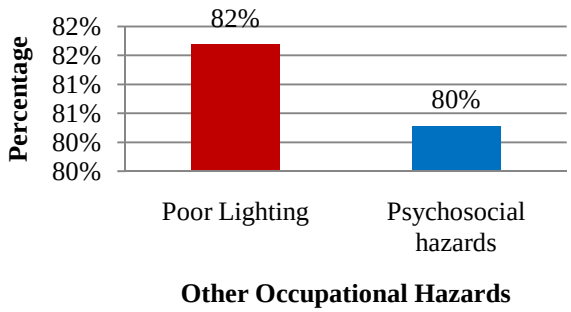


Figure 17: Other Occupational Hazards

4.2.3 Formal Health and Safety Management Systems

The Figure 18 shows the kind of Health & Management procedures the employers use at the building construction project sites for record keeping. The data collected shows that 66% replied positively that they do have some sort of Health & Management system at their construction project site for better up keep of healthier and safer work places. 70% had a system of keeping an ill-health record and an accident record.

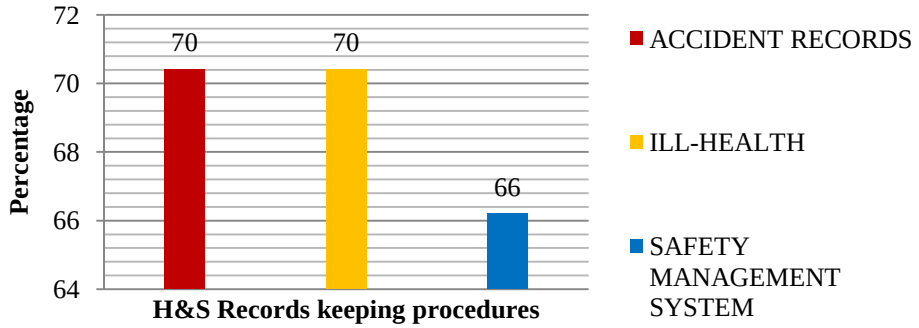


Figure 18: H&S Management Procedures for H&S Records Keeping

4.2.4 Systems in Place at Project Site

66% of building construction project sites had formal health and safety management systems in place (at the site at which they were interviewed) and 34% did not. In implementing these systems many of the construction companies had a designated health and safety role, risk assessments, an accident and ill-health reporting system and written health and safety policy. However, considerably fewer had specified health and safety performance measures and / or targets, as shown in Figure 15.

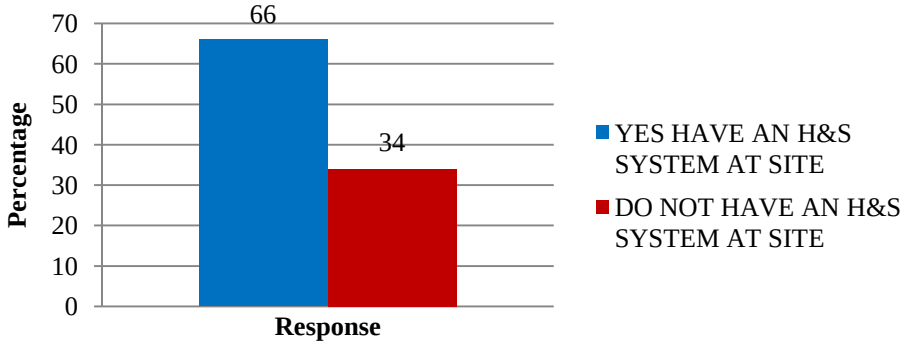


Figure 19: How many have an H&S system in place at site?

The employers at the construction project were asked why they had not developed a formal health and safety management system. Figure 16 shows the responses.

- Ninety five percent (95%) that did not have a formal H&S system in place at the building construction project site said that it is due to the lack of knowledge that they are unable to have an H&S system.
- Eighty four percent (84%) of the construction sites that did not have a formal H&S system responded that their company is too small to have it.
- Seventy four percent (74%) responded that it is not their priority to develop an H&S system for their construction projects.
- Sixty three percent (63%) responded that it is due to the time restrictions that they are unable to develop an H&S system.
- Seventy four percent (74%) responded that it is due to the unbearable costs that they are unable to develop an H&S system for their construction projects.

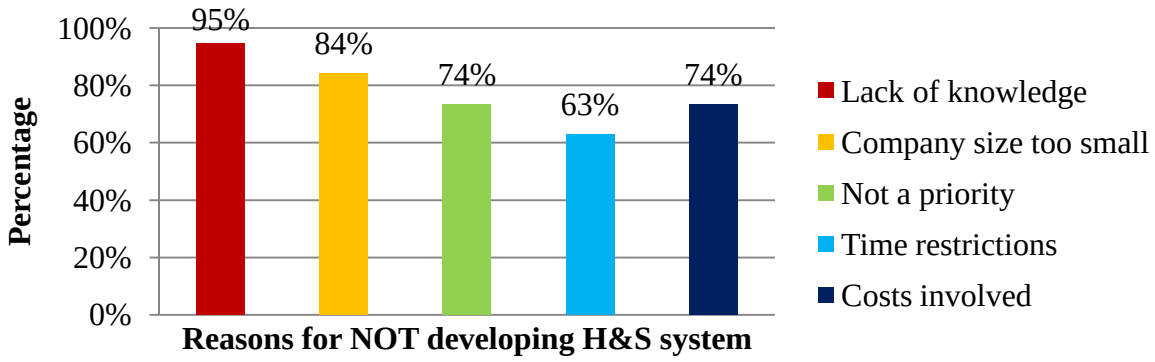


Figure 20: Reasons for not having an H&S system in place at site

To further study the features of the Health &Safety system of the construction firms that have a formal Health & Safety system, Figure 17 depicts the findings.

- Sixty – five percent (65%) of the construction projects with a formal H&S system had a designated H&S person at site.
- Sixty – two (62%) of the construction projects with a formal H&S system had an accident reporting system.
- Twenty nine percent (29%) of the construction projects with a formal H&S system had a documented risk assessment procedure.
- Thirty eight percent (38%) of the construction projects with a formal H&S system had some sort of performance measurement procedure, either verbal or written.

– Twenty one percent (21%) of the construction projects with a formal H&S system had safety performance targets and/or objectives that they hoped to achieve during a set period of time in order to have minimal or zero accident at their construction project sites.
– A healthy ninety percent (90%) of the construction projects with a formal H&S system reported to have a written H&S policy.

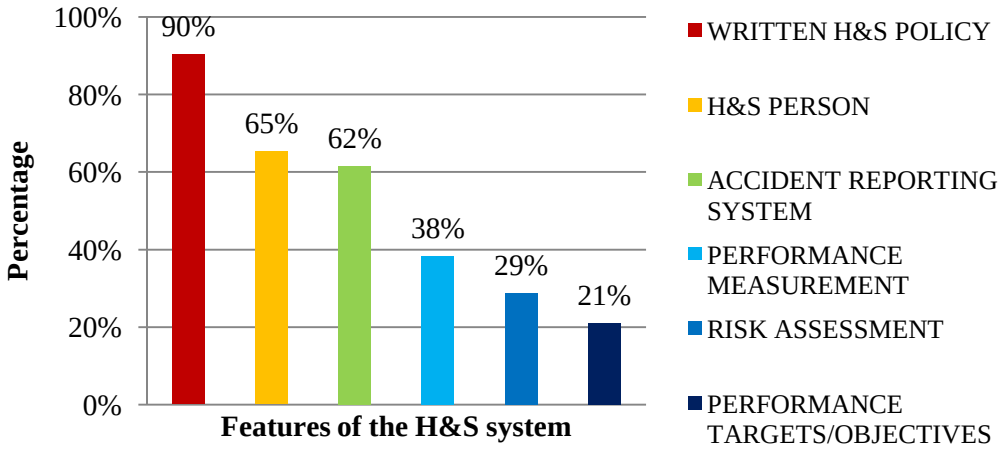


Figure 21: Features of H&S system at project sites

4.2.5 Implementation of Health and Safety Systems

The respondents were asked to choose and tick the reason(s), which applied to their construction project site, for developing and implementing the H&S system. The "Health and Safety Publicity" (65%), followed by "Company's Top management Priority" (45%), for the development of the H&S management system for the implementation and monitoring of health and safety at the construction project sites were ranked the highest amongst the top reasons to develop a health and safety management program. A jaw dropping forty two percent (42%) indicated that due to the experiences of accidents within the construction firm, a formal H&S system had to be developed, implemented, and monitored. Almost quarter of the respondents identified that size of the construction firm (32%), consultant/client pressure (26%) and insurance costs (24%) played a major role in the development, implementation and monitoring of the H&S system at the building construction project sites.

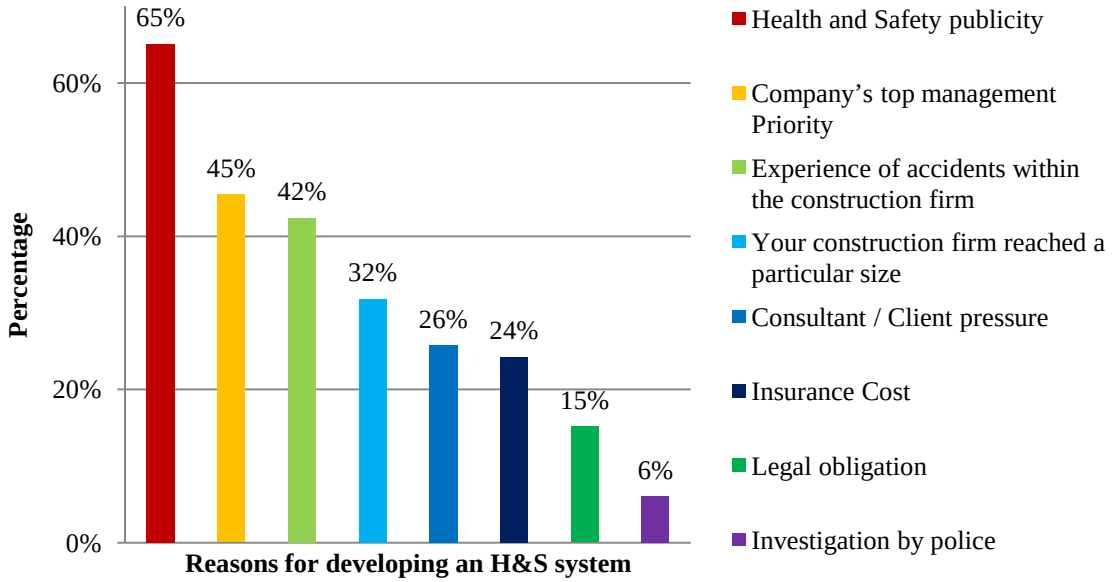


Figure 22: Reasons for developing an H&S system at site.

4.2.6 Recording Work-related Accidents and Ill-health

As mentioned before in Section 4.2.3, seventy six percent (76%) held a formal accident recording system, seventy one percent (71%) held an ill-health recording system, while seventy one percent (71%) held a formal Health & Safety Management system.
The salient features of a formal H&S system implemented and monitored at the building construction projects sites have already been disclosed in Section 4.2.4.

Size of the project and accident and ill-health record

The bar in Figure 19 shows the various P.E.C Contractor Categories that were surveyed in the Islamabad/Rawalpindi area for the purpose of this thesis.

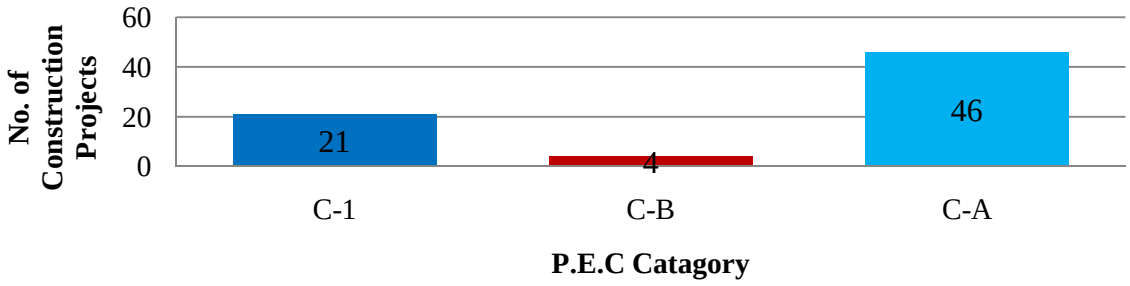


Figure 23: P.E.C. Contractor Category

As evident from Figure 20, the construction firms of P.E.C Category C-A and C-B are more vigilant in keeping a straight record of ill-health and accident at each of their construction sites in the Islamabad/Rawalpindi area. On the other hand, construction firms of P.E.C category C-1 are more casual in keeping a straight record of their accidents and do not have a vigilant H&S system at their construction sites.

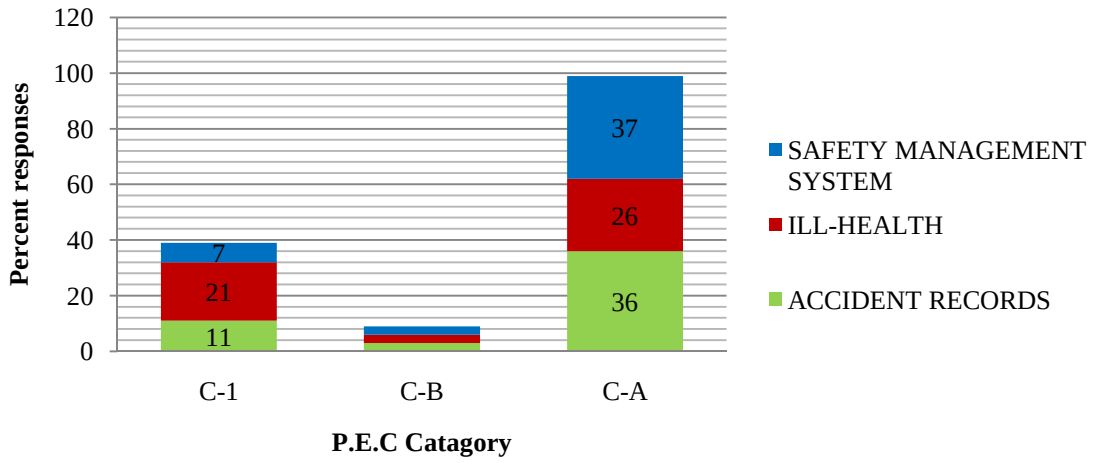


Figure 24: Features of H&S system as per P.E.C Contractor Category.

4.2.7 Cost Spent on Health and Safety at Project Site

Figure 25 depicts the trend of the cost of implementation and monitoring of H&S at the building construction projects sites in Islamabad/Rawalpindi area. The average cost incurred at the building construction projects surveyed was PKR 3,867,000. It can be observed that the investments made towards the implementation and monitoring of health and safety at the construction projects sites is not directly proportionate. The percentage is higher for smaller projects and significantly lower for larger projects carried out by large contracting firms. Due to this fact, the larger firms can bare to invest in the implementation and monitoring of health and safety management system at the construction project sites in Islamabad / Rawalpindi area. The laws of economics apply in the aspect of health and safety management system implementation and monitoring. This can e realized by observing the trend developing in the scatter plot shown in Figure 25.

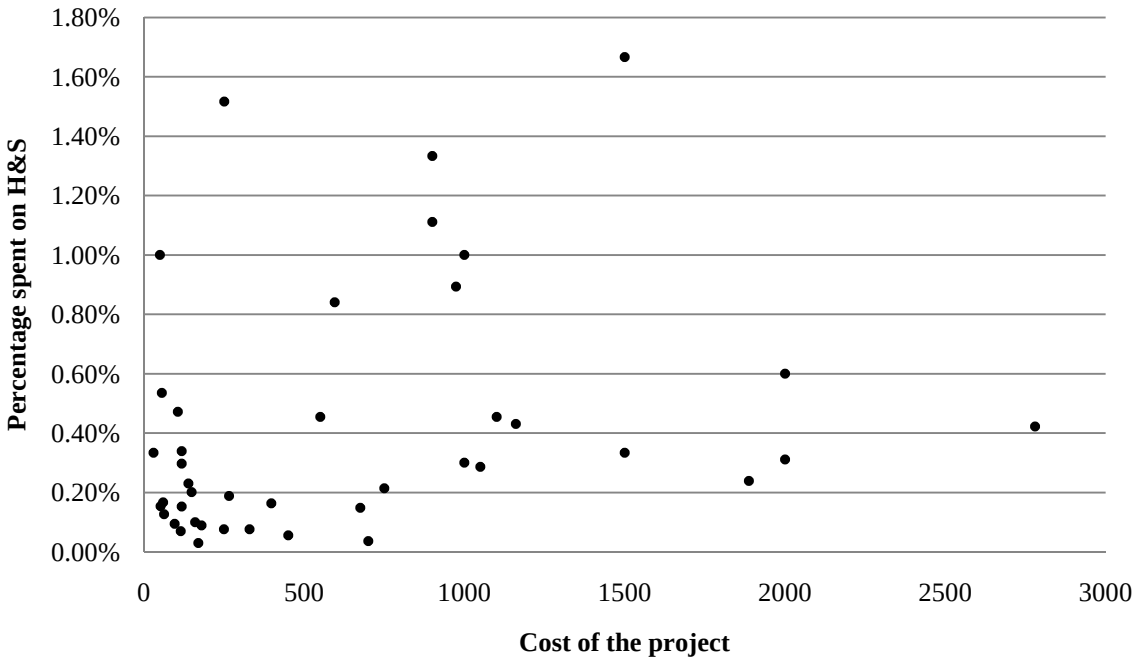


Figure 25: Scatter plot of the percentage of money spent on H&S.

4.2.8 Average Cost Incurred at Construction Sites

Cost of manual handling

We looked into the average costs incurred at the construction sites per employee and cost incurred per construction site. The results are depicted in Figure 22.

- The cost incurred at the construction sites for employing a formal health and safety specialist is bound to be the highest amongst all others. This is due to the fact that it is a recurring cost and, therefore, has to be incurred per month till construction project completion. It cannot be controlled due to the fact that the health and safety specialist has to be at the construction sites till the project handing over to the client. The construction project is bound to over-run its allocated completion duration time, causing the over head costs to escalate.
- Second largest cost incurred to implement and monitor health and safety at the building construction project sites was personal protective equipment. This is due to the fact that this is a onetime initial cost incurred at the start of the project construction phase. After that, the cost towards personal protective equipment is merely the up-keep or maintenance of the PPE. Hence, the contractors are willing to cater and bare the costs of PPE at the construction project sites.

– The cost of monitoring and training of the employees at the building construction project sites are close enough to be considered the same. Although they are not given much importance, due to the fact that it is a frustration and a dilemma for the construction project management. There is a tussle between the project site staff and the head office staff to deliver the project in time with a maximum returns/profits to the construction company. Hence, the important aspect of implementation and monitoring of health and safety at the construction project sites are kept to a mere formality rather than making it an integral part of the daily routine.

  According to the feedback by the staff at the construction project sites, monitoring and training are not given priority because it is time consuming, causing delays in the construction project daily progress, and the site staff does not take them very seriously. The labor is there to work and desires to start the day as early as possible to make the maximum money for the day. Safety training is not their priority, money is.

– The costs for buying new equipment and job/site risk assessment is given the least priority in terms of costs because of the fact that new equipment is usually not bought at the building construction projects. Some PPE bought in the past by the construction company is deployed when the contractor is mobilizing at the project site. Other new equipment, for example, shoes, goggles, safety jackets, safety masks, safety overalls, etc, are bought during mobilization. Same is the case with the risk assessment tasks of the job sites. Staff personnel do not pay attention to the risk assessment carried out by the health and safety personnel. It is treated as a mere formality rather than as a tool to mitigate and curtail accident and/or incidents at the construction sites. Hence, least cost is incurred at the construction project sites for the monitoring and risk assessment.

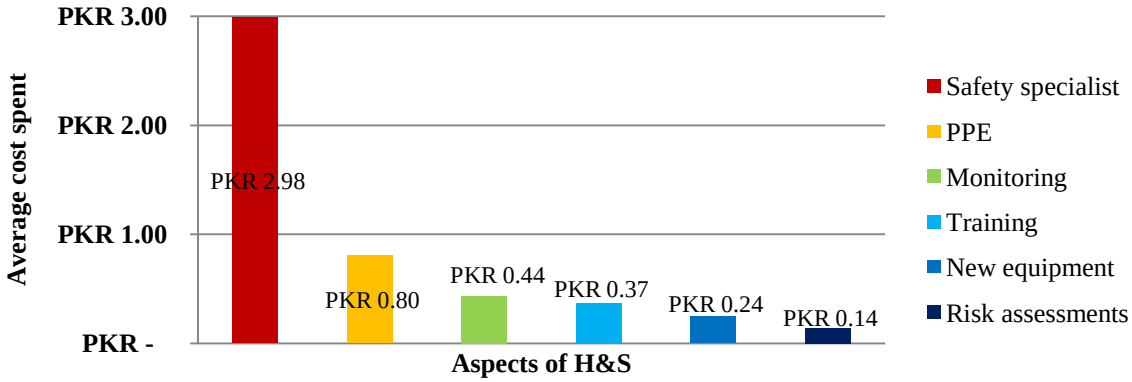


Figure 26: Average Cost of action to implement and monitor H&S at site

Figure 23 shows the importance and priority given to the type of action taken for the implementation and monitoring of health and safety at the building construction project sites in Islamabad/Rawalpindi area.

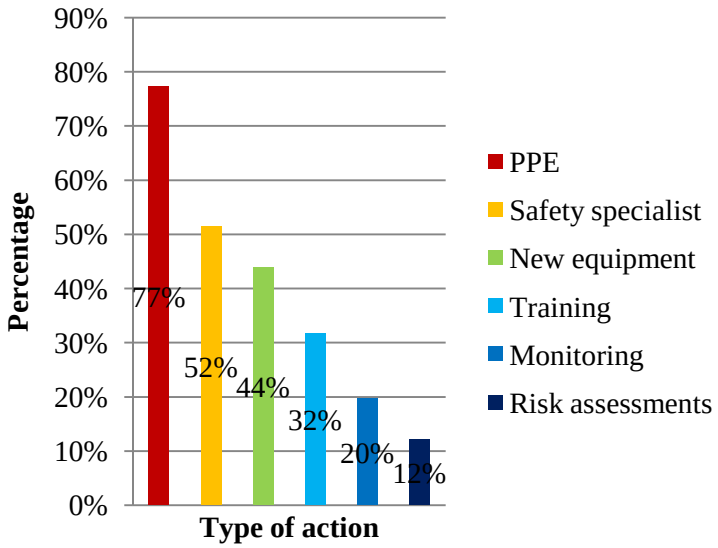


Figure 27: Type of action to implement and monitor H&S at job site

Cost of signage at the construction site

Figure 24 shows the responses when asked if the construction sites had an arrangement to have signs at the building construction sites.

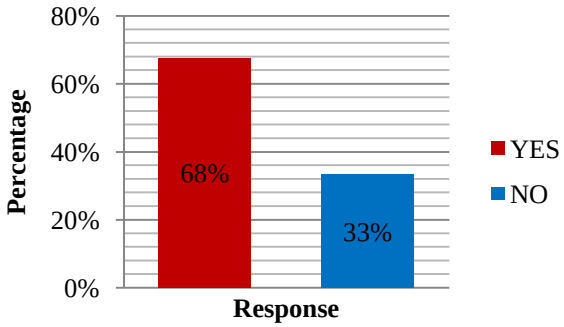


Figure 28: How many had signage implemented at job site?

Figure 25 depicts the responses at the construction site where signage was implemented to educate the on-site workers about the health and safety.

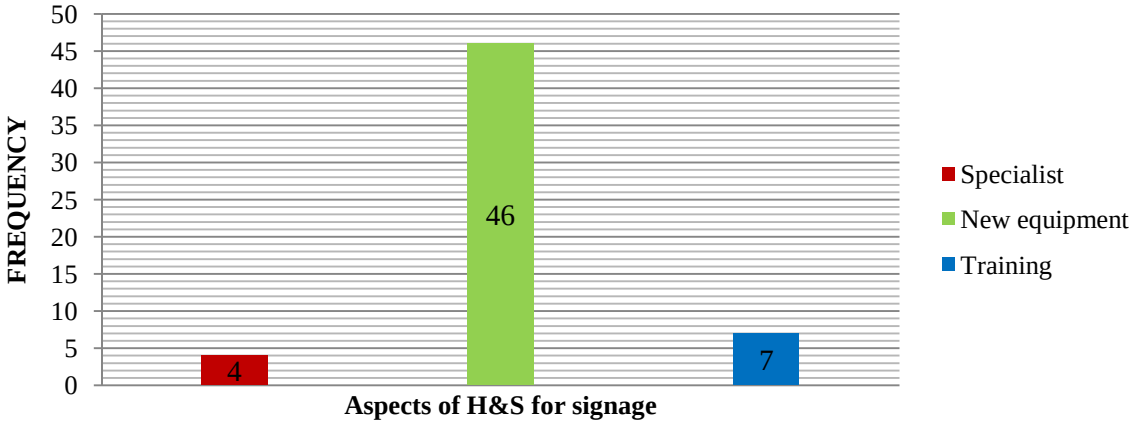


Figure 29: Type of action to implement and monitor signage.

Figure 26 depicts the average costs incurred on implementing signage facility at the building construction sites in Islamabad/Rawalpindi area. As evident from the Figure 26, providing of new equipment to implement and monitor signage is of top priority to the on-site staff. New sign boards are provided to every construction site at the start of the construction phase, and it is seen that all sign boards are well kept in all respects till the completion of the project. Training is provided in the start of the project to educate the on-site staff and labor so that they are wary of the health and safety requirements needed for safer and accident free environment.

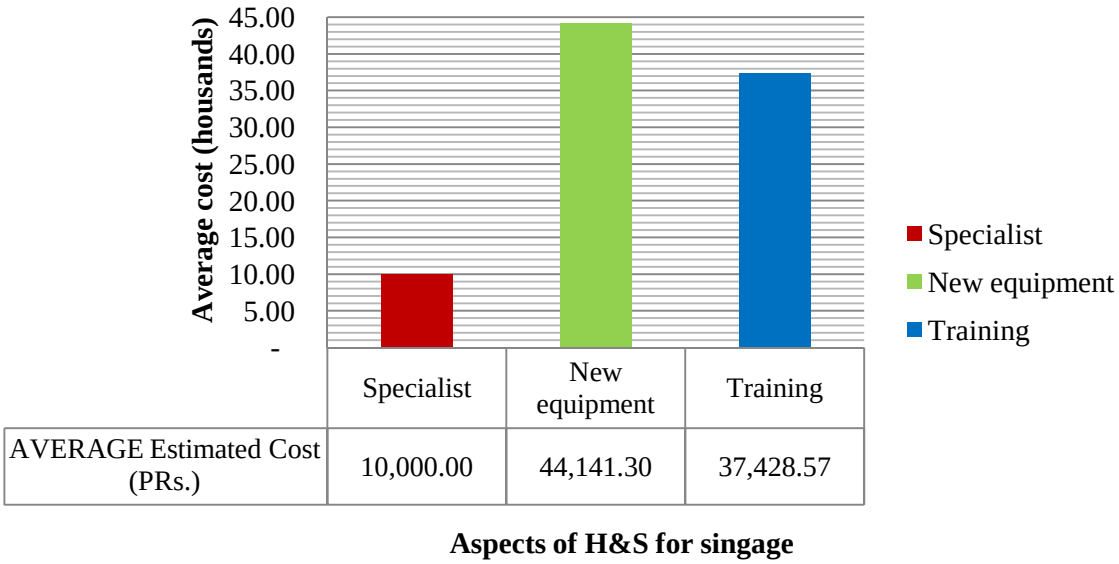


Figure 30: Average estimated cost per construction site (PRs.)

4.2.9 Nature of Investments Towards Health and Safety

Respondents were asked to report their 3 main health and safety expenditures. Table 10 shows the most frequent responses.

Table 10: 3 most frequent costly aspects of H&S

S. No.	3 most frequent responses
1	PPE
2	SITE SECURITY
3	H&S SALARIES
4	H&S TRAINING
5	SIGNAGE
6	HEALTH INSURANCE
7	FIRE FIGHTING EQPT.
8	FIRST AID EQPT.
9	HOUSE KEEPING

The three most costly aspects of implementation and monitoring of H&S at the construction projects are shown in Figure 27.

- Seventy seven percent (77%) construction sites, with a formal H&S system, had spent money on personal protective equipment (PPE).
- Sixty two percent (62%) percent of the construction sites had spent money on site security.
- Twenty percent (20%) had spent money on H&S personnel salaries.
- Seventeen percent (17%) had spent money on H&S training.
- Eight percent (8%) had spent money on signage at the construction sites.
- Eight percent (8%) had spent money on health insurance of the onsite workers.
- Less than one percent (0.5%) had spent money on first aid kits for onsite workers.
- Five percent (5%) had spent money on housekeeping and hiring of personnel for the same purpose.

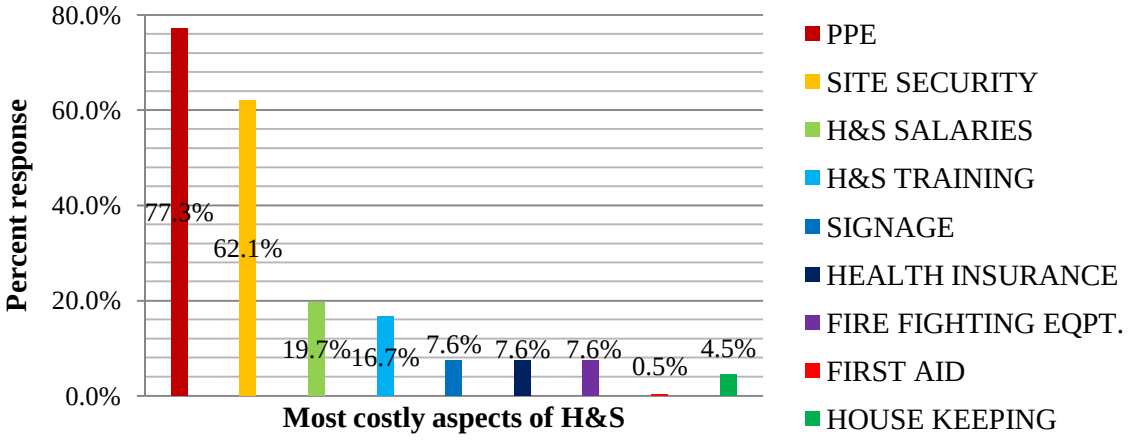


Figure 31: Most costly aspects of H&S.

As evident from the Figure 27 and discussed results, the provision of personal protective equipment (PPE) is the most popular main expenditure at the construction sites in Islamabad/Rawalpindi area. Furthermore, the security of the construction site is considered to be the second most expensive expenditure at the construction sites.

According to the feedback by the staff interviewed, personal protective equipment (PPE) and site barricading are a onetime initial expense instead of recurring. Contractors avoid recurring costs and expenditures because they are very difficult to control and can take a major toll on their profits. Recurring costs such as H&S personnel salaries, H&S training, signage, health insurance, firefighting equipment, first aid and housekeeping are recurring expenses and cannot be curtailed very easily. Hence, they are avoided.

Moreover, recurring expenses lower the chances of the contractors to acquire a construction project. If the overheads put in by the contractor are high, the chances of winning the bid for the construction project(s) are quite low.

4.2.10 Does the Size of the Construction Firm Matter?

Table 11: Average costs per employee and construction site

P.E.C CATEGORY	Average cost per employee	Average cost per site
C-A	PKR 28,591.12	PKR 3,663,588.24
C-B	PKR 3,200.00	PKR 160,000.00
C-1	PKR 6,486.49	PKR 308,571.43

As evident from Table 11, the cost spent on health and safety implementation and monitoring by the C-A P.E.C category contractors is significantly higher than the rest. This is

due to the fact that C-A category contractors bid bigger projects and employ higher number of labor at their projects. Since Pakistan has cheaper and abundant unskilled labor, making it easier for the C-A category contractors to bear the costs of implementation and monitoring of the job site health and safety rules of the construction company. Their overheads are noticeably higher than the rest and hence have to allocate a higher percentage to the health and safety of the workers at the building construction sites.

Another contributing factor being the fact that building construction projects costing more than five hundred million (500 million), the employed labor is significantly high, hence, the probability of incurring an injury is higher at building projects.

4.2.11 Effects of H&S Implementation and Monitoring

The effects of having a formal H&S system at the building construction sites were studied and the results are depicted in Figure 32 through Figure 40.

- The construction sites that had the H&S system, sixty three percent (63%) said that their illness/injury compensation claims had no effect. Two percent (2%) said they had an increase in compensation claims at the job sites, while three percent (3%) claimed that it had a decreasing effect on the compensation claims.

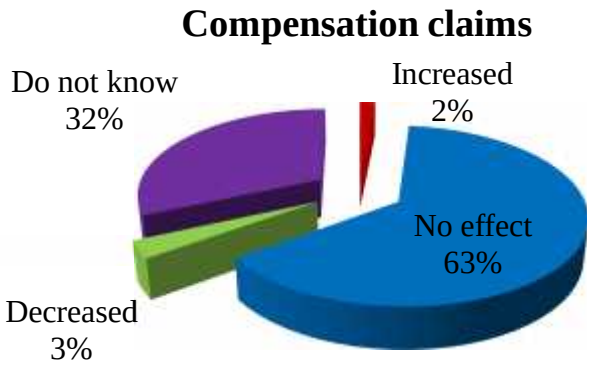


Figure 32: Effects compensation claims

- The insurance premiums remained unchanged for the construction sites for the seventy five percent (75%) of the respondents while only one percent (1%) said that the insurance premiums increased due to insurance company's policy.

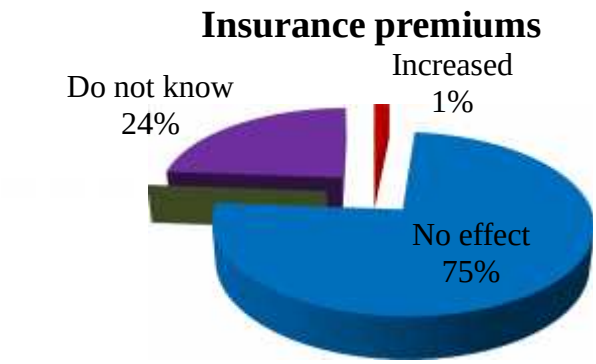


Figure 33: Effects on insurance premiums

– Thirty percent (30%) responded that the number of staff employed at the construction site increased because of having the H&S system, while forty nine percent (49%) responded that it had no effect on their number of staff employed at the construction sites.

Figure 34: Effects on number of staff employed

– Product damage/waste had no effect for sixty percent (60%) of the construction sites for those who had formal H&S systems in place, while eleven percent (11%) had a decrease in the product damage/wastage at their construction sites.

Figure 35: Effects on product damage / waste

- Twenty seven percent (27%) responded that the productivity increased due to the presence of a formal H&S system at their construction sites. Forty three (43%) responded that it had no effect on their productivity and the progress of works, while eleven percent (11%) said that it decreased the progress of works because of having an H&S system at the construction sites. It is worth mentioning that the progress of works decreased at the construction sites because there was no training for the labor and staff members. The construction sites where training was mandatory and an essential part of the weekly routine, the progress of works had no effect or had positive effects on the productivity of the work force at the construction sites.

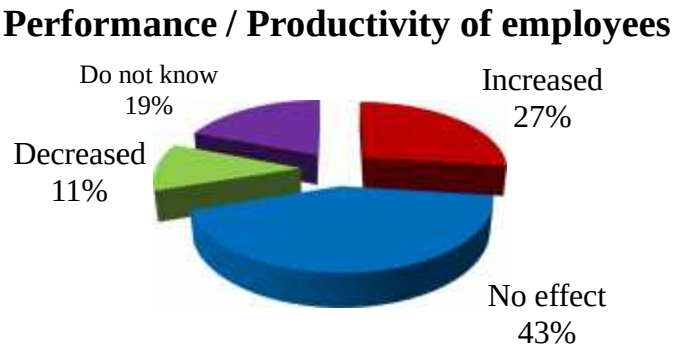


Figure 36: Effects on performance / productivity of employees

- One percent (1%) responded that the sickness absence increased, while thirty two percent (32%) responded that it had no effect. Moreover, forty eight percent (48%) of the respondents answered that it has had a positive effect on the number of sickness absences at their construction sites because of having a formal H&S system.

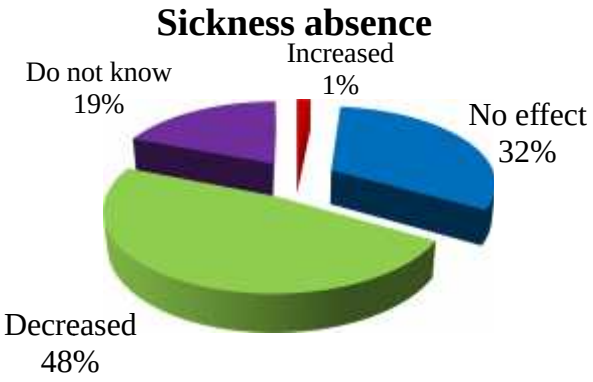


Figure 37: Effects on sickness absence

– Seventy eight percent (78%) answered that their staff moral increased due to the existence of a formal H&S system at their construction sites. While one percent (1%) said that it has no effect, while two percent (2%) said that it decreased their staff's moral. A hefty number of respondents answering that their staff moral increased due to the implementation of a company H&S system at their construction sites is evident enough that having an H&S system has a positive psychological effect and boosts the overall psyche of the worker. Once he knows that he is being taken care of by the company's management, he works more diligently with a positive attitude.

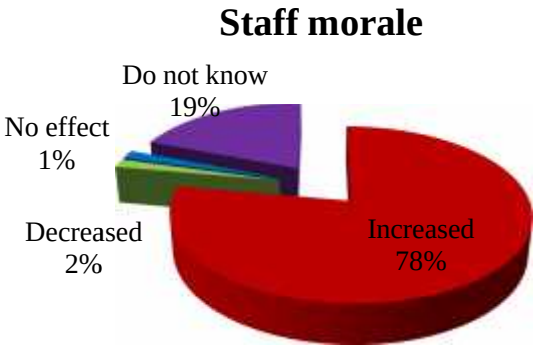


Figure 38: Effects on staff morale

– To further the point of H&S system having a positive psychological effect on the worker, the staff/worker turnover or the number of workers reporting for duty on time, increased. According to the respondents, seventy eight percent (78%) answered that the workers reported in the morning for duty with a positive attitude towards their work and complying with the company's health and safety regulations. The positivity in the staff/worker turnover had a good effect on the overall psychological atmosphere at the construction sites.

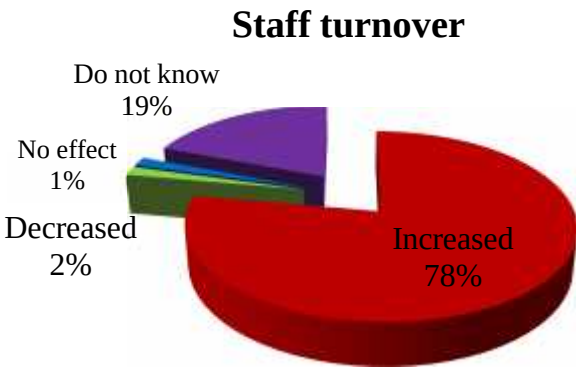


Figure 39: Effects on staff turnover

– Twenty seven percent (27%) of the respondents answered that the time lost through accidents had no effect at the construction sites with a formal H&S system. This is due to the fact that considerably low time is considered to be lost when there is an effective H&S system implemented at the construction sites. While fifty two percent (52%) answered that the time lost through accidents decreased due to the implementation of an effective H&S system.

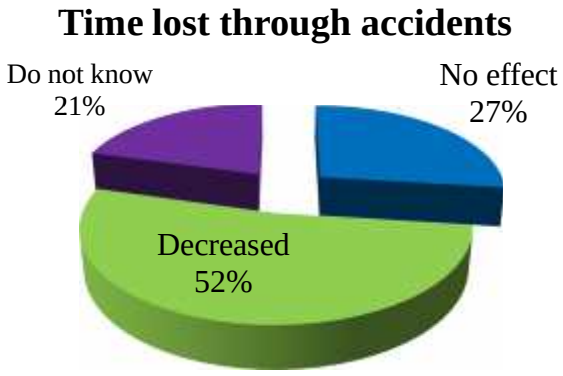


Figure 40: Effects on time lost through accidents

4.2.12 Frustrations and Barriers

Figure 41 shows the types of frustrations and barriers experienced at the construction sites where health and safety system was formally implemented and monitored.

– As evident from the results shown in Figure 41, lack of support from the on-site staff is the greatest frustration of all to cause a hindrance to the better implementation and monitoring of the health and safety system at the building construction sites in

Islamabad/Rawalpindi area. This is primarily due to the fact that compliance of construction company's safety compliance rules and regulations is difficult to follow once the project is run on the basis of greater yield. Once the labor and the on-site staff are required to complete a certain job in a certain amount of time, they do not ponder over working safely. They need to complete a given task by a given time and take their daily wages.

- Another aspect to consider is the pressure to complete the project at an accelerated rate that hinders the working of health and safety personnel. The health and safety staff cannot work with a free hand which is frustrating for the health and safety department f the company. The tussle between the on-site working staff and the on-site health and safety staff to deliver the project is quite a hindrance.
- Lack of information and guidance is the second most important concern when it comes to implementation and monitoring of a health and safety system at construction site. The lack of information and guidance being a great concern due to the fact that there are no credible sources of information that can be used by the on-site staff to better the implementation and monitoring of a formal health and safety system.
- Third main concern for the implementation and monitoring of a health and safety system is the lack of knowledge and skills in the construction company. The on-site staff and the head office staff lack the credible knowledge to realize the importance of safety and providing a healthier environment for the on-site personnel.
- It is worth mentioning that cost was the second least important frustration/barrier in the implementation and monitoring of a formal health and safety system. Buying of and compliance of very basic personal protective equipment (PPE) is the most popular aspect of the implementation of a formal health and safety management system, as evident from the findings in the Section 4.2.9. Furthermore, on the other hand, costs of keeping staff to implement and monitor health and safety system has proven to be a great hurdle in the implementation and monitoring of an exemplary health and safety management system since it takes a major toll on the construction company's profit margins. Hence, the aspect of the tussle between the H&S staff and the on-site working staff is worth the mention.
- Time required is the least concerning factor for the implementation and monitoring of a formal health and safety system.

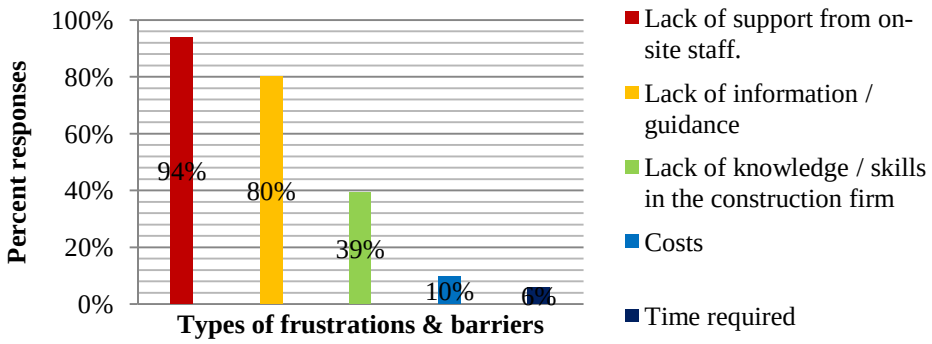


Figure 41: Types of frustrations and barriers

4.2.13 Benefits vs. Costs of Health and Safety

As evident from the feedback from the construction sites' staff, shown in Figure 30, it is financially beneficial for the contractors to have a formal H&S system implemented at the construction sites.

- Only 11% responded that costs outweighed the benefits of health and safety implementation and monitoring.
- 24% responded positively that benefits of implementing safety at the construction site were more than the cost of health and safety system implementation and monitoring.
- While another 24% responded that the benefits and costs broke even.
- 31% responded that it was too early to conclusively say if the costs had outweighed the benefits of health and safety implementation and monitoring or not.
- 9% responded that they did not know of the cost vs. benefits trend at the construction site.

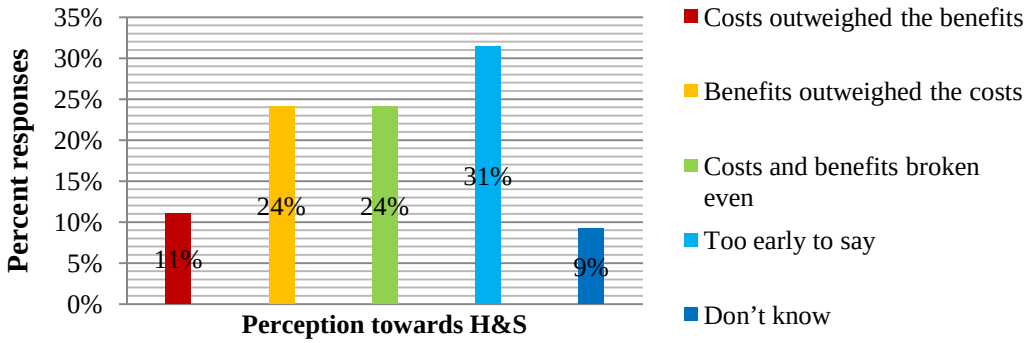


Figure 42: Benefits vs. Costs of implementation and monitoring of H&S system.

The most common advantages of having a health and safety system and the benefits reaped were similar across the 3 P.E.C. construction company categories. However, the C – A P.E.C. category construction firms displayed benefits that were more aimed at the betterment of the company's reputation in the Pakistan construction industry. On the other hand, the C – B and C – 1 P.E.C. category construction firms reported that even though investing in health and safety systems at the projects sites is beneficial for the company's image, it does take a toll on the prospects of securing projects and clients. This is evident for construction projects that are being procured through design – bid – build method, which is the most customary form of construction procurement method used in Pakistan. The clients that require safer construction companies, for example the EOBI, the World Bank, and the National Engineering Services, aim for superior working conditions for the workers at their construction project sites. These clients have specific regulations and requirements that will not allow construction companies to commence work that have minimal health and safety standards and cannot perform work under safe conditions.

The most commonly reported benefits across all sizes construction projects for those construction firms visited, starting with the most frequently reported benefit, included:

- Increased awareness and a better understanding of the health and safety risks;
- Increased staff morale;
- Superior company standing;
- Securer working environment;
- Increased safety performance;
- Increase in labor productivity;
- Reduction in absence due to sickness;
- Decrease in time lost because of accidents;
- Decrease in the number of recordable injuries;
- Safer working routines;
- Protection of Construction Company against litigation.

4.2.14 Source of Advice and Information

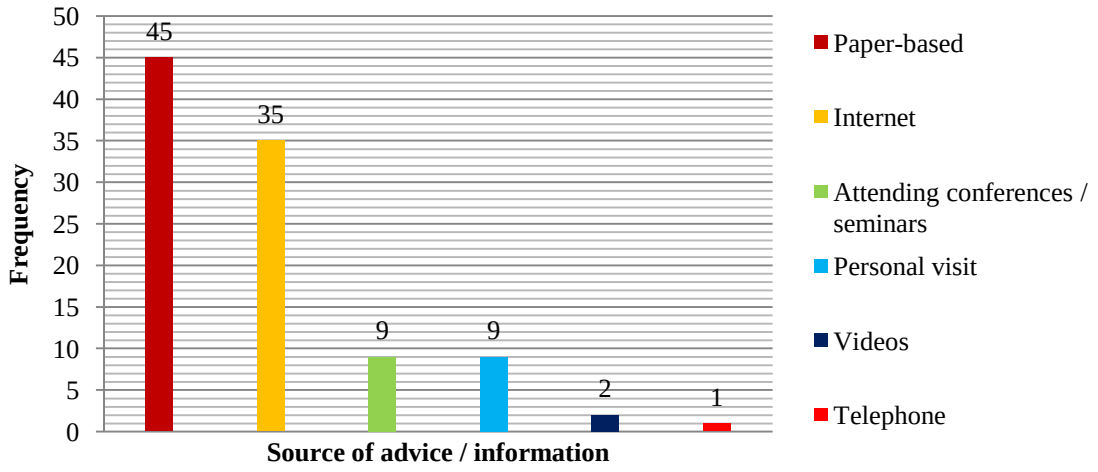


Figure 43: Source of advice & information to implement and monitor H&S.

The most basic form of information gather and consultation has been paper based, for example books and magazines. In Pakistan as well, the favorite mode of information for the health and safety personnel are the books. Followed by the second most popular mode of advice and information is through internet. Greater volumes of information is available over the internet just a click away for health and safety personnel at the construction sites. Books take up too much space at the construction site offices and, therefore, internet is a much more feasible source of advice and information.

Conferences, personal visits, videos and seeking advice through telephone is the least popular sources of advice and information for the health and safety personnel at the construction sites in the Islamabad/Rawalpindi area. Furthermore, we will discuss the results obtained related to the costs incurred on the construction projects and the trends developed after the compilation of the data.

4.2.15 Analysis of Variance (ANOVA)

This chapter includes scatter plots and linear regression analysis using the SPSS 17.0. Furthermore, Analysis of Variance (ANOVA) tables are also included. Analysis of variance (ANOVA) is a collection of statistical models used to analyze the differences between group means. In its simplest form, ANOVA provides a statistical test of whether or not the means of several groups are all equal.

4.2.16 Regression Analysis

Multiple regression analysis is widely used method in social sciences research to explore the correlation between one dependent (target, criterion) variable and more than two independent (regressors, predictors) variables. This statistical analysis tells how well a set of independent variables are able to predict the outcome of a dependent variable (Kinnear & Gray 2006; Pallant 2007 and Gaur & Gaur 2009). Kinnear & Gray (2006) defined multiple regression analysis as a 'construction of linear equation with two or more variables. Pallant (2007) explained that multiple linear regression analysis provides the model as a whole and the contribution of all variables that make up that model. Major types of multiple regression analysis defined by Hinton et.al. (2004), Pallant (2007) and Gaur & Gaur (2009) are:

1. Standard multiple regression.
2. Hierarchical multiple regression.
3. Stepwise multiple regression.

In this research, the *natural log* if total cost of health and safety is taken as the dependent variable while *natural log* of total cost of project is taken as the independent variable for simple linear regression in SPSS. Furthermore, *contractor class* is taken as an *indicator variable*. An indicator variable or dummy variable is one that takes the value 0 or 1 to indicate the absence or presence of some categorical effect that may be expected to shift outcome. It is used as a device to sort data into mutually exclusive categories simply to impact the regression model qualitatively. Table 12 shows how the indicator variable of *contractor class* was used to improve the regressed model using SPSS.

Table 12: Summary of indicator variable used to describe the contractor class

Cost of Project	Indicator Variable – Contractor Class
> Rs. 500 million	1
Otherwise	0

4.2.17 Assumptions of Regression

Four assumptions of multiple regression that researchers should always test (Practical Assessment, Research & Evaluation, 8(2)), that are as follows.

1. The relationship between the dependent variable and the independent variable is linear in nature. Although a linear regression on data can be conducted on the collected data, the least-squares regression is intended to summarize linear

relationships, so, through empirical evidence, the collected data that the relationship being modeled is linear in nature.

2. For each population denoted by values of variable X, the distribution of Y values is normally distributed. What this means is that for each collected value of construction project cost, the distribution of investment towards health and safety is normally distributed.
3. Homoskedasticity exists for the population denoted by values of the variable X. This means that the variances of these populations are equal. If distributions are not homoscedastic, then a problem of heteroscedasticity exists.
4. The errors within conditional distributions of *Y* given *X* and between conditional distributions of *X* given *Y* are independent. In practical form, this means that any observation in the data is probabilistically independent on any other observation in the collected data set.

(Johnson, R. A., & Wichern, D. W. (2007), *Applied Multivariate Statistical Analysis*. *Prentice Hall: New Jersey.*

4.2.18 Model Summary

The model summery is given in Table 13.

Table 13: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.843[a]	.710	.700	.85424

The model summary contains the essential information revealing how well our regression model fit (or did not fit) the observed data. We see that R is equal to 0.843. R Square in the model summary is computed as R to the power of 2. That is, it is equal to $(0.806)^2$. This is equal to 0.710. This expresses the proportion of variance in Y that is "explained" or "accounted for" by knowledge of X. For our data, this means that approximately 71% of the variance in Y can be accounted for by knowledge of X.

4.2.19 Analysis of Variance

The ANOVA summary table is shown in Table 14. The regression sum of squares tells us how much variability (not variance yet) is accounted for by the regression model,

which is the fitting of the least-squares line. The residual sum of squares tells us how much variability (again, not variance yet) is unaccounted for by the regression model. The total variability is the sum of both regression and residual variability (note that 138.540 = 98.405 + 40.135). The extent to which the regression sum of squares is large relative to the residual sum of squares is the extent to which more variability than not is accounted for by our model.

Table 14: ANOVA summary table

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	98.405	2	49.203	67.427	.000[a]
	Residual	40.135	55	.730		
	Total	138.540	57			

a. Predictors: (Constant), Contractor Class, Log of Proj. Cost

b. Dependent Variable: Log of H&S Cost

4.2.20 Checking for Linearity

Figure 37 shows the linear scatter plot of the independent variable *natural log of Project Cost*, and the dependent variable *natural log of investment on health and safety*. Linearity can be easily checked through such devices as a scatterplot before one conducts the actual regression (*Simple Linear Regression Using SPSS, Daniel J. Denis, 2011*).

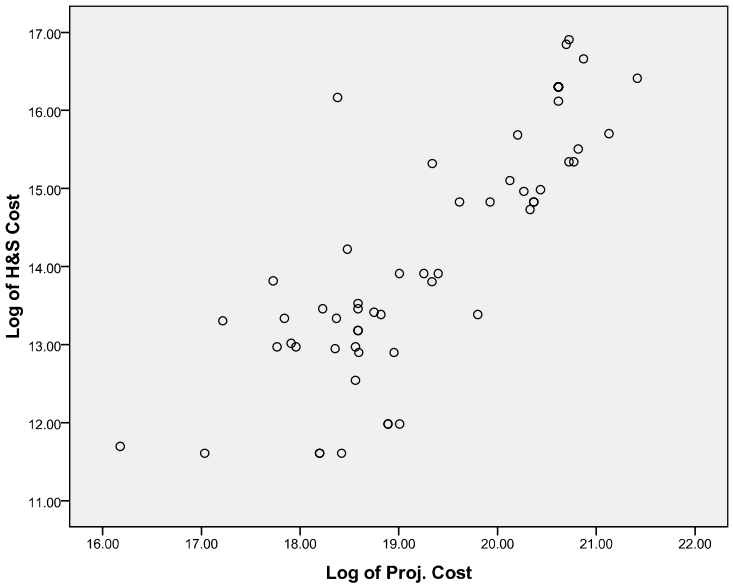


Figure 44: Scatter plot after data transformation

4.2.21 Test for Normality

A p-value of 0.01 being highly significant was used in SPSS (Gaur & Gaur 2009).

Table 15: Test for Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Log of Proj. Cost	.125	58	.024	.950	58	.018
Log of H&S Cost	.120	58	.038	.947	58	.013
Contractor Class	.410	58	.000	.608	58	.000

a. Lilliefors Significance Correction

Table 15 shows that the significant value of Shapiro-Wilk is greater than 0.01. Therefore Null Hypothesis (H_o) is to be accepted. The normality assumptions of the variables were satisfied.

4.2.22 Coefficient of Determination (R^2)

The coefficient of determination or the R^2 value is correlation between all entered independent variables and the dependent variable based on linear regression equation. R-square value tells how much variance in the dependent variable that can be explained by the independent variables. The adjusted R square is taken in to account when a lot of variables are involved in the model or when sample size is smaller than 30 (Kinnear & Gray 2006; Pallant 2007; Tabachnick & Fidel 2007 and Gaur & Gaur 2009). The R square value also provides whether a model is a good fit. According to Singh (2007), the following values of R^2 are considered to rate a regression model.

- >75% is considerably good;
- 50-75% is good;
- 25-50% is fair-minded;
- below twenty five percent (25%) is weak.

The resultant value of the coefficient of determination (R^2) for this study is 0.71. This shows that 71% of the data values lie close to the regressed line. Hence, this model can be classified as a 'good' model according to Singh (2007). Though SPSS has already provided us with R Square in the model summary, we can also obtain R Square directly through the

ANOVA table. The computation of R – Square is *Sum of Squares Regression divided by the Total Sum of Squares*. For our data, the computation is 98.405/138.540 = 0.710.

4.2.23 Degrees of Freedom

The degrees of freedom in the ANOVA table are computed in the following way: Degrees of Freedom Regression is equal to the number of predictors in the model. As such, for our data, the degrees of freedom are equal to 2, since we have 2 predictors in the model.
DF Residual is equal to N-K-1, where "N" is the total number of cases used in the regression, and "K" is the number of predictors. For our data, the computation is 57-1-1 = 55.
Degree of Freedom Total is equal to N (57), or simply the sum of DF Regression and DF Residual (2 + 55).

4.2.24 Coefficients of Regression

Coefficient of regression is a measure of how well the dependent variable is significantly predicted by the independent variables. Unstandardized and Standardized coefficients are two types of regression coefficients. Unstandardized coefficients are used to develop a regression equation from all the independent variables with their coefficients and a constant term (α) and error/residual (unexplained) factor 'ε' as shown in the Equation.2 (Gaur & Gaur 2009).

$$y = \alpha + (\beta_0)\, x_1 + (\beta_1)\, x_2 + \varepsilon$$

Equation 5: Regression Equation

On the other hand, standardized beta coefficients show which variable has the greatest influence on the dependent variable. Pallant (2007) argued that "if the significance value is less than 0.05, the variable is making a significant contribution to the prediction of the dependent variable and if the significance value is greater than 0.05, the variable fails to make a significant contribution to the prediction of the dependent variable".

Table 16: Regression Model Coefficients

Coefficients[a]						
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	β	t	Sig.
1	(Constant)	.836	3.338		.250	.803
	Log of Proj. Cost	.668	.180	.512	3.712	.000

	Contractor Class	1.168	.444	.363	2.632	.011

a. Dependent Variable: Log of H&S Cost

Equation 6 shows the interpretation of the Table 16.

$$Y' = 0.668X_0 + 1.168X_1 + 0.836$$

Equation 6: Linear Regression Model Equation

In the Equation 6, X_0 is the *Natural log of Total Project Cost* and X_1 is the indicator variable signifying *contractor class*, while *y* is the *Natural log of Total Investment on Health and Safety* at the construction project. It can be deduced that as there is a unit change in the cost of the project there is a 0.668 unit change in the natural log of investment on health and safety, while other variables are constant. Furthermore, when there is a unit change in the contractor class there is a 1.168 unit change in natural log of investment on health and safety, while other variables are constant. It is worth mentioning that this model equation is valid for a specific set of data which include certain values of *Investment on Health and Safety* (x_0) and *Contractor Class* (x_1).

Equation 7 shows the final regression model for the study as interpreted by Equation 6.

$$y = e^{0.668 \ln x_0 + 1.168 x_1 + 0.836}$$

Equation 7: Final Regression Model Equation

4.2.25 Regression Analysis Results

From the Table 14, there are no concerns regarding multicollinearity since Tolerance values are greater than 0.1 and VIF values are less than 10 (Pallant 2007). The dependent variable value will increase with the increase of values of all three independent variables. In this research, the focus is to compare the contribution of the independent variables; standardized beta coefficient 'β' is used. It can be seen that the beta 'β' value of factor FIH: Financial Control and Issues Handling is making a significant unique contribution (Sig. value less than 0.05) in predicting the dependent variable i.e. Log of H&S (*Natural log of Total cost of Health and Safety*). As the sample size is more than 30, R square value is used to assess the overall fit of the model (Pallant 2007). In this case, R square value is 0.70. This means that the independent variables are making 70.1% variance in the dependent variable,

showing a fair model (Singh 2007). Finally, in ANOVA analysis, this regression model has a high significance level.

Table 17: ANOVA table of regression analysis

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	β		
1	(Constant)	.836	3.338		.250	.803
	Log of Proj. Cost	.668	.180	.512	3.712	.000
	Contractor Class	1.168	.444	.363	2.632	.011

a. Dependent Variable: Log of H&S Cost

4.2.26 Data Transformation

Linear regression is a statistical practice to relate a dependent variable *Y* to one or more independent variables *X*. If linearity fails to hold, even approximately, it is sometimes possible to transform either the independent or dependent variables in the regression model to improve the linearity. Ideally, residuals are randomly scattered around 0 (the horizontal line) providing a relatively even distribution. This is known as homoskedasticity. Heteroscedasticity in indicated when the residuals are not evenly scattered around the zero mark line (*Berry & Feldman, 1985*). In cases where skewness is present, transformation of variables can reduce the heteroscedasticity.

To minimize the heteroscedasticity of the results of this study, *natural log* of investment on health and safety and total cost of the project were taken. Even though the linearity and the coefficient of determination (R^2) improved, the homoscedasticity still remained as an obstacle. Hence, the indicator variable, *Contractor Class*, was introduced. This improved the linearity and the coefficient of determination (R^2), and minimized the heteroscedasticity of the model.

4.2.27 Evaluating Model Fit and Verifying Assumptions Using Residual Plots

Figure 45 shows the plot of Standardized Residual against Standardized Predicted values. This plot shows that our regression assumptions of homoskedasticity is more or less satisfied, and hence, gain an understanding that that the regression outputs can be trusted. This procedure can also be used to check the adequacy of our hypothesized model.

Standardized Residuals on Standardized Predicted Values

Figure 45 shows the standardized residual against standardized predicted scatterplot. Most regression or multivariate statistics texts (*Pedhazur, 1997; Tabachnick & Fidell, 2000*) discuss the examination of standardized or studentized residuals. This is a preferable method of detection of non-linearity and homoskedasticity which involves the examination of residual plots or plots of the standardized residuals against standardized predicted values.

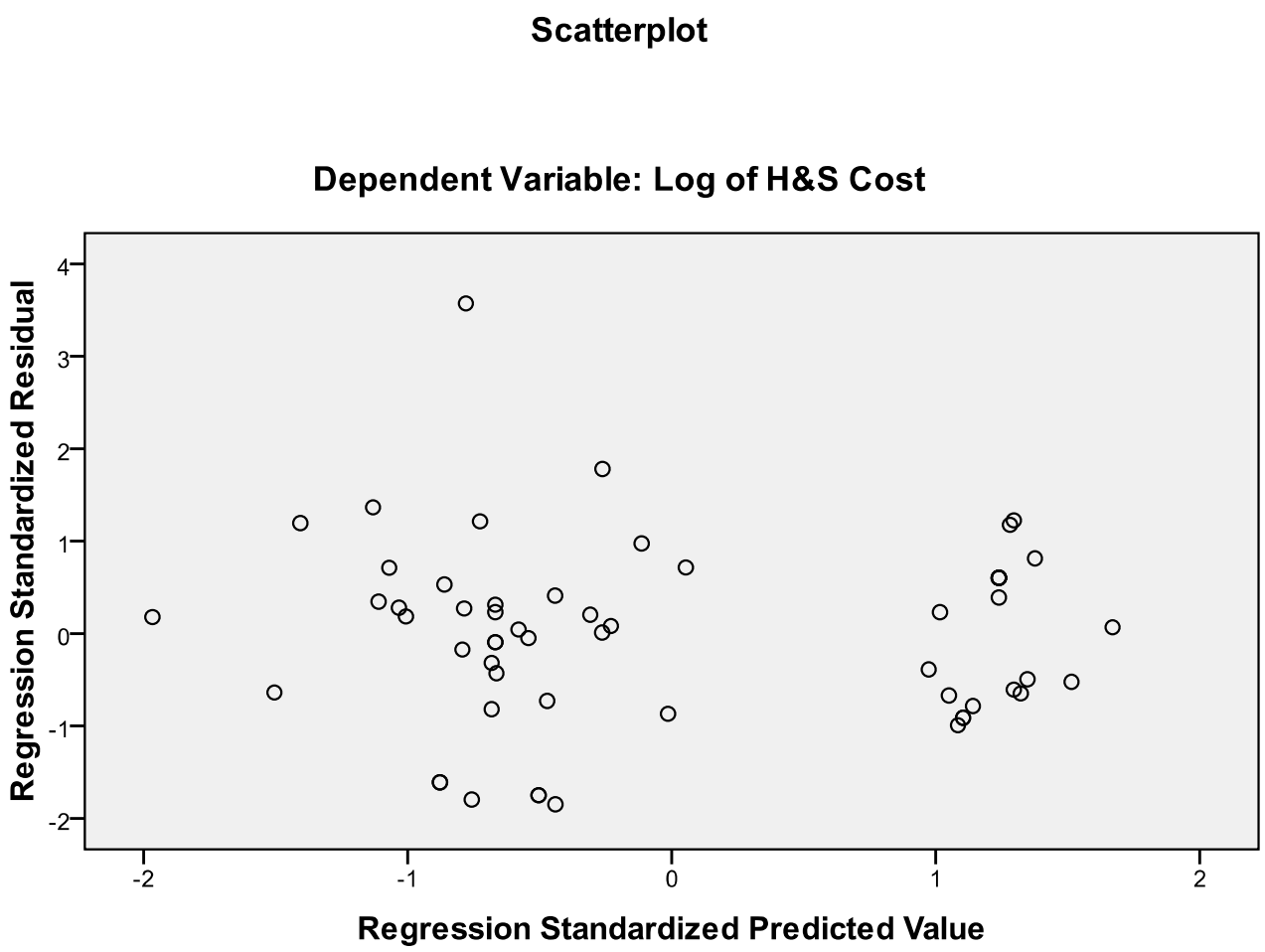


Figure 45: Plot of Standardized Residuals on Standardized Predicted

Normality of Residuals

Another assumption of having an adequate or a robust regression model is the expectation of residuals being approximately normally distributed. In other words, there is no skewness or serious deviation from normality of the residual data.

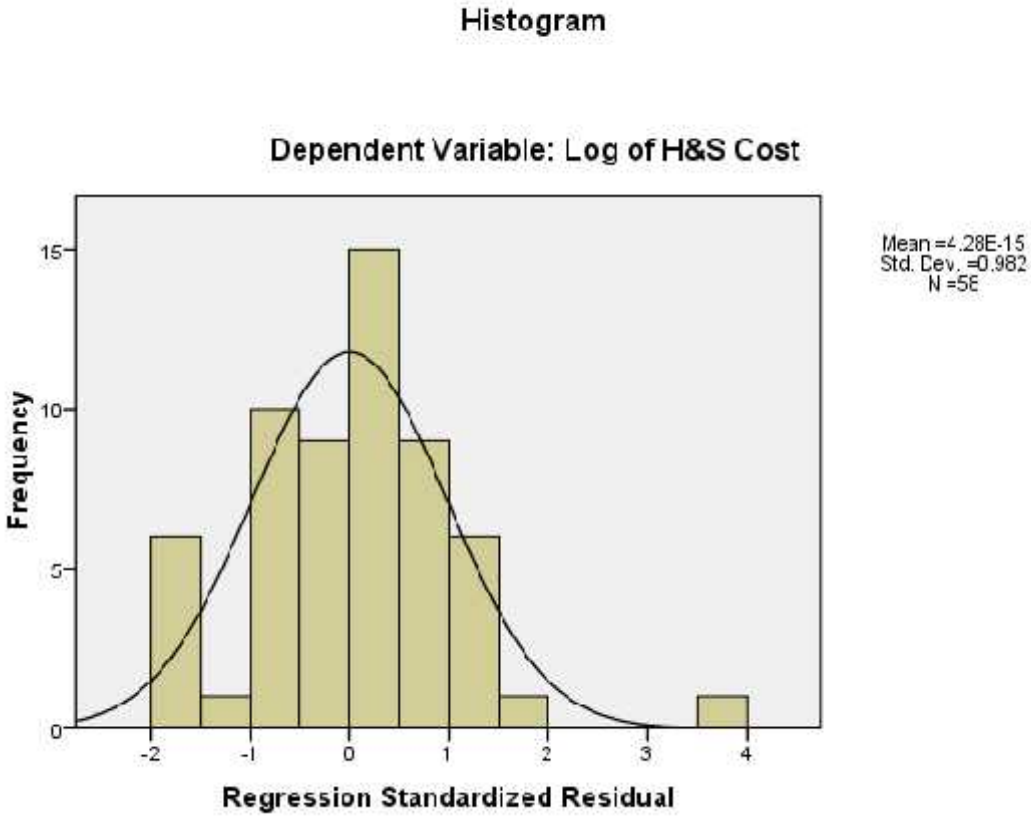


Figure 46: Residuals Histogram

It can be seen from the Figure 46, the standardized residuals are commonly what we would call "well-behaved." They do not exhibit any serious deviation from normality. However, the plot does indicate one residual is somewhat distant from the others, at close to +4 standard deviations away from the mean. This information alone should not cause us to make a rash decision regarding this. If we delete it for the sake of making your model "fit better," you are no longer practicing science, but are rather indicating that we know how to make a sample of data points coincide neatly to a straight line, which is of little use.

P-P Plots

P-P plots are constructed to visually assess the assumption of normality of the residuals. This is a plot that is used to compare "observed cumulative probability" to the "expected cumulative probability". The plot is compared to a forty – five degree line. If there are any irregular deviations from the line, then the point is considered abnormal.

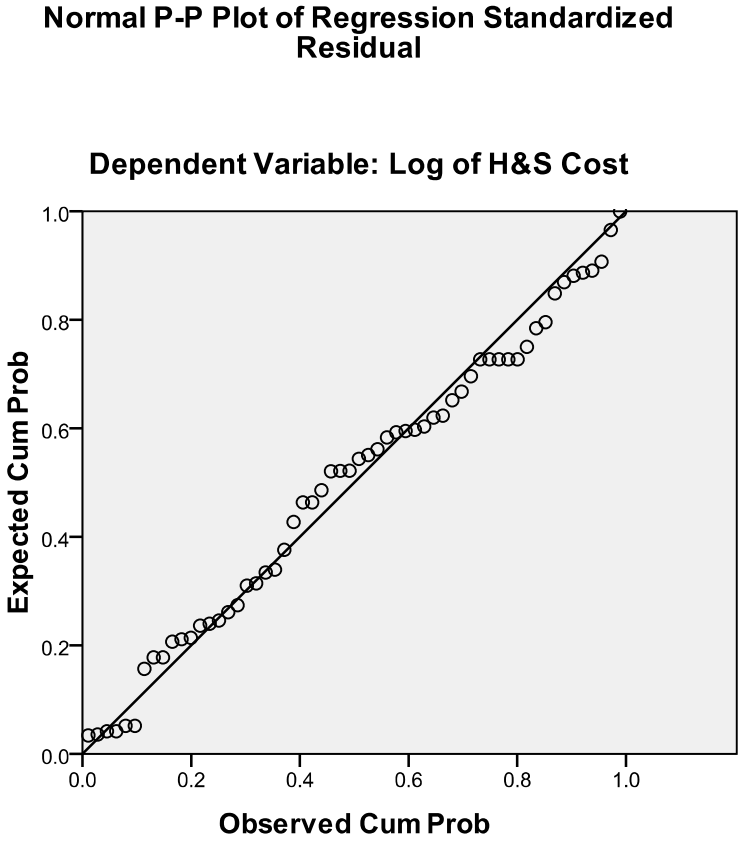


Figure 47: Normal P-P Plot of Regression Standardized Residuals

If the distribution of observed residuals matches up nicely with the distribution we would expect under normality, then residuals should fall along a straight line, as they more or less do in the plot above. If they deviate substantially from a straight line, it suggests a potential deviation from normality.

Checking for Auto-correlation

An autocorrerlated data is one that is correlated between paired values of a given function of a mathematical or statistical variable taken at usually constant intervals that indicates the degree of periodicity of the function. The autocorrelated error can take a range of different specification. Autocorrelation occurs in time-series data studies to check if the error associated with the collected data is carried over into the future. To put this concept into perspective, for example, prediction of cost of health and safety at a construction project is over estimated in one week will lead to overestimates in succeeding weeks. Tintner (1965)

defines autocorrelation as ‘lag correlation of a given series within itself, lagged by a number of times units’. In the regression context, the classical linear regression model assumes that such autocorrelation does not exist (Gujrati, Basic Econometrics (Sie), Tata McGraw-Hill Education).

For the sake of this study, in a time series regression of investment on health and safety at a building construction project, it is not uncommon to see that the investment on health and safety in the current period depends on the investment on health and safety of the previous period. That is given by Equation 8.

$$Investment\ on\ H\&S = \beta_1 + \beta_2(Cost\ of\ Proj.)_t + \beta_3(Cost\ of\ Proj.)_{t-1} + u_t$$

Equation 8: Equation of Autocorregression

The Equation 8 is known as autocorrgression because one of the explanatory variables is the lagged value of the dependent variable. The rationale for the model Equation 8 is that the investment on health and safety habits of construction companies does not change readily for psychological, technological, or institutional reasons.

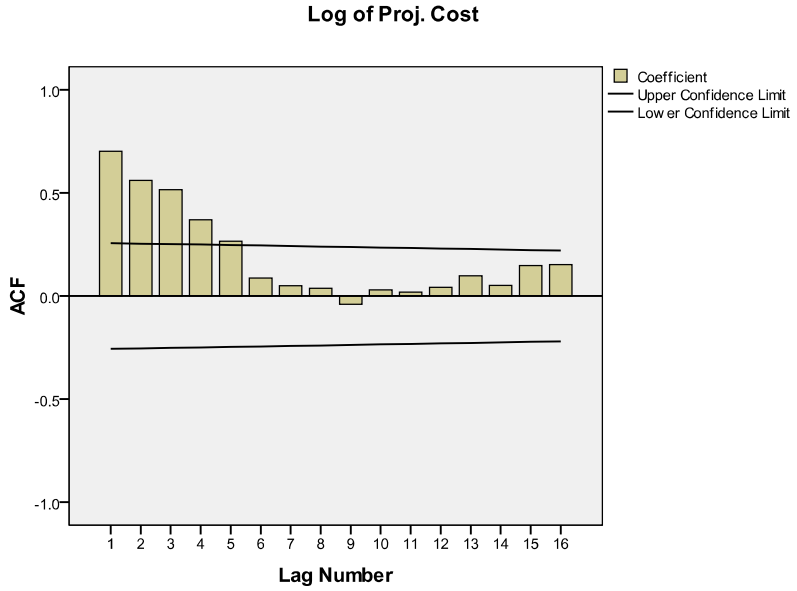


Figure 48: Autocorrelation of Natural log of Project Cost

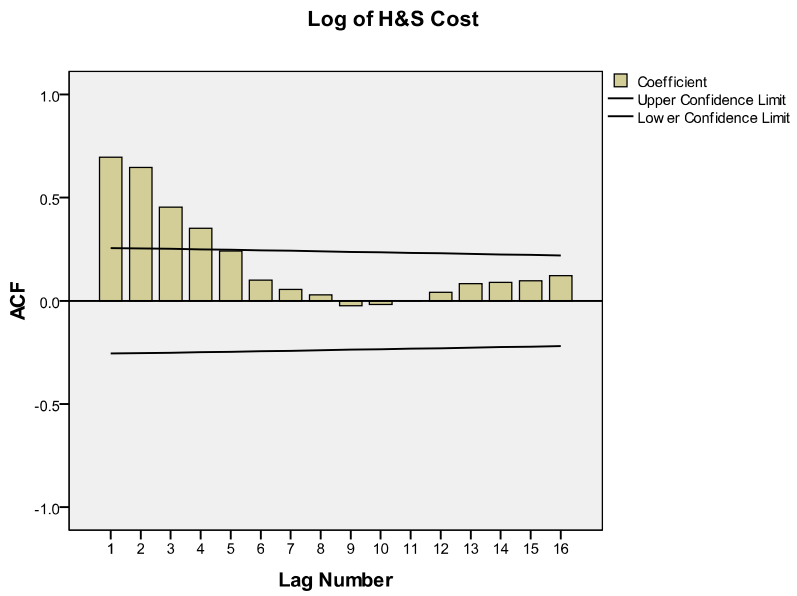


Figure 49: Autocorrelation of Natural log of Project Cost

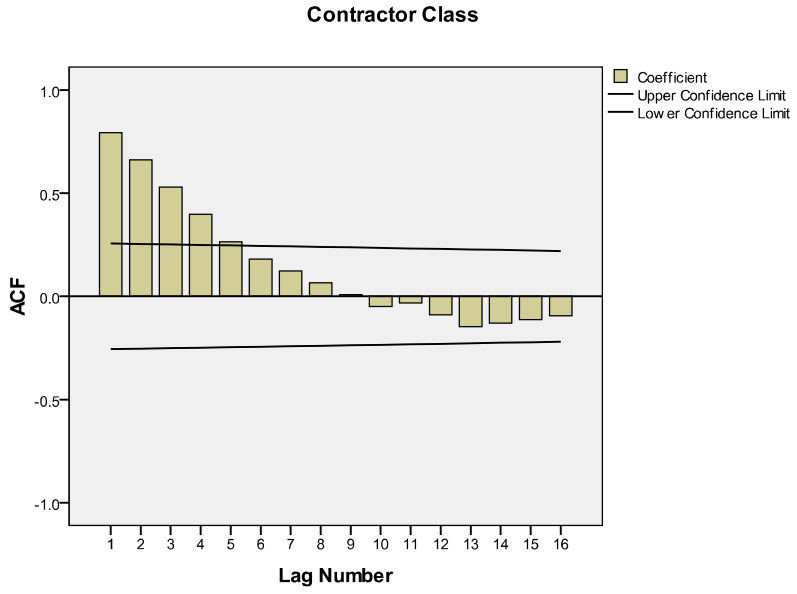


Figure 50: Autocorrelation of Contractor Class

4.3 SUMMARY

In this chapter statistical analysis has been discussed. Sixty three (63) building construction projects were analyzed using SPSS17.0, so as to assess the safety performance level of construction firms operating in the Islamabad / Rawalpindi area and the amount of money invested in various aspects of health and safety management system.

It is worth the mention that R^2 value is 0.701 which indicates the fact that the results are reliable but have a high variance. It was observed that seventy percent has an accident and an ill-health record while sixty-six percent had some sort of safety management system in place to implement and monitor health and safety management system at the construction project sites. The foremost reason for not having a formal health and safety management system was the '*lack of knowledge'* at the construction project sites while '*Costs involved*' was ranked amongst the lowest together with the '*Time restrictions*' as the reasons for not having a health and safety management system in place at the construction project sites.. The features of health and safety system at the construction project sites worth a mention is the presence of a 'W*ritten Health and Safety policy*' followed by the presence of a designated '*Health and Safety Person*' at the project sites. It is worrisome to mention that the features of '*Performance Measurement*', '*Risk Assessment*', and '*Performance Targets / Objectives*' were ranked the lowest in terms of priority to be included as features in the Health and Safety Management system at the construction project sites. The predominant reason for having a health and safety management system was '*Health and Safety publicity*' followed by '*Company's top management priority*' and '*Experience of accidents within the construction firm*'. Furthermore, '*Consultant / Client pressure*', '*Insurance costs*', '*Legal obligations*', '*investigation by the police*' were ranked amongst the lowest to be the reasons to implement and monitor health and safety management system at the construction project sites.

In this average cost, chunk of the money invested is to hire a '*Safety specialist*' at the construction sites to implement and monitor the health and safety management system. While on the other hand, the least money is invested in '*training*', '*New equipment*', and '*Risk Assessments*'. The results highlight that large construction firms operating in the Islamabad / Rawalpindi area have a fairly strict health and safety management system in place at the construction project sites. The money invested by the C – A P.E.C Category contracting firms in safety is less in terms of percentage compared to the C – B and C – 1 Category contracting firms. Hence, the larger firms achieve economies of scale on larger construction projects than the above mentioned P.E.C category contractors.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

5.1.1 Motivators to Implement and Monitor Health and Safety

The main motivators to take action were health and safety publicity, construction firm's top management priority and experience of accidents within the construction firm. Hence, it is evident from the before mentioned results that construction firms would have been motivated earlier if they had been aware of the issues. The publicity that they have been exposed to has therefore been effective in promoting action. Further publicity may be required to prompt other construction firm of other P.E.C contractor categories to take similar action. When construction firms' project sites staff were asked what frustrations they faced when setting up systems, other than time and costs, many reported lack of knowledge and information together with the lack of support from the on-site staff. When asked what information would have been useful, the general themes were around practical information / tools to identify what is required to set up a formal health and safety system, indicating the kinds of publicity that might be most appropriate for construction projects being carried out by construction firms of lower P.E.C contractor category.

A hefty percentage of the construction sites' organizations had a written health and safety policy (79%), almost half had an accident reporting system (53%), a designated health and safety role/person (56%),while documented risk assessments was carried out by a quarter of the construction sites (25%) followed by performance measures and targets (33% and 18% respectively). However, the Pakistani construction firms that had been in business longer were more inclined to measure safety performance on a regular basis and have targets in place together with a superior psyche of keeping themselves and the jobsites safe to promote safety culture within the construction company. This perhaps suggests that it is not until systems have been in place for some time that organizations look to set performance targets and measure their health and safety performance and work towards achieving them. Hence, it can be deduced that there is relatively less information and knowledge available for the monitoring and assessment of health and safety regulations than implementation.

5.1.2 Implementing Health and Safety Investments / Costs

As discussed earlier in Section 4.2.13.1, the general trend is evident that the benefits outweigh the costs of implementing and monitoring a formal health and safety system at the building construction sites in Islamabad / Rawalpindi area. The benefits are not tangible and cannot be quantified in terms of defined units. Furthermore, benefits cannot be recorded in terms of money. They can only be released or 'felt' at the construction sites, according to some supervisors interviewed at the construction sites where health and safety implementation and monitoring was taken seriously.

As discussed in detail in Section 4.2.11, fifty nine percent (59%) of the respondents answered that there was a positive effect on the number of sickness absences at their construction sites because of having a formal H&S system. Meaning, less construction site personnel were experiencing injuring and taking sick leaves. Furthermore, ninety six percent (96%) answered that their staff moral increased due to the existence of a formal H&S system at their construction sites. As explained before, the staff moral increased due to the implementation of a company H&S system at their construction sites. It was evident enough that having an H&S system has a positive psychological effect and boosts the overall psyche of the worker. Once the worker knows that his safety and security is the company's top priority, he works more diligently with a positive attitude towards his work.

To further the point of intangible benefits of having an H&S system at the construction sites, according to the respondents, ninety six percent (96%) answered that the workers reported in the morning for duty with a positive attitude towards their work and compliance with the company's health and safety regulations. The positivity in the staff/worker turnover had a good effect on the overall psychological atmosphere at the construction sites. The above mentioned explained points are 'intangible' benefits and cannot be quantified in terms of units. These effects can only be 'felt' by the construction site personnel and it is evident in the workers' attitude, his overall commitment towards his work and company H&S policy, his moral. These benefits in turn work towards the development of a pro-safe worker and, consequently, the development of a safety culture that can benefit the client and the consultant due to better quality control, timely completion of the project and woks that are cost effective.

5.2 RECOMMENDATIONS

It is recommended that the owner / top management of the construction company, the supervision consultant, and the client should emphasize on the implementation and monitoring of a sound Health and Safety Management System at the building construction project sites. Unless the top management of the construction companies do not realize the fact that safety is an integral part of the proceedings at the construction projects sites, the safety condition and performance levels cannot be raised. This is only possible by investing in the better health and safety conditions at the construction sites. It is evident that from this research that providing personal protective equipment (PPE) and site security is not a problem. It is hiring of health and management personnel to implement and monitor health and safety at the construction site that makes the top management of the construction companies reluctant to invest money in health and safety.

As already mentioned in this research, the larger companies (P.E.C Category C – A) can afford to invest heavily at large projects since the investment is fraction of the cost of the project. The smaller companies (P.E.C Category C – B, C – 1 and lower) cannot afford to invest, at least invest in all aspects of health and safety implementation and monitoring, because the investments are of a larger percentage of the cost of the project. In this case the consultant / client has to realize the fact that the implementation and monitoring of health and safety management system is an underlying cause of project having less cost over-runs, higher quality standards and workmanship, and less time over-runs at the construction projects. The consultant/client has to provide the contractor with a budget for the implementation and monitoring of health and safety management system at the construction project sites. This budget can be clearly disclosed in the contract documents. This may create a level playing field for all construction firms that decide to bid for a construction project without having to worry about losing the bid because of *over-head costs*.

5.3 RESEARCH LIMITATIONS

As expected with most researches, there were some limitations on this research and its findings. First, to some extent, the field survey and result compilation was carried out with the assumption that in a given setting the relationship between investment on health and safety and improved safety performance was linear, i.e., an increase of 50% of safety investment would lead to a 50% reduction in number of incidents / accidents. This, to a large

extent, may not happen in real situations since some safety initiatives were very costly and had little impact on safety performance and other might be quite reasonable in cost and yet have a strong influence on safety performance. As seen by the results depicted, the concept of *economies of scale* came into the picture to conclude that the relationship between the investments on safety is not linearly related to the cost of the project as most people might assume.

Secondly, because of the complexity of the data required for this research, only eight costs related to health and safety were considered, which include the following:

1. Designation of a safety professional;
2. Performing risk evaluations of labor-intensive job;
3. New or changes to existing equipment;
4. Stipulation of Personal Protective Equipment (PPE);
5. Employees' training;
6. Examining and monitoring safety controls;
7. Cost of implementing signage;
8. Cost of accidents / incidents.

The safety performance evaluation method was used to evaluate the outcomes and assess the safety management system at different construction sites. The advantage of using this assessment tool is that it is simple and direct. This method uses safety performance scores using a questionnaire to evaluate the investment towards safety. This method is not multifarious and can only function at the construction site management level and not the construction company management or administrative levels. Nevertheless, the quantitative aspects of this research provided a systematic method to understand the significance and benefits of safety management system for project stakeholders, especially the prime contractors and sub – contractors.

The third limitation of this research was the calculation of intangible benefits. For many reasons, the intangible benefits were difficult to measure in monetary terms. Intangible benefits of safety investments at construction site level may include workers' motivation, client's satisfaction, company's image, reputation, and publicity in the construction business, etc. There was a systematic methodology that was adopted to address the intangible benefits of investing in safety. This was done by getting a response in form of perception rather than tackling this aspect subjectively.

Another limitation was detected during data collection. Some representatives of the construction companies at the construction sites were reluctant to give cost figures and most did not respond to the question of the number of injuries / fatalities that were experienced and their associated costs. According to them, such information is bad publicity of the construction company.

5.4 FUTURE RESEARCH RECOMMENDATIONS

The scope of this thesis was to survey building projects based on traditional procurement method in twin cities i.e. Islamabad and Rawalpindi. Further study on these lines can be carried out in other parts of the country as well in order to get wider viewpoint of the contractors. This study provides a basis to evaluate key stakeholders performances on infrastructure projects (roads, bridges, dams etc.) other than building projects.

5.4.1 Percentage for H&S Expenditure

To further the recommendations, it should be recognized that a certain percentage of the total cost of the project should be kept for the building construction project. The amount disclosed in Pak-rupees is to be disclosed in the bid so that a set amount of money is spent towards the health and safety of the construction projects. This will cap the amount of money which is recognized as a cost of health and safety that is to be spent on the H&S at the construction project site and will be strictly monitored by the employer and the consultant. The contractor will be bound contractually and financially to comply with the Health and Safety regulations.

During interviews with some of the biggest names in the construction industry, the contractors recognized that cost spent towards the PPE and site security/barricading is not an issue. This is due to the fact that is an initial fixed cost and is not recurring. Recurring costs take a major toll on the construction company's profits, therefore, they avoid recurring expenses, such as H&S personnel salaries and housekeeping costs to name a few. If these recurring costs are imbedded in the 'bid price' as a percentage, then it will be relatively easier for the contractor to incorporate health and safety at the constriction sites with good quality. This will obligate the contractor to implement health and safety procedures and keep-up with his health and safety record keeping. This will ensure that the construction site staff is well informed of the health and safety regulations and will be well educated and trained. This is

will leave no options, excuses or loopholes for the contracting firm to cut corners and compromise on the health and safety of the hardworking personnel at the construction site.

5.4.2 Pakistan Occupational Safety and Health Authority

The POSHA would be responsible for regulating the health and safety related issues in Pakistan, for example OSHA is for USA. It is evident from the site visits and interviews that a government body to regulate, monitor and implement is required for better health and safety at the construction sites in Pakistan.

POSHA should have regional and citywide offices to better monitor and implement health and safety regulations at the construction sites of Pakistan. Regular visits to the construction sites should be conducted by the POSHA Safety inspectors. POSHA will coordinate with the P.E.C so that the list of contractors and construction projects are up to date since every construction firm has to renew its license yearly. Therefore, this will make it more efficient and effective for the POSHA inspectors to monitor the H&S situations at the construction project sites. The inspectors will have the power to impose any penalties, whether it be financial or in the form of stoppage of works, at the construction project sites.

The POSHA inspector will have access to all areas at the construction site and can talk to anyone for a brief interview about the situation of H&S at the construction site. All data will be recorded by the POSHA inspector and will be directly reported to the P.E.C registrar office. Any penalties will have to be paid off in full to the P.E.C to be qualified for license renewal for the next one year and, therefore, being able to work in Pakistan as a safe constructor. Failure to do so will cause delays in obtaining the P.E.C license certificate. Once all penalties have been paid, the constructor will become eligible for the yearly license renewal. History about any and all penalties will have to be kept in strict secrecy and for only certain eyes only. Employers will have access to the information only for the purpose of prequalification of constructors for a particular project.

5.4.3 Return on Investments (ROI) Analysis

This subject needs to be studied and investigated since the construction companies consider safety as an expense and not an investment; it needs to be proven that return on investment of safety is in fact positive. This requires the identification of direct and indirect costs of safety at the construction sites. This particular research requires time since costs are sensitive matter for the construction companies and the identification of dead costs or the

money spent towards matters that can be avoided after identification. Again, it should be reminded that implementation and monitoring of safety at the construction sites reaps long term benefits and the effects are evident if and when given time. It is worth the mention that intangible benefits may outweigh the tangible benefits but this can only be perceive and cannot be deduced in monetary and quantified terms.

5.5 SUMMARY

As evident from the gathered data analysis, it is recommended that training and education regarding keeping our construction sites healthy and safe should be the top priority of all employers, consultants, and contractors in Pakistan.

It is recommended that all construction firms, irrespective of size and location, should be registered as a safe or an unsafe contractor, which ever case might be, with the Pakistan Occupational Safety and Health Authority (POSHA). Only a governmental regulatory authority can make it possible to safe-guard the workers at the construction sites.

Furthermore, a capped percentage or a lump-sum amount should be disclosed during the bidding phase of the project so that the financial obligation of the contractor is fulfilled and there are no excuses for compromising on the up-keep of the health and safety of the site staff and personnel.

Apart from the above briefly discussed points, the economic benefits of health and safety will become evident in the long run for the construction companies once they realize how effective a formal health and safety management system can prove to be for them. Implementation of H&S starts with the investment in Personal Protective Equipment (PPE) and once the ball gets rolling, one never knows how far it will go. Initial investment in PPE will make the construction companies realize how keeping up with an H&S system can reap benefits in the long-run after ‘economies of scale’ comes into play.

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APPENDIX I: LIST OF BUILDING PROJECTS

CONSTRUCTION COMPANY NAME	PROJECT
SKYWAYS (PVT.) LTD.	CINEPLEX CINEMA, I-8
SKYWAYS (PVT.) LTD.	PLAY LAND, I-8
SKYWAYS (PVT.) LTD.	4 STORIED RESTAURANT, I-8
SKYWAYS (PVT.) LTD.	SUPER MARKET,I-8
SKYWAYS (PVT.) LTD.	EOBI OFFICE, I-8
Moinsons (Pvt.) Ltd.	HBFCL Building, I-8
Moinsons (Pvt.) Ltd.	Statelife Insurance Tower, Blue Area
GUARANTEE ENGINEERS (PVT.) LTD	IMMIGRATION TOWER, H-8
SKYWAYS (PVT.) LTD.	SHEIKH ZAYED INTL. ACADEMY, H-8
USMANI ASSOCIATES	MINISTRY OF SCIENCE & TECHNOLOGY, G-5
IZHAR CONSTRUCTIONS (PVT.) LTD	PTET TOWER, BLUE AREA
GUARANTEE ENGINEERS (PVT.) LTD	GRAND HYAAT HOTEL AND APARTMENTS, G-5
AL-GHURAIR GIGA PAKISTAN (PVT.) LTD	LINGAM TOWER, DHA PHASE II
AL-GHURAIR GIGA PAKISTAN (PVT.) LTD	GULMOHAR TOWER, DHA PHASE II
AL-GHURAIR GIGA PAKISTAN (PVT.) LTD	WTC, DHA PHASE II
AL-GHURAIR GIGA PAKISTAN (PVT.) LTD	DEFENCE RESIDENCY
SHAHZAMAN CONSTRUCTION (PVT.) LTD	JUDICIAL COMPLEX, PHASE I
SHAHZAMAN CONSTRUCTION (PVT.) LTD	JUDICIAL COMPLEX, PHASE II
SHAHZAMAN CONSTRUCTION (PVT.) LTD	NATIONAL ACCOUNTABILITY BUREAU, G-5
SHAHZAMAN CONSTRUCTION (PVT.) LTD	ISLAMABAD HELIPAD, H-6
IZHAR CONSTRUCTIONS (PVT.) LTD	STAFF RESIDENCES CAT. 1 & 2 BANGLOES NUST CAMPUS, H-12
IZHAR CONSTRUCTIONS (PVT.) LTD	RESIDENCES AND APARTMENTS CAT. 3
IZHAR CONSTRUCTIONS (PVT.) LTD	RESIDENCES AND APARTMENTS CAT. 4 & 5
IZHAR CONSTRUCTIONS (PVT.) LTD	ATTAR-1 NUST BOYS HOSTEL, H-12
IZHAR CONSTRUCTIONS (PVT.) LTD	ATTAR-2 NUST BOYS HOSTEL, H-12
IZHAR CONSTRUCTIONS (PVT.) LTD	GHAZALI-2 NUST BOYS HOSTEL, H-12
IZHAR CONSTRUCTIONS (PVT.) LTD	NUST PRINTING PRESS BUILDING (SMME), H-12
IZHAR CONSTRUCTIONS (PVT.) LTD	NUST EXAMINATION HALL, H-12
IZHAR CONSTRUCTIONS (PVT.) LTD	NUST IMEDOR
IZHAR CONSTRUCTIONS (PVT.) LTD	NUST CONSTRUCTION OF BOUNDARY WALL, H-12
MUMTAZ CONSTRUCTION COMPANY	COMMERCIAL PLAZA IN RAWALPINDI
MUMTAZ CONSTRUCTION COMPANY	WATER WORKS AT ANCHORAGE SIHALA, PAKNAVY
M.N. CONSTRUCTIONS	MINISTRY OF JUSTICE BUILDING, G-11

CONSTRUCTION COMPANY NAME	PROJECT
QAVI ENGINEERS (PVT.) LTD.	NESPAK HOUSE, ISLAMABAD
QAVI ENGINEERS (PVT.) LTD.	HIT COMPLEX, TAXILA
HABIB RAFIQ (PVT.) LTD	ISLAMABAD STOCK EXCHANGE TOWER, BLUE AREA
HABIB RAFIQ (PVT.) LTD	Construction of New Parliament Lodges
GUARANTEE ENGINEERS (PVT.) LTD	FFC SONA TOWER, RWP
BUILDERS ASSOCIATES (PVT.) LTD.	EOBI House, ISLAMABAD
BUILDERS ASSOCIATES (PVT.) LTD.	PTET Tele-House, ISLAMABAD
BUILDERS ASSOCIATES (PVT.) LTD.	OEC Tower, ISLAMABAD
IZHAR CONSTRUCTIONS (PVT.) LTD	FFBL HEAD OFFICE BIULDING, DHA-II
IZHAR CONSTRUCTIONS (PVT.) LTD	SILVER OAKS APARTMENTS, F-10 ISLAMABAD
INTERHOM (PVT.) LTD.	NEW PAKISTAN SECRETARIAT, ISLAMABAD
SHACHAL CONSTRUCTIONS (PVT.) LTD.	CONSTRUCTION OF BOUNDARY WALL, FATIMA JINNAH UNIVERSITY, RWP
KESTRAL (PVT.) LTD	UNMOGIP, DIPLOMATIC ENCLAVE
KESTRAL (PVT.) LTD	EMAAR MODEL HOUSES, EMAAR CITY
DARWISH ENGINEERS (PVT.) LTD.	SMME-CENTRAL WING, NUST MAIN CAMPUS
DARWISH ENGINEERS (PVT.) LTD.	SMME-EAST WING, NUST MAIN CAMPUS
TAHIR BUILDERS (PVT.) LTD.	PRINTING PRESS, NUST MAIN CAMPUS
TAHIR BUILDERS (PVT.) LTD.	RAZI-I HOSTEL, NUST MAIN CAMPUS
TAHIR BUILDERS (PVT.) LTD.	RAZI-II HOSTEL, NUST MAIN CAMPUS
BUILDFAST COUNTRYWIDE (PVT.) LTD	NUST GYMNASIUM, H-12
BUILDFAST COUNTRYWIDE (PVT.) LTD	NUST AUDITORIUM, H-12
BUILDFAST COUNTRYWIDE (PVT.) LTD	NUST S.A.D.A., H-12
BUILDFAST COUNTRYWIDE (PVT.) LTD	WORLD BANK, G-5
BUILDFAST COUNTRYWIDE (PVT.) LTD	UET GYMNASIUM, UET TAXILA
BUILDFAST COUNTRYWIDE (PVT.) LTD	NUST WATER WORKS, H-12
KESTRAL (PVT.) LTD	FATIMA JINNAH UNIVERSITY, RWP
BUILDFAST COUNTRYWIDE (PVT.) LTD	STAFF APARTMENTS AT ISLAMABAD CLUB, ISLAMABAD
BUILDFAST COUNTRYWIDE (PVT.) LTD	JUNIOR MANAGER RESIDENCES AT ISLAMABAD CLUB, ISLAMABAD
BUILDFAST COUNTRYWIDE (PVT.) LTD	RIMMS BUILDING, NUST MAIN CAMPUS
BUILDFAST COUNTRYWIDE (PVT.) LTD	IGIS BUILDING, NUST MAIN CAMPUS
BUILDFAST COUNTRYWIDE (PVT.) LTD	IRR BUILDING, NUST MAIN CAMPUS
BUILDFAST COUNTRYWIDE (PVT.) LTD	O.H. & U.G. WATER TANKS AT ISLAMABAD CLUB, ISLAMABAD
BUILDFAST COUNTRYWIDE (PVT.) LTD	SEECS - NUST
GULZARI ASSOCIATES	GIRLS HOSTEL AT ISLAMIC UNIVERSITY, H-10
GULZARI ASSOCIATES	GIRLS HOSTEL AT ISLAMIC UNIVERSITY, H-10
GULZARI ASSOCIATES	BOYS HOSTEL AT ISLAMIC UNIVERSITY, H-10
ZOOM CONSTRUCTIONS (PVT.) LTD.	PAKISTAN SPORTS BOARD GYMNASIUM, ISB

SCHOOL OF CIVIL & ENVIRONMENTAL ENGINEERING

APPENDIX II: QUESTIONNAIRE COVERING LETTER

Dear Sir,

Performance and success of a project is generally evaluated on the basis of cost, quality and time in which the contracted scope of works is achieved in Pakistan. However, the element of safety is proving to be an aspect that cannot be ignored. The safety of the workers is an underlying indicator of a projects success.

In partial fulfillment of the requirements for the degree of Master of Sciences in Construction, engineering and Management from NUST, H – 12, Islamabad, the undersigned intends to conduct a field survey and developed a questionnaire to deduce the trend for the cost of health and safety implementation amongst construction companies' construction projects. As a representative of the contractor, you are kindly requested to take few minutes from your precious time to estimate some of the required costs of implementing health and safety at your construction site by completing the attached form.

All information provided in this regard will only be used for academic purposes and kept in utmost confidentiality.

Thank you for your support and cooperation in advance.
Yours sincerely,
Emad Faheem Faruqui
Post Graduate Student – Construction Engineering & Management
Cell. No. 0332 – 327 – 8784
Email: emad.faruqui@yahoo.com

Dr. Rafiq Choudhry (Ph. D)
Thesis study Advisor
National Institute of Transportation (NIT)
School of Civil & Environmental Engineering (SCEE)
NUST, Islamabad

APPENDIX III: QUESTIONNAIRE

SECTION A: GENERAL INFORMATION

1. Which PEC Contractor's category do you belong to?

C – 1	C – B	C – A
❑	❑	❑

2. Please fill in the following general information relevant to your construction site.

Construction Firm Name	
Site	
Salaried Staff	
Daily Wages Staff/Labor	

3. What was your construction project's cost? ***Please provide a response for your site***

PKR.

SECTION B. TYPES OF HAZARDS

1. Which of the following hazards are of particular concern at your construction project? *Tick all the boxes relevant to your project site below.*

Chemicals	❑
Restricted spaces	❑
Dust	❑
Discharge of material	❑
Electricity	❑
Immoderate temperatures	❑
Dropping temperatures	❑
Fire	❑
Smoke	❑
Labor-intensive work	❑
Moving parts of machinery	❑
Noise	❑
Unfavorable Lighting	❑
Pressure systems	❑
Psychosomatic dangers	❑
Slipping/ tripping dangers	❑
Elevated work locations	❑
Vehicles / Transportation	❑
Hand / Arm Vibration	❑
Whole Body Vibration	❑

SECTION C. HEALTH AND SAFETY MANAGEMENT PROCEDURES

1. Tick the appropriate box for which your construction site keeps records of.

Accidents	❑
Ill Health	❑

2. Are formal health and safety management systems in place at your site? ***Please tick the appropriate box:***

Yes	❑	***If YES, GO TO 4.***
No	❑	***If NO, GO TO 5.***

If you do NOT record this data please go to SECTION D

If you answered 'YES' to question '2', please continue with Section C.

3. We are interested to know what your health and safety systems include***. Please tick all boxes that apply in the table below:***

A delegated health and safety person	❑
An Accident Reporting system	❑
Standardized risk evaluation	❑
Safety Performance evaluation	❑
Performance targets / objectives	❑
Written Health and Safety policy	❑

4. Please tick the boxes that apply to your construction site**.**

Experience of accidents within the construction firm	❑
Health and Safety publicity	❑
Insurance Cost	❑
Legal obligation	❑
Consultant / Client pressure	❑
Company's top management Priority	❑
Union pressure	❑
Investigation by police	❑
Your construction firm reached a particular size	❑

SECION D. ACCIDENTS AND ILL HEALTH

1. We are interested to know how many accidents have occurred on this construction site.

Severity of injury	Number of accidents	Estimated cost (PKR.)
Less than 1 day off work		
1 to 3 days off work		
4 or more days off work (not including main injuries)		
Non fatal chief injuries; any injury needing admission to hospital for over 24 hours.		
Fatalities		

SECTION E. IMPLEMENTATION COSTS

Fill out this section if you have answered YES to Question 2 of Section C. If NOT, proceed to the next section.

1. Please estimate the money spent on health and safety on this project? ***Please tick the box that applies to your construction project site. You should include training fees, employee time, capital and equipment costs, etc.:***

Cost Category	Cost		Estimated Cost (PRs.)
1	Less than Rs. 10,000	❑	
2	Rs. 10.001 – 30,000	❑	
3	Rs. 30,001 – 60,000	❑	
4	Rs. 60,001 – 90,000	❑	
5	Rs. 90,001 – 120,000	❑	
6	Rs. 120,001 – 150,000	❑	
7	Rs. 150,001 – 180,000	❑	
8	More than 180,000	❑	
9	Do not know	❑	

2. List any ***three*** features of health and safety that you spend the most on this project?

1	
2	
3	

3. ***Please tick one box if the implementation of H&S has affected your construction site in any way.***

Aspect of Health and Safety	Increased	No effect	Decreased
Reimbursement claims	❑	❑	❑
Insurance premiums	❑	❑	❑
No. of staff utilize ed	❑	❑	❑
Product damage/ waste	❑	❑	❑
Performance / Productivity of employees	❑	❑	❑
Nonattendance due to illness	❑	❑	❑
Staff confidence	❑	❑	❑
Staff yield	❑	❑	❑
Time lost due to accidents	❑	❑	❑

4. On balance, in your opinion, at your construction project, have the:

Costs of implementing health and safety systems outweighed the benefits	❑
Benefits outweighed the costs	❑
Costs and benefits broken even	❑
Too early to say	❑
Don't know	❑

5. What mode of information/advice is most suitable that apply to your construction firm/project construction site?

1.	**Internet**	❑
2.	**Books/magazines**	❑
3.	**Attending symposiums / seminars**	❑
4.	**Videos**	❑
5.	**Telephone**	❑
6.	**Personal visit**	❑

6. Is there any other information or advice you would like to give?

7. Were there any frustrations / barriers that you faced when you first considered implementing health and safety systems? ***Please tick all boxes that apply in the table below:***

Deficiency of information / guidance	❑
Deficiency of help from on-site staff.	❑
Knowledge / skills deficiency in the construction firm	❑
Time required	❑
Costs	❑
Others (Please Specify)	❑

SECTION F. COST OF SAFETY OF EMPLOYED WORK FORCE

Please consider the following activities (**I – III)** to answer the following questions for your construction project.

i. **Working at heights (Formwork, Steel Fixing, and Concrete Pouring);**
ii. **Working at ground level (Formwork, Steel Fixing, and Concrete Pouring);**
iii. **Working below ground level (Formwork, Steel Fixing, and Concrete Pouring).**

1. Have you taken any applicable action to manage manual handling risks at this construction project?

YES	❑	***If YES, continue***
NO	❑	***If NO, proceed to the next section***

2. What did this action concern and what were the cost implications? **Indicate the cost using the categories below and provide an estimated cost if you can.**

Aspect of Health and Safety	**Estimated Cost (PRs.)**
Employment of a safety professional	
Performing risk assessments of labor intensive asks	
New or changes to equipment	
Stipulation of personal protective equipment (PPE)	
Safety preparation for employees	
Safety evaluation and monitoring safety controls	

SECTION G. SIGNAGE

This section includes assessment of your construction firm on this construction project to provide the proper signage to educate and mark which zones are safe and which zones are not.

1. Does your construction project have signs, caution boards, and other warning signs to warn employees and bystanders of the dangerous zones of the construction project site?

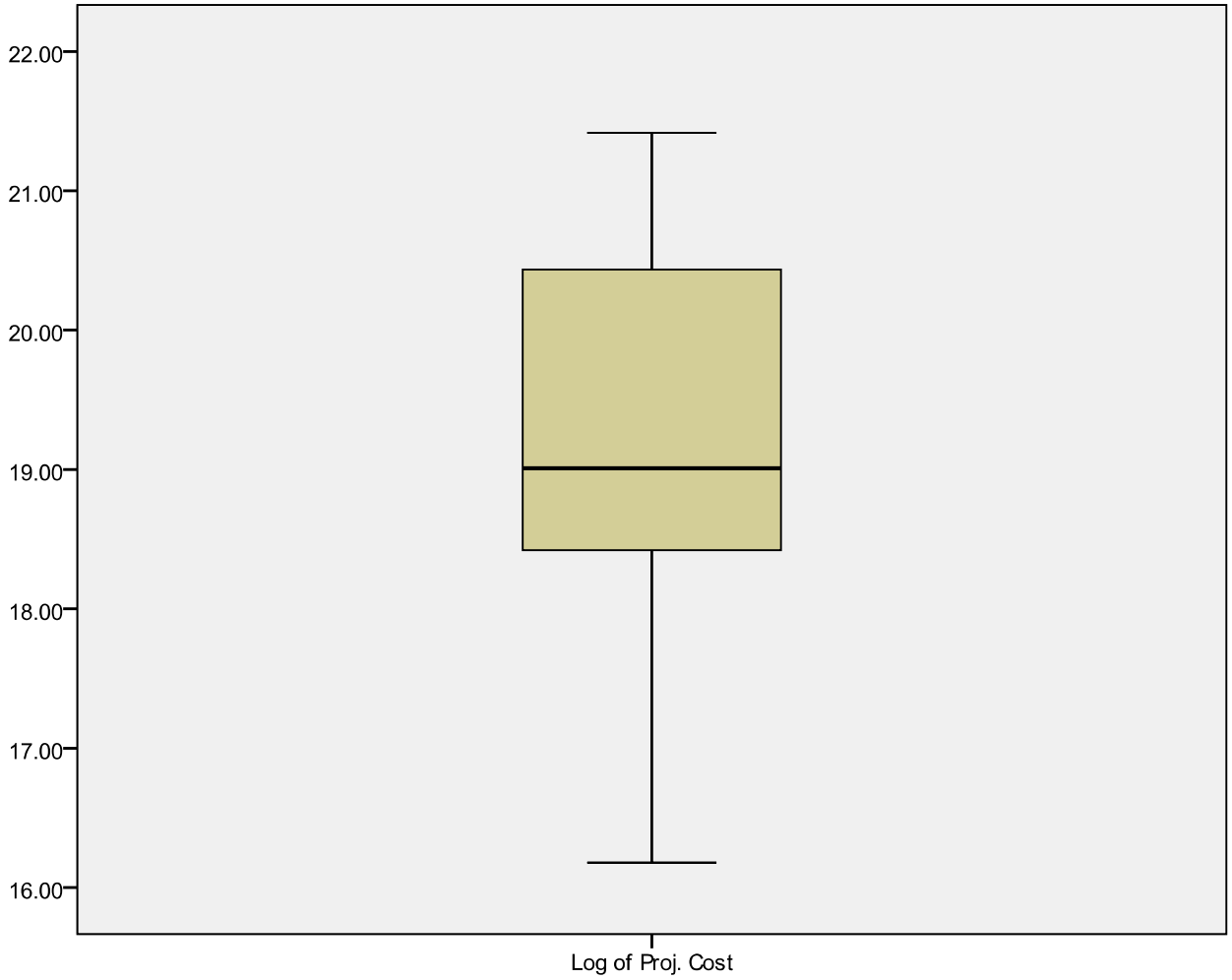
YES	❑	***If YES, continue***
NO	❑	***If NO, END***

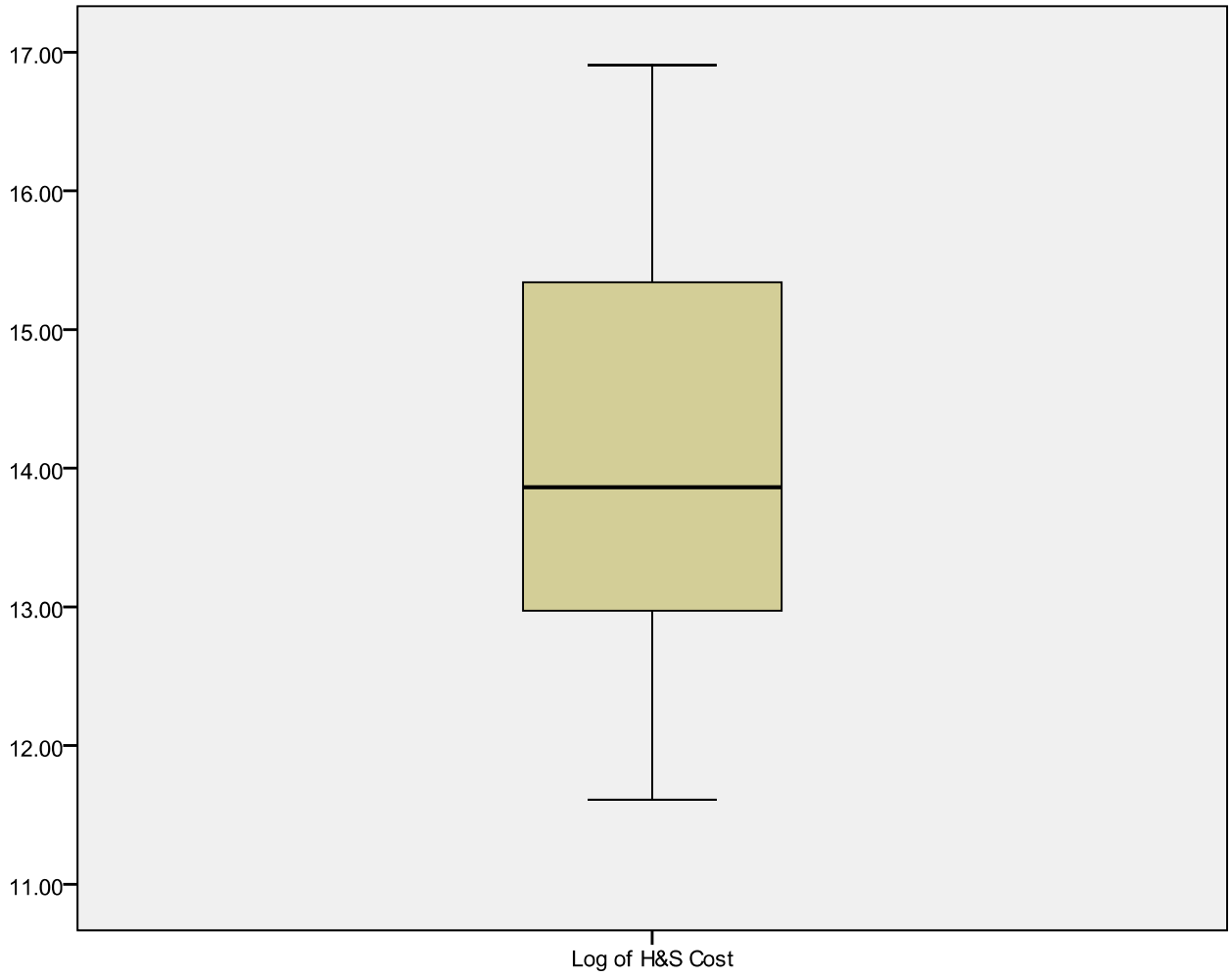
2. What changes in particular did you see after implementing signage on your construction project? **Briefly explain please.**

3. Tick the appropriate task involved for implementing signage and disclose the costs involved.

Aspect of Health and Safety to implement and monitor Signage	Tick if action taken	Estimated Cost (PRs.)
Employment of a specialist		
New equipment or changes to existing equipment		
Training and information for employees		

APPENDIX V: CHECK FOR OUTLIERS




17.00
16.00
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