

**RISK MANAGEMENT ON BUILDING CONSTRUCTION**

**PROJECTS IN PAKISTAN**

by

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A thesis submitted in partial fulfillment of

the requirements for the degree of

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in

**Department of Construction Engineering and Management**

**National Institute of Transportation**

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*This is to certify that the*

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Has been accepted towards the partial fulfillment

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**DEDICATED**

**TO**

**MY PARENTS, TEACHEARS**

**AND**

**MY FAMILY**

## **ACKNOWLEDGEMENT**

First I want to thank Allah Almighty Who gave me the opportunity and ability to complete my master degree. I also want to thank my parents and family, without their prayers it would not have been possible and they were always there to support me through the hardships that I have been facing in my way.

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## **ABSTRACT**

Risk management is an important field of construction industry and has gained more importance internationally due to the latest researches carried out on large scale. In Pakistan, however, it is relatively a new field which requires more attention to get benefit out of it. The building construction projects in Pakistan are facing a number of risks which are having negative effects on the project objects like time, cost and quality etc. This study is based on the findings of the questionnaire base survey on risk management on building projects in Pakistan reporting the significance of different kind of risks, their ultimate responsibility and the effectiveness of some most common risk management techniques practiced in the industry. Two type of risk management techniques were considered i.e. preventive techniques which can be used before the start of project to manage the risks which are predicted to come up during project execution. Remedial techniques which are used during execution phase once risk has already occurred. The study revealed that the financial issues for the projects, accidents at site and the defective design are the most significant risks effecting most of the building projects. It is further reported that for most of the risk occurring at sites during implementing phase like issues related to the subcontractors, labors, machinery, material availability and quality, contractor is responsible for managing them while client is responsible for the risks like financial issues, issues related to the design documents, changes in codes and regulations and scope of work. The results of analysis further reported that the production of proper schedule by getting updated data of the project and guidance from the previous similar projects are the most effective preventive risk management techniques while that of close supervision and coordination within the projects are the most effective remedial risk management techniques. It may be concluded that the most significant risks must be managed with greater effort to reduce/eliminate their effects on the project. As the study concludes that preparation of proper schedule and good coordination during implementation stage are very important thus will help project managers focus on the critical areas for better management of the project.

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## **INTRODUCTION**

### **1.1 RISK**

Risk is defined as exposure to loss/gain, or the probability of occurrence of loss or gain multiplied by its respective magnitude. Events are said to be certain if the probability of their occurrence is 100 percent or totally uncertain if the probability of occurrence is 0 percent. In between these extremes the uncertainty varies quite widely (Jaafari 1999). Risk can be explained as “the chance of something happening that will have an impact on objectives, may have positive or negative impact” (Smith, 1999), “a combination of hazard and exposure” Chicken and Posner (1998). While there are various definitions of risks, there are different ways for the categorization of these risks as well. As some categorize risks in construction projects broadly as internal and external risks while others classify risks in more detailed categories like political risks, financial risks, market risks, intellectual property risks, social risk, safety risks etc. (Songer et al. 1997). The construction business like any other business is risky. However, construction projects are perceived to have more inherent risks due to involvement of many contracting parties such as owners, designers, contractors, subcontractors, suppliers etc. (PMI 2004). Construction activity is particularly subjected to more risks than other business activities because of its complexity; a construction project usually requires a multitude of people with different skills and interests and the coordination of a wide range of disparate, yet interrelated, activities.

The unique features of a project and many other external uncertainties further compound such complexity. It is not uncommon to find construction projects with cost overrun, time delay and poor quality caused by various risks (Shen, 1997). Owing to the importance of risks and its effects on the projects, there is need for effective analysis and management of these risks for good performance on the projects. Construction projects have a lot of risk involved in their starting phase from day one until its completion. It has been said by experts that contractors have to cater the risk throughout project implementation where as owners have to pay for risk. The process of taking a project from its planning phase up to its completion is not only complex rather risky in nature. A project requires bunch of multi-skilled, dynamic, and diversified staff to achieve required goals of any project, in the presence of number of unforeseen risk factors.

Research indicate that entire supply chain has a responsibility to work collectively to manage project risks and that clients, contractors, consultants, suppliers and subcontractors all contribute to this problem(Kumeraswamy et al. 2000: Loosemore 2000). This mean that all the parties involved in the project team contribute to different kind of risk. One common risk is that of bad communication among the different parties which leads to negative impact on the project. It is the responsibility of each and every party to take effective part in identification and management of these risks. One common problem is that there is no enough time at the bidding stage to study and assess all the project documents and forecast and manage risks on the basis of that. The other problem is that some key personals are

not included in the team at the bidding stage, who have to ultimately take charge of the project and whose input at the bidding stage could have been beneficial. Also in the competitive bidding process, most of the projects are allotted to the bidders on the lowest cost criteria so to have competitive bid, the bidders have very little interests in considering different type of risks for preparation of bid in a worry that their bid will be too high then and will reduce chance of their selection. Thus schedules and estimates are prepared without consideration of effects of most of the risks into it, therefore, once the project starts and different kind of risks arises, creates problem for the project implementation team to perform activities according to the schedule and allocated budget giving rise to time and cost overruns. The risk perception is an important factor or risk management process, the attitude of the industry practitioners toward different type of risks regarding its impact on the project. A lot of work has been carried out on this important field of risk and its management . Therefore, the surveys have been conducted in several countries at different times including the United States, the United Kingdom, Saudi Arabia, Australia, Canada and Israel (Lyons and Skitmore, 2004) but most of the work is conducted in the developed and very less work has been done in developing countries like Pakistan. Thus this survey is conducted to get the people perception regarding different type of risks so that they can be effectively managed.

## **1.2 RISK MANAGEMENT**

Risk is inherent and difficult to deal with, and this requires a proper management framework both of theoretical and practical meanings. Risk management is “a system which aims to identify and quantify all risks to which the business or project is exposed so that a conscious decision can be taken on how to manage the risk. Significant improvement to construction project management performance may be achieved from adopting the process of risk management” (Flanagan and Norman, 1993). According to AS/NZS 4360:1999 “Risk management is a logical and systematic method of establishing the context, identifying, analyzing, evaluating, treating, monitoring and communicating risks associated with any activity, function or process in a way that enable organizations to minimize losses and maximize opportunities”. Risk analysis and management are important part of decision making process in construction company.

The construction industry and its client are widely associated with high degree of risks due to nature of construction business activities, processes, environment and organizations (Kartam and Kartam 2000), but the construction industry has poor reputation in coping with risks, many projects fails to meet deadlines and cost targets. Clients, contractors, the public and others have suffered as a result (Edwards 1995). In view of that the construction is a high risk business which haunts every participant in the business, an effective analysis and management of construction associated risks remains a big challenge to the industry practitioners.

To manage different type of risks, different approaches can be used such as risk avoidance, risk reduction/elimination, risk retention, risk transfer, risk sharing etc. Broadly speaking, the risk management techniques can be separated into two main categories that are Preventive risk management techniques and Remedial risk management techniques. From this study point of view these two main categories have been considered for purpose of the survey. The perception regarding the effectiveness of different type of risk management techniques have been studied and summarized accordingly. The two main categories of risk management techniques considered in this survey are described in some detail as follows:

### **1.2.1 Preventive Risk Management Techniques**

As it is clear from the very name that these techniques are used to preventive the occurrence of the risk that are expected to arise. Loosemore et.al. (2006) concluded that the best way to manage a risk is to avoid it. The risk can be avoided at the planning stage before the start of projects by incorporating necessary changes considering the necessary risks. Preventive management techniques are used at the planning stage to avoid/minimize necessary risk by considering them before start of the project and planning for it.

### **1.2.2 Remedial Risk Management Techniques**

Remedial risk management techniques are those techniques which are used to reduce the negative effect of the risk that have already occurred. Although with the application of preventive risk management techniques some risks can be avoided but all the risks cannot be eliminated and will arise from time to time during the execution of project for which remedial management techniques are used to reduce the risks and ideally eliminate them. In Saudi Arabia, Assaf and Al-Hejji (2006) found that only 30 percent of construction projects were completed within the scheduled completion dates and that the average time overrun was between 10 percent and 30 percent.

For effective management of the risks, it is important that how the people in this industry perceive about each risk. The object of this paper is to know the attitude of building construction practitioners towards different type of risks and their respective responsibility. It also presents the most effective techniques in preventing/mitigating different type of risks.

### **1.3 OBJECTIVES**

The main goal of this study is to have insight into risks in building construction projects in Pakistan and risks management techniques adopted to manage them. The objectives of this study are as follows:

1. To identify risks on building projects so that they can be managed in achieving project objectives.



2. To identify the major risk management techniques being practiced in managing risks in the construction industry of Pakistan.
3. To find risk ranking and investigate their responsibilities among clients and contractors for managing risks effectively.
4. To investigate effectiveness of risk management techniques for managers to manage risks more efficiently.

#### **1.4 SCOPE**

The study is aimed at study of the risks that exists in the construction industry of Pakistan and the risk management techniques in practice to manage these risks. The scope of study is limited to the building construction projects only which are in implementation phase and the offices of clients, contractors and consultants in Rawalpindi and Islamabad. Different construction projects and offices of clients, contractors and consultants in Rawalpindi and Islamabad area are visited for distribution of the questionnaire and getting feedback. The questionnaire will also be distributed in the clients, consultants and contractors offices who are dealing with the building construction projects for collection of the necessary data. The questionnaires will be filled by minimum engineer level position with some understanding of the risks and the risk management techniques as there is very little awareness regarding risks and its management in construction industry of Pakistan and the position below that of engineer level are not expected to provide the required level of input.

## **1.5 EXPECTED OUTCOMES**

As per the objectives already defined, first expected outcome will be a list of the risks that exist on the building construction projects. It will be prepared with the help of extensive literature review and discussion with the industry professional to finalize the list of the most applicable risks. The second outcome will be the list of risk management techniques used in the industry for management of these risks. This will also be prepared in the same way as that of the risks. Then these lists will be incorporated into the questionnaire for required data collection. Once the questionnaires are collected and data compiled there after the significance of risks will be determined and the output will be the list of the risks organized according to their relative significance. The responsible parties for each risk will be determined with the help of data collected thus segregating the lists according to their responsible party. The last outcome will be the list of the risk management techniques organized according to their effectiveness in the management of the risks on the basis of the respondents data collected through the survey.

## **LITERATURE REVIEW**

### **2.1 INTROCUCTION**

This chapter briefly presents the review of research literature already conducted on the topic of risk and its management in construction industry. Researches on this topic have been conducted in different countries mostly in the developed countries in which different aspects of risks and their management are studied and presented. The study of the previous research literature will help in understanding and clarification of the topic and will help in development of framework for this study to be conducted on the building construction sector of Pakistan's construction industry.

### **2.2 RISK**

Risk is the chance of anything happening which will have impact on the project objectives which may be positive or negative (Smith, 1999), combination of the hazard of the risk and the time of exposure to that risk (Chicken and Posner, 1998). It can also be explained as the likelihood of the occurrence of a definite event/factor or combination of events/factors which occurs during the whole process of construction to the detriment of the project (Faber, 1979). Thus we can say that the risk is any undesirable situation that will affect the project either in positive or negative manner. From this study point of view we will consider and study only the negative effective

that the projects have due to different type of risks. Risk is perceived “as the potential for the unwanted or negative consequences of an event or activity” (Rowe, 1977), “a combination of hazard and exposure”(Chicket JC, Postner T. The Philosophy of risk. Thomas Telford;1998). Recent researches tends to emphasize the two edged nature of risks, such as “a threat and a challenge” (Flanagan and Norman, 1993), the chance of something happening that will be some impact on the project objectives may those be positive impact of negative impact(AS/NZS 4360), combination of the probability or frequency of occurrence of any defined threat and the magnitude of its consequence when occurred (Association of PM, 2005). Project risk can also be defined as an uncertain event or condition that, if it occurs, has positive or negative effect on at least one project objective such as time, cost, scope or quality (Project management institute standard committee, a guide to PMBOK, PMI; 2004). From these studies this is also clear that any risk can be separated into two portions that is the consequence of that risk and the chance or probability of its occurrence. Thus those risks with high probability of occurrence and severe impacts on the projects are the most significant risks and will affect the project objectives the most and the one with lesser probability and consequence will be the least significant risks and will affect the project objectives to the lesser extent.

Pender (2001) in his study describes that the projects are unique by definition and knowledge of future is limited. In this climate of uncertainty, decision become more demanding and the subject of risk become more important because of anticipation of possible deviation from project objectives. Risks and uncertainties are obvious in all

the construction activities (Construction industry institute (CII), 1989), a lack of predictability about structure outcome or consequences in a decision or planning situation (Hertz and Thomas, 1983), “the uncertainty associated with estimates of outcomes, there is a chance that results could be better than expected as well as worse than expected” (Lifson and Shaifer, 1982). So we come to the conclusion that reason behind the occurrence of different kind of risks is that there is uncertainty associated with the project future which cannot be predicted with surety although can be judged with certain probability. Thus there is uncertainty left in the judgment regarding the schedule, cost etc. because of the occurrence of different situations that may arise in future. Thus occurrence of different kind of risks is obvious on any projects which need to be managed proactively and reactively.

Researchers divide project risks into internal and external. Internal risks initiate within the project while the external risks occurs due to the project environment in which the project is executed (Aleshin, 2001). Thus we can say that broadly speaking risks can be divided into two categories that are internal and the external risks. The internal risks occur within the project and are project related. These risks are usually under the control of the project teams who are involved in the project while the external risks are the risk occurring outside the project having detrimental effects on the project. These are not under direct control of the project teams as they are occurring outside the project domain. The internal risks are then subdivided according to the party who is the actual originator of those particular risks such as Owner, designer, contractor, supplier etc. The external risks are also categorized as natural, political, social, cultural

and economic etc. which are then subdivided accordingly. The below Fig. is taken from S.M. El-Sayegh (2007) which shows the categorization of risks as discussed above (See Fig. 2.1).

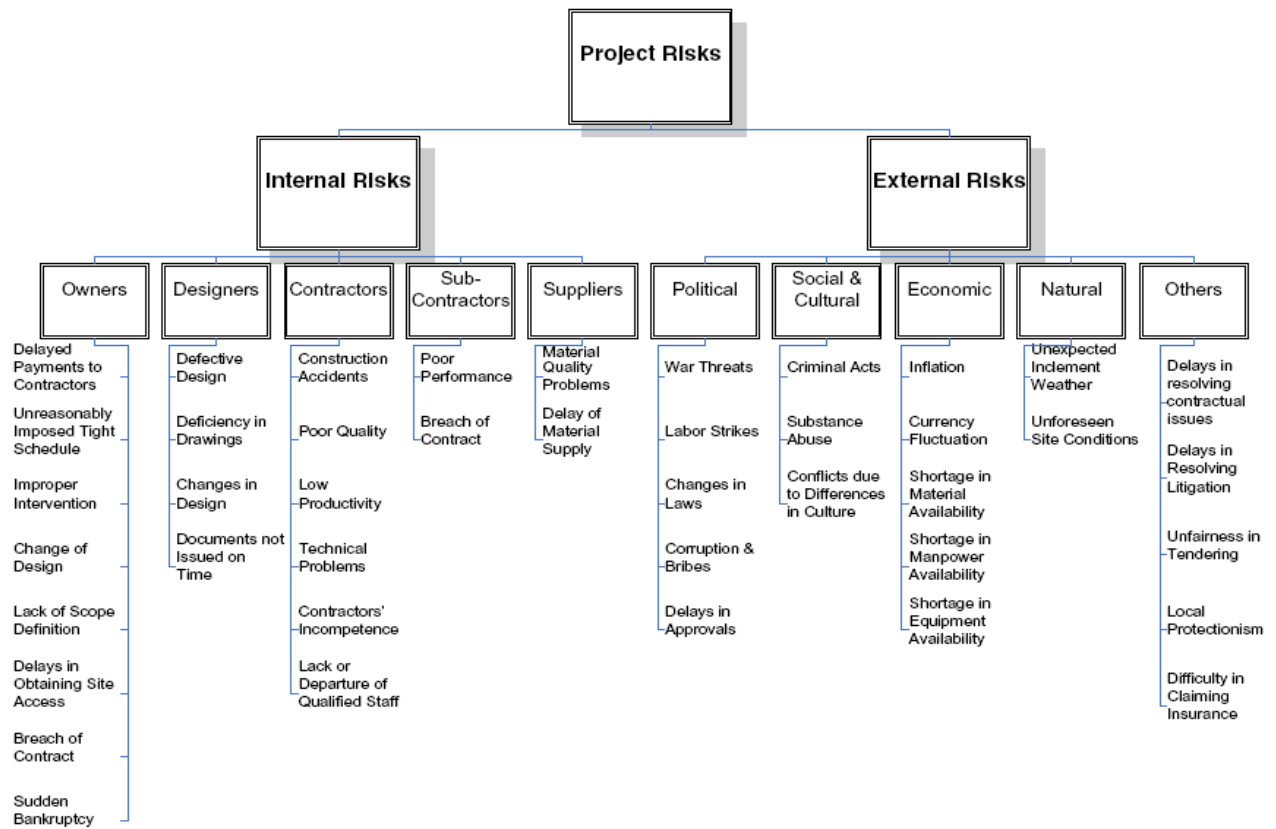


Fig. 2.1: Construction risks categorization (Adopted from S.M. El-Sayegh (2007))

Cost and time overruns have been caused to occur in the projects because of failure to deal with the risks that occurs in the project (Thomas and Perry, 1992). Thus the risks need to be managed proactively and reactively to reduce ideally eliminate their effects. Thus risk management is an important field of the construction projects and if used effectively can avoid projects going out of budgets and schedules.

## **2.3 RISK MANAGEMENT**

“Risk analysis and management are important part of the decision making process in the construction industry. The construction industry and its clients are widely associated with the high degree of risk due to the nature of the construction business activities, process, environment and organization” (Kartam et al., 2001), but the construction industry has a poor reputation in coping with risks, many projects thus fails to achieve cost and time targets for the project. Clients, contractors, the public and others have suffered as a result (Edwards, 1995). “Construction activity is particularly subject to more risks than other business activities because of its complexity; a construction project usually requires a multitude of people with different skills and interests and the coordination of a wide range of disparate, yet interrelated, activities. The unique features of a project and many other external uncertainties further compound such complexity. It is not uncommon to find construction projects with cost overrun, time delay and poor quality caused by various risks” (Shen, 1997). “Despite advances in the art and science of forecasting future events and trends, it is not possible to foreshadow what lies ahead with any degree of certainty and reliability, so the major handicap is the exposure to unknown events, such as presence of covert

objectives” (Fawler and Walsh, 1999), or “a sudden change in safety regulations or introduction of new taxes or other external events” (Morris and Hough, 1987). It is quite clear from these studies that construction is a high risk industry due to the uniqueness of projects and different parties involved in the project making up the project team. Although all the parties are involved in the project and struggle for the successful completion of project, but still every party has their own interests which may be conflicting at times giving rise to different kind of risks which if not managed properly at proper time can affect the project objectives giving rise to time and cost overruns. As a result of this all the parties involved in the project suffer.

Management of risk is to minimize the particular risks, controlling them or sharing them with other parties having better control over them and does not mean to merely passing them off to another party (Edwards, 1992). This mean that passing or transferring certain project risk to other party is not a very good approach towards management of these risks as the other party may not be capable of effectively managing that risks resulting in the project being negatively affected by occurrence of that risk. However for good management of the project risks, the approach of transferring it to the party having maximum control over it can be beneficent e.g. the design documents related risks can be transferred to the consultants as they ha maximum control over it. In a similar way the field activities related risks may be transferred to the contractor and so on.

Risk Management is the system of identifying and quantifying all the risks to with the project is exposed and are expected to occur so that a conscious decision can



be taken to manage the risks (Flanagan and Norman, 1993). Risk management is the formal and systematic process of identifying risks, analyzing them so that it may be responded throughout the lifecycle of the project so that necessary decision can be taken to eliminate its effects, minimize them and/or control them accordingly (Wang et al., 2004). Thus risk management is not a single activity rather it is a complete system which includes identification of risks, analyzing these risks, responding to these risks and continuously monitoring and reviewing the risk responses for effective management of the risks and initiate any additional responses if required.

For the organization to be successful in its projects, it should be committed to proactive management of the risks and following this process consistently (PMI, 2004). “A risk management system should establish an appropriate context; set goals and objectives; identify and analyze risks; influence risk decision making; and monitor and review risk responses” (Akintoye and Maclead, 1997). So we can say that broadly speaking there are two approaches towards the management of different kind of project risk. First one is the proactive approach to manage the risks ahead of their occurrence. This method is used at the planning stage to forecast different kind of risks that may arise during lifecycle of the project and planning for minimizing (ideally eliminating) its effects. The second approach is the reactive approach used for management of the risks once they have occurred. This approach is used at the project implementation stage to manage the already occurred risks so as to minimize its adverse effects on the project objectives.

The need to perform risk management in construction project has risen day by day due to increasing complexity, size, competition, clients-customers requirements, politic-economic problems and heavy physical conditions in such projects (Okmen, 2002). The basic idea is to learn from the experiences and to introduce experience based solutions of how risks could be (or could have been) avoided (Artto, 1997). PMBOK included risk management as one of the nine focuses in project management (the other eight being integration, communications, human resources, time, cost, scope, quality and procurement management) and explains it as a systematic process of identifying the risks, analyzing them, and responding to project risk. It includes maximizing the probability and consequences of positive events and minimizing the probability and consequences of adverse events to project objectives. Thus in construction industry, risk management is one of the important issue which has gained more importance after the recent development and the researchers conducted on it. Risk management can be more effective if the experiences from the previous projects are incorporated into it. Although most of the construction projects are unique in nature, yet they have many similar kind or risk which can be managed in similar manners. So it is quite beneficent if the learning from the previous projects is incorporated in the risk management process of the upcoming project and managing accordingly for better result and more effectiveness of the management process.

The risk management techniques may be classified into preventive and remedial risk management techniques. These are discussed in some details as follows:

### **2.3.1 Preventive Risk Management Technique**

Preventive risk management techniques are those techniques which are used at the planning stage before the start of project to avoid certain kind of risks from the occurrence. Thompson and Perry (1992) concluded that the risk management is most valuable at the early stage of the project that is the proposal stage due to the availability of flexibility in the design and planning to consider different risks and how they can be avoided. So we can say that it is better to plan rather than to react thus planning effectively at the early stage for expected risks ideally to avoid them from occurrence.

### **2.3.2 Remedial Risk Management Technique**

Remedial risk management techniques are those techniques which are used once the risks have already occurred. Although preventive management techniques are used for avoidance of risks and ultimately reduce the project risks but still there are a number of risks which are unavoidable and will occur from time to time at the execution phase of the project. According to a study conducted by Weiler and Chris (1998), around 80 percent of the projects exceeds the scheduled time even with the employment of software techniques for project development. So it is not possible to avoid all the project risks and there is a need to have risk management techniques which have to be employed once the risks have already occurred for reduction of their negative effects on project objectives.

## **RESEARCH METHODOLOGY**

### **3.1 INTRODUCTION**

This chapter describes the methodology followed for achievement of the objectives of this research study. It describes the data collection procedure and the techniques used for the analysis of the data to obtain the results. The chapter describes how the whole process of the study will run, how data will be collected and analyzed to achieve the objectives.

### **3.2 RESEARCH PLAN**

Risk can be explained as “the chance of something happening that will have an impact on objectives, may have positive or negative impact” (Smith, 1999). PMBOK included risk management as one of the nine focuses in project management and explains it as “a systematic process of identifying, analyzing, and responding to project risk. It includes maximizing the probability and consequences of positive events and minimizing the probability and consequences of adverse events to project objectives”. Owing to the importance of risk and the risk management in projects, the study is aimed at investigating the risk faced by the building construction projects in Pakistan and the risk management techniques used to manage these risks. The research plan can be subdivided into four main phases i.e. Preliminary study, Data collection, Data analysis and write-up of the study.

1. In the preliminary study phase, appropriate literature related to the study will be searched in journals and books and reviewed to get the necessary knowledge of the research topic and objectives locked accordingly. The research studies already conducted in the topic will be reviewed in detail for the design of the questionnaire. The questionnaire will then be developed on the basis of the literature review. It will be then discussed with the industry experts at the pilot run stage for necessary improvements and then finalized accordingly to be used in the data collection phase.
2. In the data collection phase, the sole tool for data collection is that of the questionnaire. The questionnaire will be distributed in the construction companies dealing with the building construction projects which included the clients, consultants and that of the contractors. All these companies will be physically visited for any clarification related to any ambiguity faced in questionnaire filling. Once the questionnaires were filled, they will be recollected for the use in the analysis phase.
3. Data analysis phase, composes of the necessary analysis of the data collected through the filled questionnaires. The data will be entered and compiled in the excel sheet for different analysis to be carried on this compiled data. The percentage scoring criteria will be used as a necessary tool for finding the significance of risks and risk management techniques. The percentage scoring is calculated by multiplying the RII by 100 with the help of excel sheet and

risk responsibility also calculated accordingly. Different graphs be plotted for effective display of the results.

4. The last phase is the write-up phase with deals with the publications as per the data collected and analyzed. The results published and discussed in detail and then necessary conclusion and recommendations also published in the same write-up.

The complete study process is shown in the Fig. 3.1 .

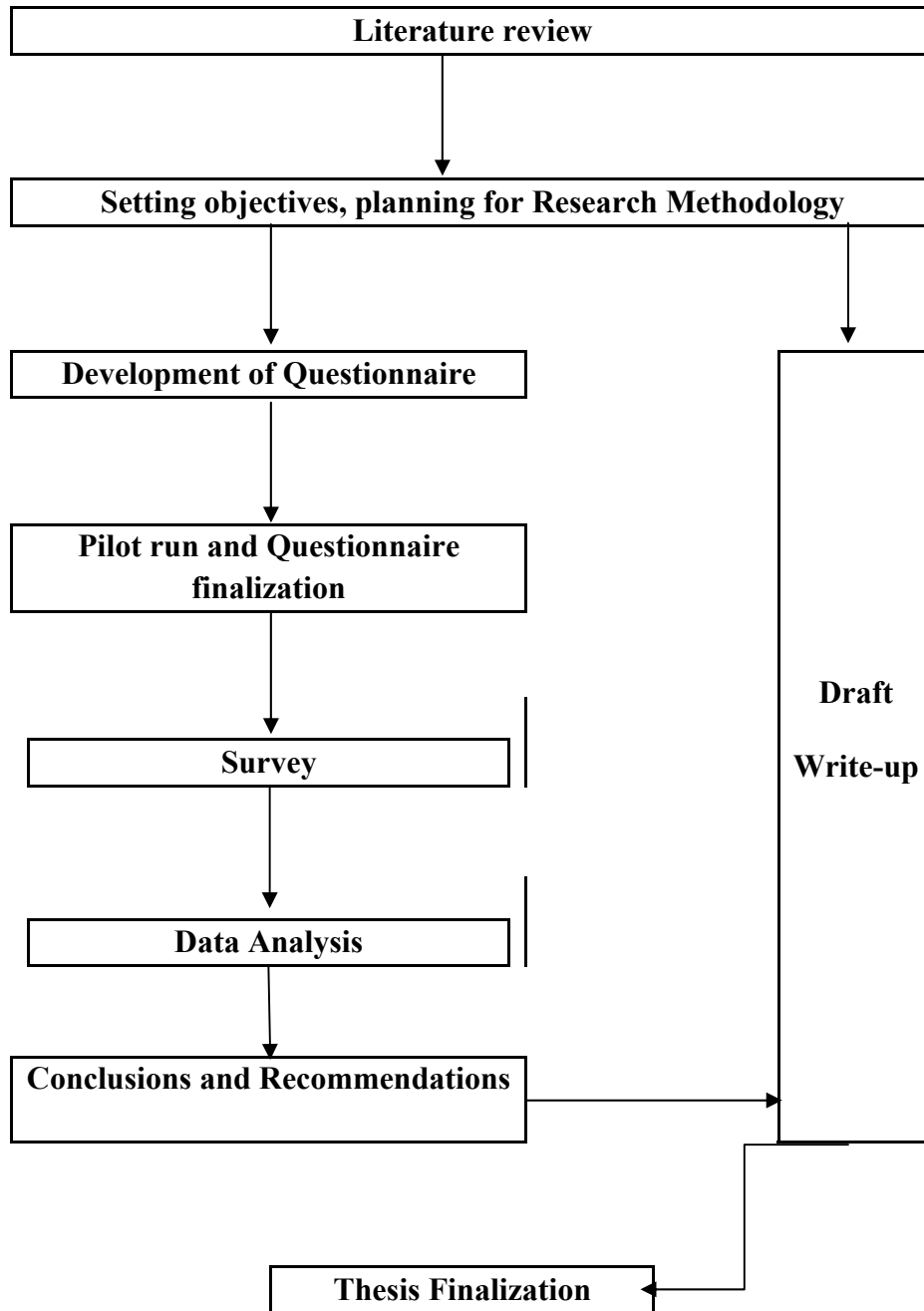


Fig. 3.1: Research Plan

The different phases of this research as discussed are described in detail as under.

### **3.3 PRELIMINARY STUDY**

This is the first phase of the study. It is carried out to have the prerequisite knowledge of the topic and have insight into the studies already carried out in this field. The necessary literature is searched from different journals and books and studied in detail. On the basis of this study the objectives will be developed and finalized. The preliminary questionnaire be developed on the basis of this study and the objectives of this study. The questionnaire consists of two main portions. The first one is related to the different risks faced by the building projects and the second portion deals with the risk management techniques, preventive and remedial, used to manage these risks. Different research studies are reviewed in detail to highlight different type of risks face by construction projects in different regions of the world. Once the complete list of the construction related risks was prepared, it will then be filtered for the most appropriate risks related to the building construction projects in Pakistan after detailed discussion with the industry experts. So, the first part of the questionnaire consists of 37 different type of risks mainly from Kartam N.A. and Kartam S.A. (2000); Hameed and Woo (2007); Sayegh (2007) and thorough discussion with industry practitioners as per the local conditions. The respondents are required to give scoring to these risks as per their significance on liker scale (1-5) with 1 representing the least significant and 5 representing the most significant risk. The respondents are also required to identify the party responsible for that particular risk out of client, contractor and shared responsibility. As consultant act as the clients



agent so the risk responsibility related to consultant were considered to be that of the client. The second portion of the questionnaire deals with the different risk management techniques used for management of these risks. The risk management techniques divided into two categories that are the preventive risk management techniques used before the start of the project to minimize or eliminate the expected risk and the remedial risk management techniques that are used once the risk has already occurred, to minimize its negative effects. This portion consisted to total 12 risk management techniques with 6 each for preventive and remedial risk management techniques and were mainly from Kartam N.A. and Kartam S.A. (2000) and finalized after thorough discussion with industry professionals. The most applicable risk management techniques followed in building projects in Pakistan are selected. The respondents are required to give scoring to these management techniques as per their significance on liker scale (1-5) with 1 representing the least significant and 5 representing the most significant risk management technique. Thus the questionnaire is ultimately finalized for use in the survey for necessary data collection.

### **3.4 DATA COLLECTION**

Once the questionnaire is prepared, it is ready to be used for data collection that will be used for the research study. “The non probability sampling techniques are useful when there are limited resources, an inability to identify the members of population, and a need to establish the existence of problem” (Henry 1990). “Non probability samples that are unrestricted are called convenience samples” (Cooper and Schindler 2001). In convenient non probability sampling the members of population

are chosen based on their relative ease of access which was used for the survey. The questionnaire will be distribute in different construction companies in Islamabad/Rawalpindi which included the clients, consultants and the contractor companies working in building construction. The companies will be physically visited for distribution of the questionnaires and clarification of any ambiguities relation to the questionnaire filling. The questionnaire is required to be filled by minimum engineer level position who have necessary knowledge of the risks and the risk management techniques as in Pakistan there is very less awareness of the risks and the risk management techniques on the lower levels. The data represents the perception of the respondent how he/she thinks of the significance of different risk, its responsibility and the significance of risk management techniques. The filled questionnaires will be collected back accordingly once they are filled.

### **3.5 DATA ANALYSIS**

Once the questionnaires are collected back, they are ready to be compiled and analyzed in the data analysis phase. The MS Excel will be used as the main data compilation and analysis tool in this research study. The data will be entered into the excel sheet for all the questionnaires and compiled accordingly so as to make it ready for necessary analysis.

The Relative Importance Index (RII) is normally used in a number of studies to fine the significance of any attribute under consideration. “The RII is commonly used method in construction to obtain priority ranking of attributes, and it is particularly

useful where a structured questionnaire is used to solicit measurements that are subjective in nature” (Holt, 1997).

Cheung et al. (2010) used the following formula to calculate RII.

$$RII_a = \frac{\sum_{i=1}^n R_{a_i}}{Mn}$$

Where “RII<sub>a</sub>” is the relative importance index of attribute “a”, “R<sub>a<sub>i</sub></sub>” is rating score against attribute “a” from respondent “i”, “M” is the maximum score obtainable and “n” is the number of responses. Another formula has been used by Chinyio et al. (2010) to calculate RII which is as under:

$$RII = \left( \frac{\sum W}{A \times N} \right)$$

Where “RII” is the relative importance index, “W” is the respondent’s score, “A” is the maximum score obtainable and “N” is the number of responses. Similar type of formula has also been used by Kumaraswami and Chan (2010) in their study to calculate RII:

$$RII = \frac{\sum w}{A \times N}$$

Where “RII” is the relative importance index, “w” is the respondent’s score, “A” is the maximum score obtainable and “N” is the number of responses.

However, I have used the percentage scoring criteria to find the significance of each risk and effectiveness of risk management technique as it is generally used in our daily life and is easy to understand by everyone. It is found just by multiplying the RII with “100”. The one with more percentage score as the more significant and lesser percentage score representing the lower significance. The percentage scoring is calculated using the below mentioned formula.

$$\text{\%age score} = \frac{\sum W}{A \times N} \times 100$$

Where “W” is the score obtained from each respondent, “A” is the maximum score which is “5” in this case and “N” is the total number of respondents for this survey. Using the above mentioned formula, the significance of all the risks and the risk management techniques will be found and summarized.

The data related to the risk responsibility will also be summarized and percentage responsibilities calculated for each category as per the respondent’s data. For each category the risk responsibility is ultimately considered his responsibility if the percentage responsibility as per the respondent’s data is equal to or more than 50 percent. The percentage responsibility was calculated using the below mentioned formula:

$$\text{\%age responsibility} = \frac{R}{N} \times 100$$

Where “R” is the total number of the respondents opting for the responsibility of that particular category out of client, contractor and shared and “N” is the total number of respondents in this study (total questionnaires).

Once the analysis calculations are completed, the necessary graphs will be plotted using the excel inbuilt features for effective representation of the analysis findings and results.

### **3.6 SUMMARY**

This chapter describes the framework of the research study conduct on the subject. A questionnaire will be prepared which will be modified and finalized after discussion with the experts. Data will be collected with the help of the questionnaire which will be compiled and analyzed accordingly to achieve the research objective.

## **RESULTS AND ANALYSIS**

### **4.1 INTRODUCTION**

This chapter provides the data analysis and results of the questionnaire based survey conducted in Pakistan on risk management in building construction projects. The data collected with the help of questionnaire based survey is compiled and is ready to be analyzed. The chapter describes the complete analysis stage as to how the collected data is analyzed and results presented for necessary conclusions and recommendations.

### **4.2 RESULTS**

The filled questionnaires are collected back from the respondents and the data entered into the excel sheet for further analysis. Total 86 questionnaires were collected in completely filled form. The respondents included all the three main parties to the construction contracts that are client, contractor and the consultant. The respondents also possess different experience. This data is represented in Fig. 4.1 and 4.2.

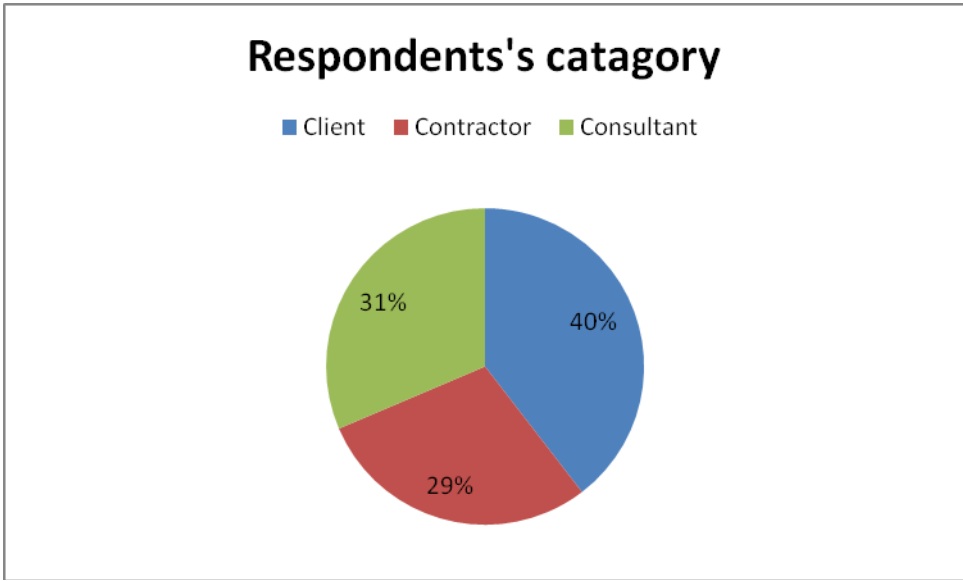


Fig. 4.1: Respondent's category

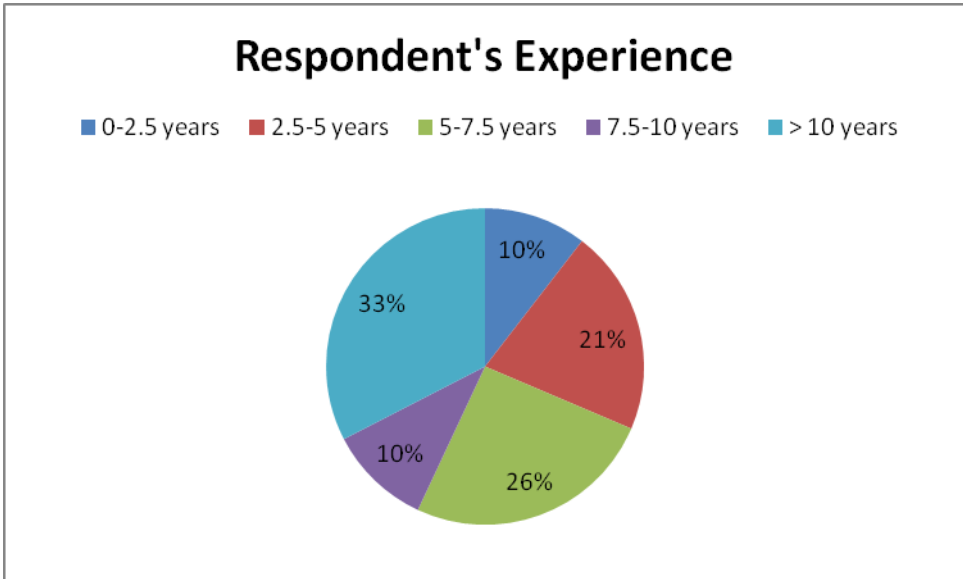


Fig. 4.2: Respondent's experience

Once the data was entered into excel sheet, the percentage scoring criteria was used to find out the significance of each of the risk and the effectiveness of risk management techniques and then percentage responsibility of each of the party for every risk was calculated on the basis of the responses provided in the questionnaires. On the basis of this the ultimate responsible parties were identified for each risk.

The questionnaire used in this study can be divided into three independent portions. The first one related to the significance of the identified risk, the second one to the responsible party for each of these risks and the last portion to the effectiveness of the identified risk management techniques. The collected data and its results after the analysis are discussed in the following part.

#### **4.2.1 RISK SIGNIFICANCE**

The different risks that were already highlighted from literature review and discussion with the industry experts are incorporated in the questionnaire to find their significance. Total 37 risks are incorporated in the questionnaire for which the respondents were required to give scoring on likert scale (1-5) (See Appendix I).

The data collected from the filled questionnaires for this portion was entered and compiled in the excel sheet (See Appendix II). Once the data was compiled, percentage scoring was calculated for each of the risk which identifies its significance. The risk with greater percentage score represents the higher significance and vice versa. The percentage score is calculated using the following formula already discussed in the previous chapter:



$$\text{\%age score} = \frac{\sum W}{A \times N} \times 100$$

Where “W” is the score obtained from each respondent, “A” is the maximum score which is “5” in this case and “N” is the total number of respondents 86 for this survey.

The compiled data of all the 86 questionnaires is shown in the Table 4.1 which represents the responses of all the respondents, the total score obtained and the percentage score obtained by each of the risk. Once the percentage score was calculated, the risks were arranged in descending order with most significant risks at the top and least significant at the bottom. The data is also represented graphically in Fig. 4.3.

Table 4.1: Risk ranking

S/No	Risks	Obtained score					Total score	percentage score
		1	2	3	4	5		
R-1	Payment delays	0	2	21	38	25	344	80
R-2	Risk of funding problems for project	1	6	14	37	28	343	80
R-3	Accidents/Safety during construction	1	5	25	24	31	337	78
R-4	Risk of Defective Design	0	16	22	16	32	322	75
R-5	Inaccurate execution plan/schedule	1	4	25	49	7	315	73
R-6	Poor performance of Sub contractor	4	9	19	38	16	311	72
R-7	Risk of Exchange Rate Fluctuation and Inflation	4	11	19	34	18	309	72
R-8	Improper Scope of work definition in contract	3	18	16	32	17	300	70

S/No	Risks	Obtained score					Total score	percentage score
		1	2	3	4	5		
R-9	Risk of bad quality Material / Equipment	2	17	24	24	19	299	70
R-10	Shortage/Delay of material supply	1	13	30	28	14	299	70
R-11	Risk of Changes in scope of work	0	14	26	38	8	298	69
R-12	Poor coordination with Subcontractor	7	6	29	30	14	296	69
R-13	Delay in availability of drawings	2	13	31	28	12	293	68
R-14	Shortage of plant and equipment	4	14	29	23	16	291	68
R-15	Risk of Differing site conditions	2	11	31	37	5	290	67
R-16	Lack of qualified staff	2	18	30	22	14	286	67
R-17	Inaccurate estimation of quantities of work	3	14	32	27	10	285	66
R-18	Risk of Unforeseen Site Conditions	3	15	29	33	6	282	66
R-19	Poor Productivity of plant and equipment	2	18	32	26	8	278	65
R-20	Delays in Obtaining Permits	2	19	33	22	10	277	64
R-21	Poor competence and productivity of labor	7	21	22	23	13	272	63
R-22	Delays due to disputes with contractor	1	19	37	25	4	270	63
R-23	Risk of Defective material from supplier	5	25	24	17	15	270	63
R-24	Delays due to lack of availability of utilities	1	24	30	25	6	269	63
R-25	Risk of Labor, Materials and Equipment availability	7	25	17	26	11	267	62
R-26	Corruption including Bribery at sites	10	20	24	13	18	264	61
R-27	Adverse weather conditions	5	24	28	23	6	259	60
R-28	Political instability	8	22	25	23	8	259	60
R-29	Third Party Delays	6	19	36	25	0	252	59
R-30	Risk of Insufficient Technology	8	27	24	21	6	248	58
R-31	Risk of Natural Disasters	4	33	28	14	7	245	57
R-32	Inappropriate Risk Allocation in contract	4	31	30	16	5	245	57
R-33	Inadequacy of Insurance	4	34	29	14	5	240	56

S/No	Risks	Obtained score					Total score	percentage score
		1	2	3	4	5		
R-34	Risk of labor disputes and strikes	16	25	21	18	6	231	54
R-35	Terrorism/War threats	16	29	23	11	7	222	52
R-36	Risk of Change in Codes and Regulations	14	32	25	10	5	218	51
R-37	Theft/Robbery of material at site	14	33	23	13	3	216	50

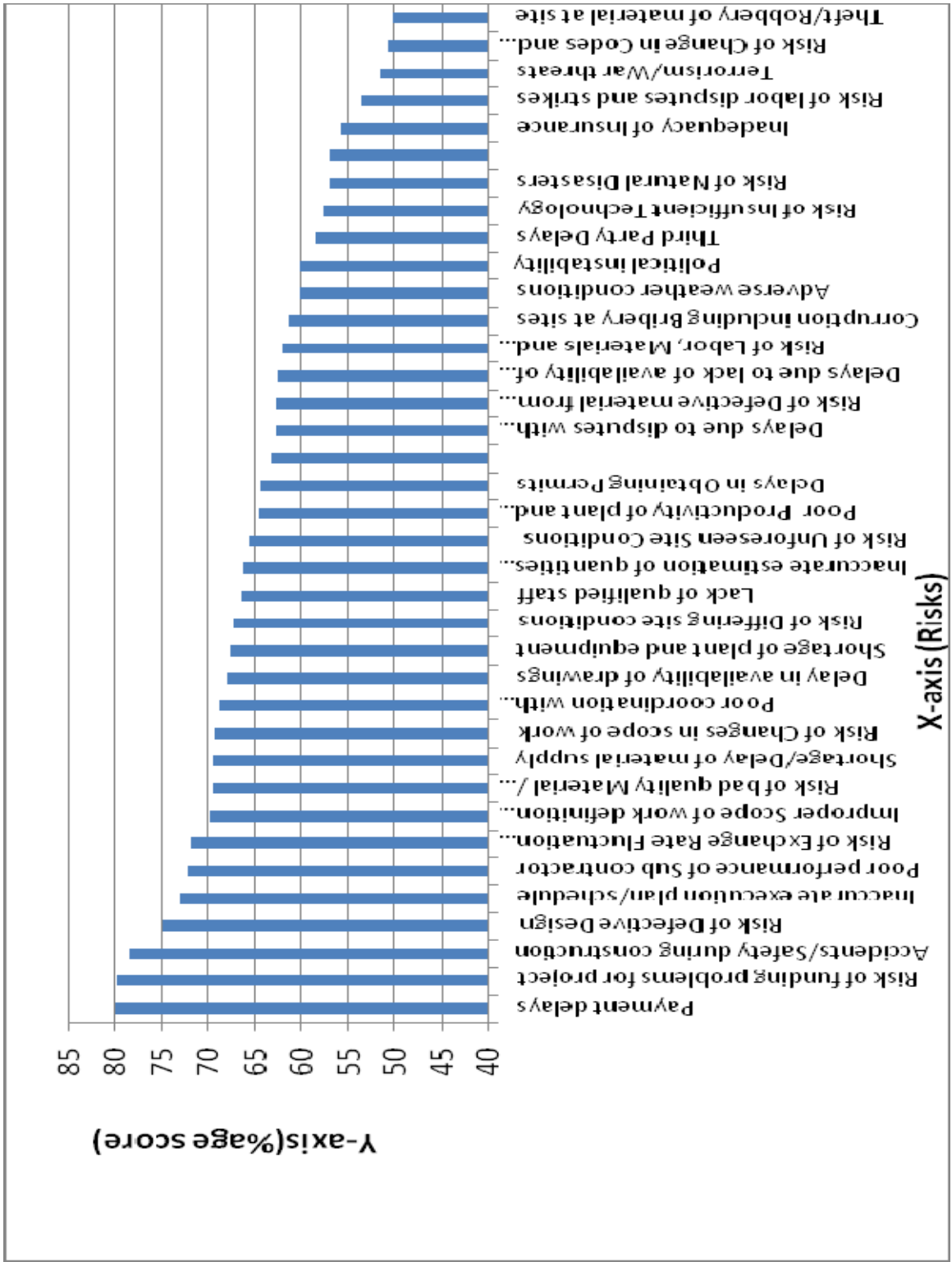


Fig 4.3: Risk Significance

#### **4.2.2 RISK RESPONSIBILITY**

The second part of the questionnaire deals with the responsible party for each of the risk. There categories for responsibility are identified that are the client, contractor and shared responsibility (See Appendix I). The consultant's responsibility is not mentioned in the questionnaire as he is acting as the owner's representative and his responsibility is ultimately considered as that of the client's responsibility.

The data for the responsible party regarding each risk is compiled in same way as that of the significance (See Appendix III) and the percentage responsibility for each of the risk was calculated using the below mentioned formula:

$$\text{\%age responsibility} = \frac{R}{N} \times 100$$

Where "R" is the total number of the respondents opting for the responsibility of that particular category out of client, contractor and shared and "N" is the total number of respondents which is 86 in this study (total questionnaires). The compiled data and the results are shown in the Table 4.2.

Table 4.2: Risk responsibility

S/No	Risks	No. of respondents			Responsibility in %age		
		Client	Contractor	Shared	Client	Contractor	Shared
1	Accidents/Safety during construction	6	55	25	7	64	29
2	Risk of Defective Design	68	3	15	79	3	17
3	Risk of funding problems for project	77	2	7	90	2	8
4	Delays in Obtaining Permits	50	16	20	58	19	23
5	Risk of bad quality Material / Equipment	3	75	8	3	87	9
6	Risk of Natural Disasters	30	4	52	35	5	60
7	Inaccurate execution plan/schedule	4	73	9	5	85	10
8	Delays due to disputes with contractor	15	9	62	17	10	72
9	Risk of Unforeseen Site Conditions	29	16	41	34	19	48
10	Risk of Differing site conditions	37	14	35	43	16	41
11	Inaccurate estimation of quantities of work	28	38	20	33	44	23
12	Delay in availability of drawings	75	4	7	87	5	8
13	Risk of Insufficient Technology	6	62	18	7	72	21
14	Theft/Robbery of material at site	2	77	7	2	90	8
15	Risk of Change in Codes and Regulations	50	5	31	58	6	36
16	Inappropriate Risk Allocation in contract	27	9	50	31	10	58
17	Risk of Exchange Rate Fluctuation and Inflation	30	11	45	35	13	52
18	Third Party Delays	8	49	29	9	57	34
19	Risk of Changes in scope of work	61	6	19	71	7	22
20	Inadequacy of Insurance	17	30	39	20	35	45
21	Improper Scope of work definition in contract	50	4	32	58	5	37
22	Risk of Labor, Materials and Equipment availability	2	80	4	2	93	5
23	Risk of labor disputes and strikes	0	80	6	0	93	7
24	Poor performance of Sub contractor	2	80	4	2	93	5
25	Poor coordination with Subcontractor	4	77	5	5	90	6
26	Terrorism/War threats	25	2	59	29	2	69
27	Risk of Defective material from supplier	2	77	7	2	90	8
28	Shortage of plant and equipment	3	78	5	3	91	6
29	Poor Productivity of plant and equipment	2	83	1	2	97	1
30	Shortage/Delay of material supply	2	79	5	2	92	6

S/No	Risks	No. of respondents			Responsibility in %age		
		Client	Contractor	Shared	Client	Contractor	Shared
31	Lack of qualified staff	0	45	41	0	52	48
32	Poor competence and productivity of labor	1	82	3	1	95	3
33	Payment delays	67	5	14	78	6	16
34	Delays due to lack of availability of utilities	39	19	28	45	22	33
35	Adverse weather conditions	22	4	60	26	5	70
36	Political instability	23	5	58	27	6	67
37	Corruption including Bribery at sites	5	17	64	6	20	74

Once the percentage responsibilities are calculated, the ultimate responsibility of a single party needed to be reached upon. As a bench mark the risk was considered to be the responsible of a particular party if his percentage responsibility came out to be greater than 50 percent. Thus the risks were divided into 4 different categories according to their responsible party categorized as owner's responsibility, contractor's responsibility, shared responsibility and unidentified responsibility where none of the category obtained responsibility of more than 50 percent. The data of each of the category are represented as follows in the Tables 4.3, 4.4, 4.5, 4.6 and shown in graphical form in Fig. 4.4, 4.5, 4.6 and 4.7.

Table 4.3: Contractor's responsibility

S/No	Risks	Responsibility in percentage		
		Client	Contractor	Shared
1	Accidents/Safety during construction	7	64	29
2	Risk of bad quality Material / Equipment	3	87	9
3	Inaccurate execution plan/schedule	5	85	10
4	Risk of Insufficient Technology	7	72	21
5	Theft/Robbery of material at site	2	90	8
6	Third Party Delays	9	57	34
	Risk of Labor, Materials and Equipment			
7	availability	2	93	5
8	Risk of labor disputes and strikes	0	93	7
9	Poor performance of Sub contractor	2	93	5
10	Poor coordination with Subcontractor	5	90	6
11	Risk of Defective material from supplier	2	90	8
12	Shortage of plant and equipment	3	91	6
13	Poor Productivity of plant and equipment	2	97	1
14	Shortage/Delay of material supply	2	92	6
15	Lack of qualified staff	0	52	48
16	Poor competence and productivity of labor	1	95	3



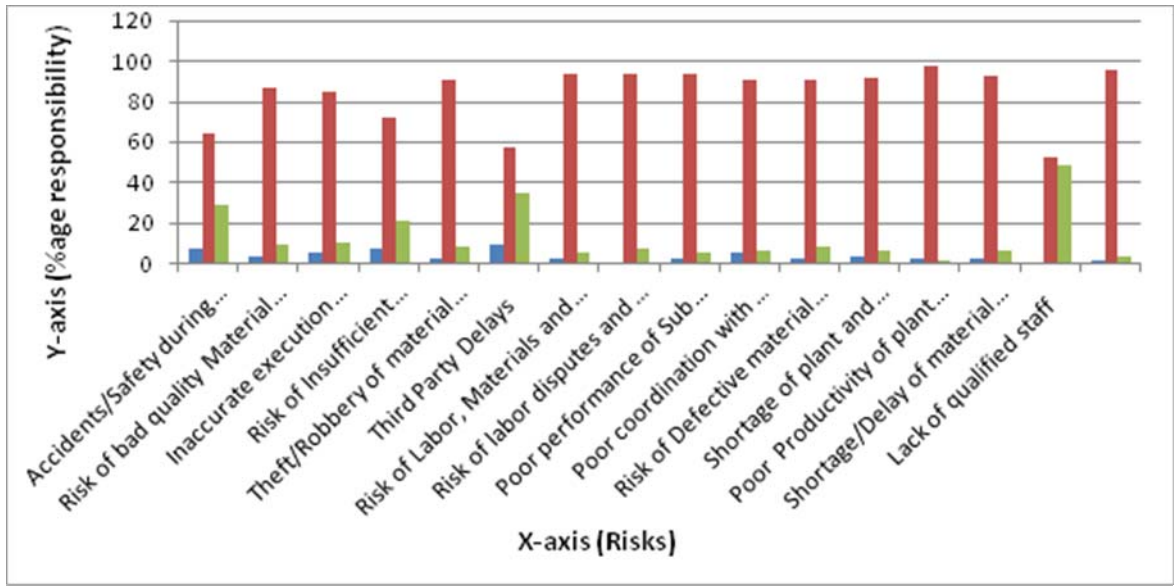


Fig. 4.4: Contractor's responsibility

Table 4.4: Client's responsibility

S/No	Risks	Responsibility in percentage		
		Client	Contractor	Shared
1	Risk of Defective Design	79	3	17
2	Risk of funding problems for project	90	2	8
3	Delays in Obtaining Permits	58	19	23
4	Delay in availability of drawings	87	5	8
5	Risk of Change in Codes and Regulations	58	6	36
6	Risk of Changes in scope of work	71	7	22
7	Improper Scope of work definition in contract	58	5	37
8	Payment delays	78	6	16

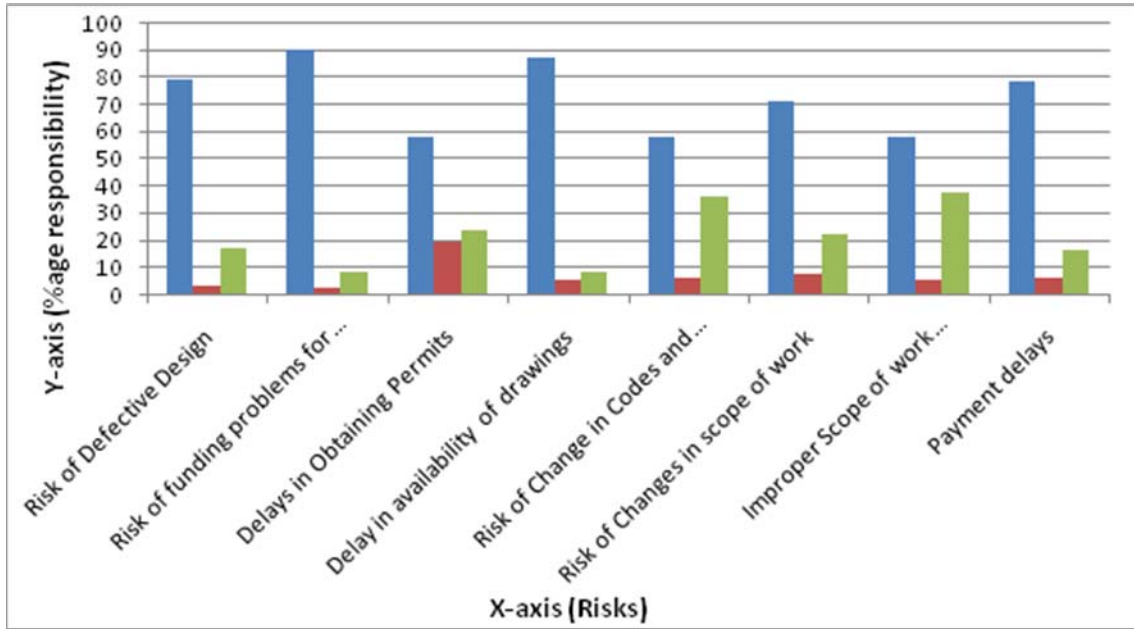


Fig. 4.5: Client's responsibility

Table 4.5: Shared responsibility

S/No	Risks	Responsibility in percentage		
		Client	Contractor	Shared
1	Risk of Natural Disasters	35	5	60
2	Delays due to disputes with contractor	17	10	72
3	Inappropriate Risk Allocation in contract	31	10	58
4	Risk of Exchange Rate Fluctuation and Inflation	35	13	52
5	Terrorism/War threats	29	2	69
6	Adverse weather conditions	26	5	70
7	Political instability	27	6	67
8	Corruption including Bribery at sites	6	20	74

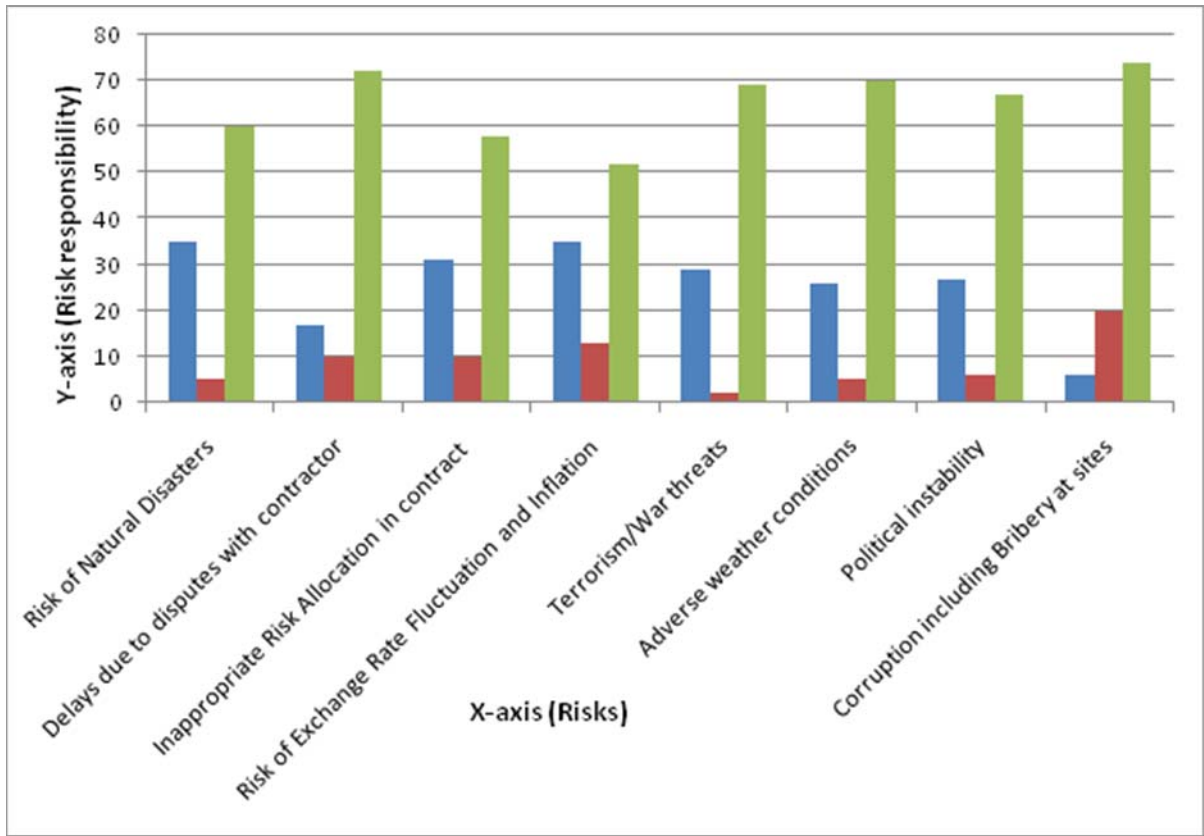


Fig. 4.6: Shared responsibility

Table 4.6: Unknown responsibility

S/No	Risks	Responsibility in percentage		
		Client	Contractor	Shared
1	Risk of Unforeseen Site Conditions	34	19	48
2	Risk of Differing site conditions	43	16	41
3	Inaccurate estimation of quantities of work	33	44	23
4	Inadequacy of Insurance	20	35	45
5	Delays due to lack of availability of utilities	45	22	33

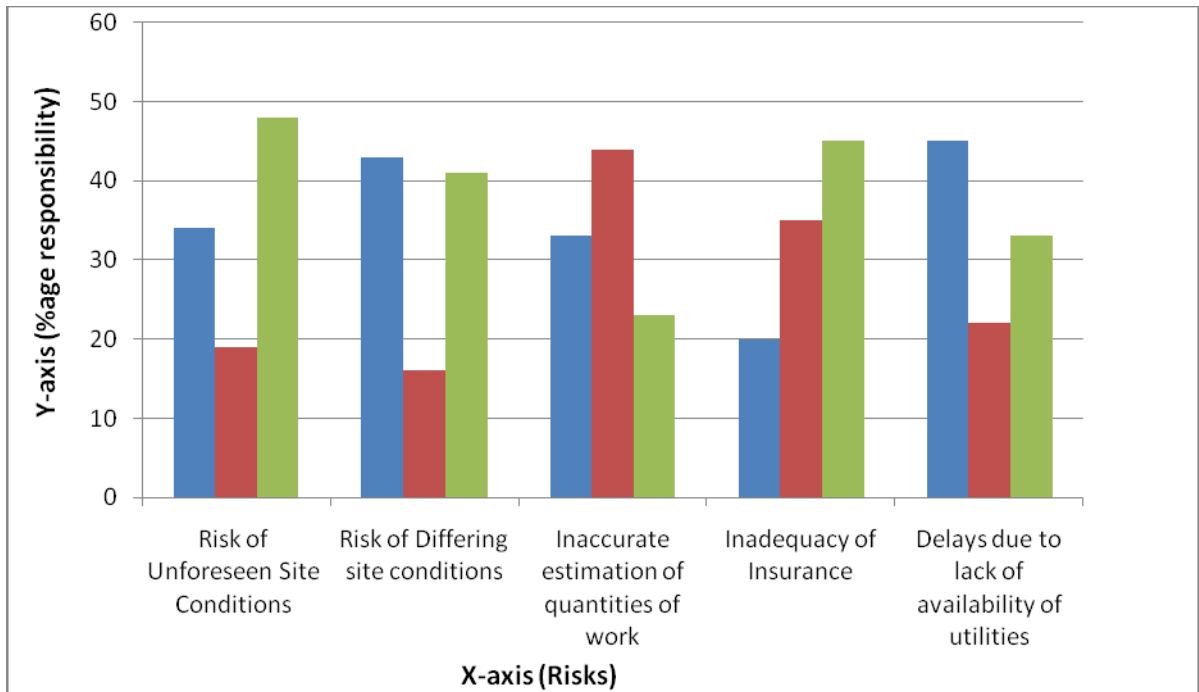


Fig. 4.7: Unknown responsibility

#### 4.2.3 EFFECTIVENESS OF RISK MANAGEMENT TECHNIQUES

Managing risks means minimizing, controlling and sharing of risks and not merely passing them off to another party (Edwards, 1992). There are different type of risk management techniques like risk avoidance (Prevention), risk retention, risk reduction (mitigating) and retention and risk transfer.

In the third part of questionnaire two type of the risk management techniques were incorporated to be responded by respondents on likert scale (1-5) that are Preventive techniques and remedial techniques (See Appendix I). Responding 1 means lowest effectiveness and 5 means the highest effectiveness. 6 type of risk management

techniques each for preventive and remedial were incorporated in the questionnaire mainly from the Kartam N.A. and Kartam S.A. (2000) and rephrased after discussion with industry professionals for ease of understanding of respondents in the local industry. Analysis was performed for both the type of risk management techniques i.e. preventive and remedial and their effectiveness found out in the same way as that for the risks.

#### **4.2.3.1 Preventive Risk Management Techniques**

Loosemore et.al. (2006). Risk Management in Projects 2nd. Ed., Taylor & Francis, New York. 157 p concluded that the best way to manage a risk is to avoid it. The risk can be avoided at the planning stage before the start of projects by incorporating necessary changes considering the necessary risks. Preventive management techniques are used at the planning stage to avoid/minimize necessary risk by considering them before start of the project and planning for it. The data regarding the attitude of the respondents towards the effectiveness of the considered preventive risk management techniques was collected (See Appendix IV) and summarized in the Table 4.7 arranged in the order of reducing effectiveness:

Table 4.7: Effectiveness of preventive risk management techniques

S/No	Risks Management (Preventive Method)	Obtained score					Total score	percentage score
		1	2	3	4	5		
PM-1	Produce a proper schedule by getting update project information	0	2	5	47	32	367	85
PM-2	Refer to previous and ongoing similar projects for accurate program	0	3	16	43	24	346	80
PM-3	Utilize different risk analysis techniques for accurate time estimate	0	2	30	44	10	320	74
PM-4	Add risk premium to time estimate	1	7	35	31	12	304	71
PM-5	Depend on personal judgment to produce a proper program	2	10	38	31	5	285	66
PM-6	Transfer or share risk to/with other party	2	26	25	27	6	267	62

The PM-1 represents the most effective risk and that of PM-6 represents the 6<sup>th</sup> and the least effective preventive risk management technique as per the analysis performed on the collected data. The results are shown graphically in Fig. 4.8.

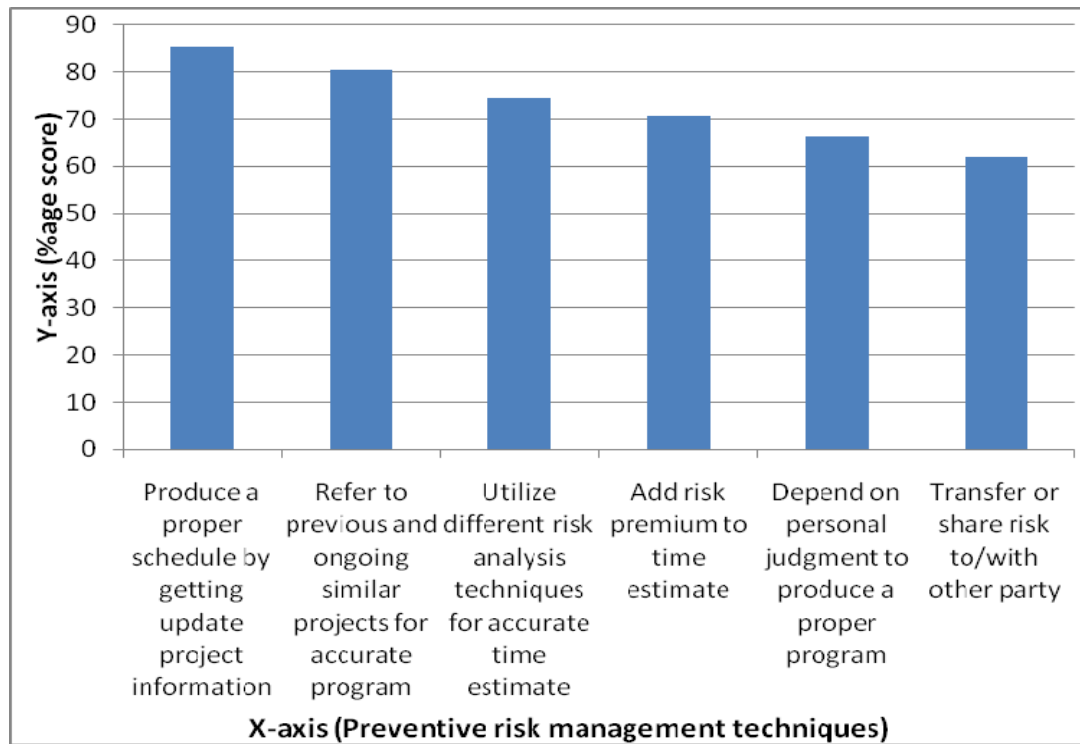


Fig. 4.8: Effectiveness of preventive risk management techniques

#### 4.2.3.2 Remedial Risk Management Techniques

Although with the application of preventive risk management techniques the risks cannot be eliminated and will arise from time to time during the execution of project for which remedial management techniques are used to reduce the risks and ideally eliminate them. In Saudi Arabia, Assaf and Al-Hejji (2006) found that only 30 percent of construction projects were completed within the scheduled completion dates and that the average time overrun was between 10 percent and 30 percent. The data of the questionnaire, as to how the respondents perceive about the effectiveness of given remedial risk management techniques was collected (See Appendix V) and

summarized in the Table 4.8 and the percentage scoring calculated for each of the management technique to find its effectiveness. These techniques are arranged in the order of decreasing effectiveness and are shown graphically as well as follows:

Table 4.8: Effectiveness of remedial risk management techniques

S/No	Risks Management Remedial Method)	Obtained score					Total score	Total score
		1	2	3	4	5		
RM-1	Close supervision by subordinates for minimizing unsuccessful work	0	2	15	35	34	359	83
RM-2	Coordinate closely with subcontractors	1	6	12	43	24	341	79
RM-3	Change the sequence of work by overlapping activities	0	8	26	38	14	316	73
RM-4	Increase manpower and/or equipment	1	15	31	25	14	294	68
RM-5	Change the construction method	0	22	25	32	7	282	66
RM-6	Increase the working hours	4	20	34	21	7	265	62

The RM-1 represents the most effective risk and that of RM-6 represents the 6<sup>th</sup> and the least effective remedial risk management technique as per the analysis performed on the collected data. The results are represented graphically in Fig. 4.9.



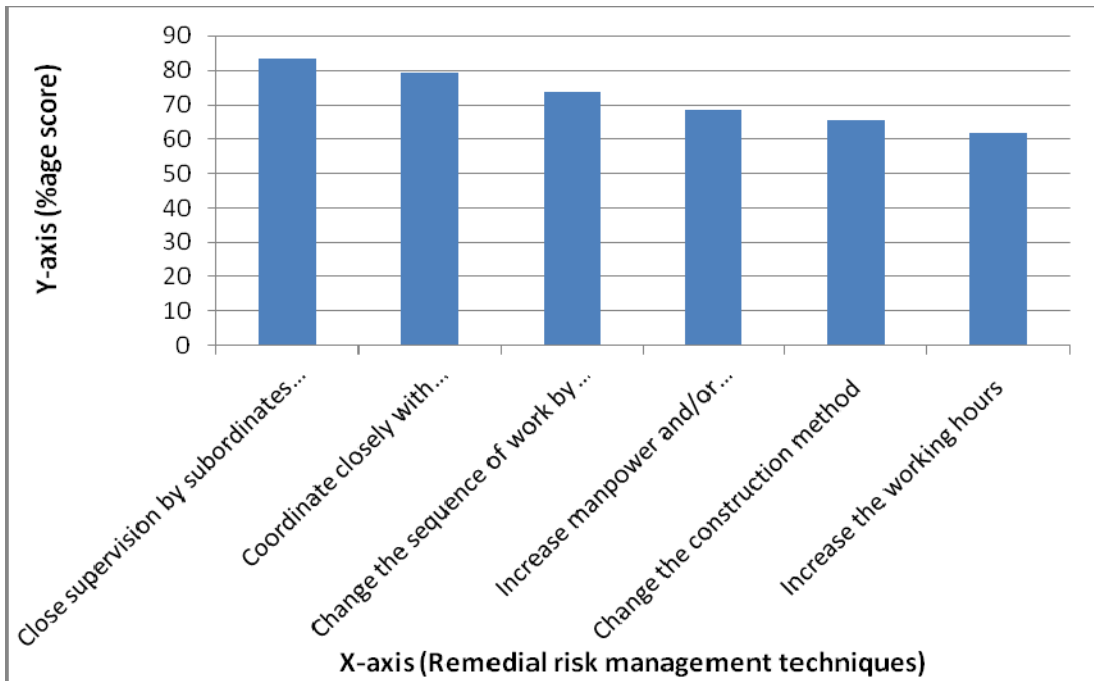


Fig. 4.9: Effectiveness of remedial risk management techniques

### 4.3 SUMMARY

The chapter discussed the complete analysis process and results are presented. It presents the risk ranking on the basis of the survey data analyzed and found the ultimate responsible party for each of these risks under consideration. It has also summarized the ranking of risk management techniques considered according to their effectiveness in managing the risks encountered.

## **CONCLUSIONS AND RECOMMENDATIONS**

### **5.1 INTRODUCTION**

In this chapter the conclusion on the basis of this research study are discussed. The initial research objectives are reviewed and on this basis of this study, conclusions are drawn for these objectives. The results are discussed in detail for each objective and recommendations are provided for further study on the topic.

### **5.2 REVIEW OF OBJECTIVES**

The four objectives of the study are as follows:

5. To identify risks on building projects in the construction industry through literature review and discussion with experts.
6. To identify major risk management techniques in industry through literature review and discussion with experts.
7. To find risk significance and its responsibility through questionnaire based survey.
8. To find effectiveness of risk management techniques through questionnaire based survey.

The objectives are discussed one by one as to how they are achieved. The first objective regarding the identification of risks involved in the building construction

projects in Pakistan was achieved through thorough literature review. The risks involved in such projects were extracted from a number of research studies already carried out in the same field. This list was then compiled and discussions were made with the industry experts to identify only those risks specifically related to the building projects in Pakistan. The final list was then incorporated in the questionnaire for the purpose of finding its relative importance and party responsible for each risk.

The second objective is pertaining to the identification of the risk management techniques applied in these projects to manage risks. The risk management techniques were mainly extracted from the study carried out in Kuwait already discussed and then these were also discussed with the industry experts for finalization of the list. The risk management techniques were segregated into two types that are preventive and remedial risk management techniques. After discussion with the experts the lists for both the categories were finalized and incorporated in the questionnaire for finding its relative significance.

The third objective was to find the relative significance of each risk and identify the party responsible for that particular risk. As the final list of the risk was already prepared that was incorporated in the questionnaire to find relative significance of each. The respondents were required to give importance to each on the liker scale with “1” representing lowest significance and “5” for highest significance. The data for all the questionnaire once analyzed, the relative significance of all the risk was found through percentage scoring method. The one with maximum percentage score as most significance and the one with lowest percentage score as least

significance level. Regarding the identification of responsible party for each risk, the respondents were required to identify each category for its responsibility out of the three categories that are owner, contractor and shared responsibility. The category of the consultant was not incorporated in the questionnaire as he is acting as the client's representative and the risks related to him as considered to as ultimately relating to the owner. On the basis of this the ultimate responsibility was identified through questionnaires data analysis. In this way the significance of each risk and the party responsible for each risk were found.

The fourth and last objective of this study was regarding the effectiveness of the risk management techniques adopted to manage these risks. As already discussed, they were segregated into two categories that are the preventive risk management techniques and the other is remedial risk management techniques discussed in detail in the earlier chapters. They were incorporated in the questionnaire and the respondents were required to give scoring to them on the likert scale, "1" for least effective management technique and "5" for the most effective technique. The data once analyzed, effectiveness of each management technique was found through the percentage scoring technique. The one getting highest percentage score as most effective and the one with lowest percentage score as the least effective management technique.

## 5.3 CONCLUSIONS

The data which was collected through the questionnaire based survey was collected and analyzed as already discussed to achieve the study objectives. On the basis of those results, conclusion were made which are discussed in detail as follows:

### 5.3.1 Risk Significance and Responsibility

The significance of the risks was found using percentage scoring technique already described earlier in this paper. The one getting the highest percentage score has highest significance and the one with lowest percentage score has least significance. Total 37 risks were incorporated in the questionnaires which were then arranged in the order of reducing significance on the basis of the analysis results. The results regarding the top 10 most significance risks and the party ultimately responsible for that risk are discussed here.

*Payment delays*, topped the list getting maximum percentage score for its significance for which responsibility lies with client getting 78 percent response rate. This shows that the maximum delays occurring on building projects in Pakistan are due to late payment by the contractor by the client. This is a chain activity, once the contractor is not getting their bills cleared from the contractor so he is having shortage of the running financing and is unable to continue the work with the desired pace. The other issue associated with this is that he is unable to pay to the subcontractors who are involved on most of the activities and thus their work stops which is totally dependent on the contractor's payment to them. Thus necessary measures should be

taken to facilitate the timely payments to the contractors and intern to the subcontractors so that the project work should not stop and avoid time and cost overruns.

*Funding problem for projects*, is second on the list and responsibility again goes to client with response rate of 90 percent. This superimposes the significance of first risk that is “Payment delays” as funding problem arises on numerous building projects giving site to the payment delays and ultimately contributes towards time and cost over runs. This is obviously due to that fact that Pakistan is developing country and often face problems regarding funding for the projects.

*Accidents/Safety*, is also among the top risks which are mostly ignored in Pakistan but is main delay factor as per this survey and must be addressed properly. The responsibility goes to contractor with 64 percent response rate, so most of the respondents thinks that this is the responsibility of contractor and he should take care of it and contractor are reluctant to invest in safety as they think that this is just the additional cost which is not giving any benefit. Also the client dost not support contractor for the same due to which the safety situation on the construction sites is further deteriorated. So to improve the safety on sites, client should also take equal responsibility which will definitely affect the projects positively and would be beneficial for both the client and contractor.

*Defective design*, is also the major risk factor as per this survey securing 4<sup>th</sup> positing and responsibility lies with client with 79 percent response rate. So steps

should be taken by the client and consultant to work closely and also involving the contractor if the contract permits to have correct design and avoid problems during execution of project. There are some build ability issues also associated with these designs. So is the contractor is involved at the project design phase, will give rise to better design as the suggestions of the party who is going to actually implement the project will be incorporated into design avoiding issues at the later stage. One other important fact is that contractors do not review the design thoroughly at the bidding stage and thus discrepancies are not cleared at that early stage. So although the responsibility of any defects in the design lies with the client but it is also the responsibility contractor to review the design thoroughly at the early stage so the defects can be removed and any delays in the later stage.

*Inaccurate schedule*, also comes among the top lists for which contractor is responsible with 85 percent response rate. So a thorough study of project and contract documents is required by the contractor and considering different risk factors for preparation of accurate schedule which can be achievable to avoid time and cost overruns afterwards. The contractors tries to squeeze the schedule as much as possible at the bidding stage to get benefit out of it having lesser project completing time without realizing that it may not be practically achievable. It is also worth mentioning here that although the contractor is responsible for inaccurate schedule as he is preparing it but the client should also take full responsibility with the help of consultant to validate the schedule provided by the contractor help to make it as practical as possible so that it may be achievable.

*Poor performance of subcontractors*, is also one of the major risk factor and responsibility lies with contractor with 93 percent response rate as client has no direct contract with subcontractors and are directly under the main contractor. Efforts should be made for selection of competent subcontractors with good previous tract record to avoid this risk. There are some contracts where the main contractor is bound to subcontract to only those subcontractors identified by the client. In this case although the subcontractors have direct contract only with the main contractor but reduces the influence of the main contractor on the subcontractors who are nominated by the client. So the subcontractor may not be competent enough to undertake the work. So the client should give full authority to the contractor for rejection of any subcontractor nominated by him who is not competent enough for the work. One other reason may be that the selection procedure of the subcontractor is not stringent enough to select the best subcontractors. The contractor select subcontractor on the basis of the lowest bid which gives rise to the incompetent subcontractor or the subcontractor having major error in the bid giving rise to the lower cost. So to avoid this, there should be systematic procedure for subcontractor selection agreed by both client and contractor to filter out all the incompetent subcontractors and subcontract work to the best available subcontractors.

*Exchange rate fluctuation and inflation*, is also one of the most important risk factor in developing countries like Pakistan. There is a mixed response on this risk with response rate of 52 percent for shared responsibility and 35 percent for client responsibility which may be due to the fact that this risk in not under control of any



contracting party and very little can be done to reduce effect of this risk. As in the countries like Pakistan where there is political instability and economic issues, the exchange rate fluctuation and inflation is obvious and none of the party is in the position to avoid this risk. The only activity which can be done to mitigate this risk is to forecast for this risk. As the duration of the project is already known with certain accuracy, the exchange rate fluctuation and the inflation can be forecasted on the basis of running trends and specific value for it can be incorporated in the contract cost. Once it is incorporated in the contract at the early stage and planning is done for it, the effect of it at the latter stage will be reduced avoiding its adverse effects on the project.

*Improper scope of work definition in contract*, also secures main importance. This risk has also mixed response with client responsibility with 58 percent response rate and shared secures 37 percent. This may be due to the fact that although client is responsible for scope of work definition but contractor should also play its part in thorough understanding of all the contract documents and clear any ambiguity which may have negative effects on the project. As the scope of work is defined by the client and incorporated in the contract, the contractor pays very little attention to it and wants to win the contract by hook or by crook. There may be ambiguities in the scope of work definition but contractor is also responsible for complete review and understanding of the contract documents and clarify any ambiguity at the early stage regarding this very important risk which will be beneficial for both the client and the contractor.

*Bad quality material and equipment*, is also the main contributing risk factor and contractor securing its responsibility with 87 percent response rate on most of the building projects in Pakistan, contractor is responsible for provisioning of material and equipment and thus under direct control of contractor. Although most of the respondents think that contractor is responsible is for this risk but it doesn't mean that the client has no obligations for it. As the completed project has to be ultimately handed over to the client and if bad quality material is used in the project with the use of bad quality equipment, it will be great concern in future. Thus the client has the responsibility for provision of specifications and approved brands in some cases and ensure that the material used is of desired quality. Regarding the equipment, contractor should validate the construction equipment available with the contractor which will be used on his facility. In this way this risk can be avoided to a great extent.

*Shortage/Delay of material supply*, is in the top 10 most significant risks list and contractor directly responsible for this risk with 92 percent response rate as supply of material in most of the contracts is contractors responsibility and should plan accordingly to avoid this risk. As the mega building projects are mostly undertaken in the major cities where there is traffic issues and restrictions on the entry of the heavy vehicles used for the transportation of construction material and also due to the security issues some restrictions are implemented. The client should also facilitate enough space for onsite storage of the construction material and the contractor should make use of it to the maximum extent. If feasible minimum working days should be

mentioned in the contract for which the material should be immediately available on site for use which can be used in cases where there is problem in the material supplies.

### **5.3.2 Effectiveness of Risk Management Techniques**

**Preventive management techniques:** Total six number preventive risk management techniques were considered and incorporated in the questionnaire to find their relative effectiveness as per the feedback from the responded collected through the questionnaires. Percentage scoring method was used here as well to get the effectiveness of each technique. The management techniques were then arranged in the order of reducing effectiveness. The top three preventive risk management techniques are discussed in some details as follows:

*Produce a proper schedule by getting update project information*, topped this list 85 percent score. Thus we can conclude that out of the preventive risk management techniques under discussion, this is the most effective management techniques as per the respondent's feedback. Once the updated project information is collected and the schedule is prepared, it will give rise to preparation of the most optimum schedule that may be achievable with very little deviation as it is prepared on the updated data regarding the project and will not be subjected to any major change. Thus necessary efforts should be made to collect updated data regarding the project with all the necessary major changes incorporated in it and make it basis for schedule preparation avoiding problems in later stages.

*Refer to previous and ongoing similar projects for accurate program*, is second in the list getting percentage scoring of 80 percent. This technique is pointing towards the preparation of accurate schedule considering all the risk factors by taking guidelines from the similar projects already executed and under execution so that the schedule may be achievable. Once the similar projects already completed and those in the execution phase are studied, necessary information can be collected regarding the issues associated with those projects which will have high probability of occurrence on this project thus proactively managing them to avoid them or reduce their effects thus minimizing their adverse effects on the project. Once all the risk factors are considered there will be high probability of project completed within the planned schedule.

*Utilize different risk analysis techniques for accurate time estimate*, secures third position in the list obtaining 74 percent score. Although different risk management techniques used on mega projects internationally are not very commonly used in Pakistan except for few projects but if necessary efforts are made for to utilize them on the building projects here in Pakistan can be a real bonus thus giving rise to most optimum schedule incorporating all the risk factor that may arise in the execution phase and making our self ready for their management. Thus it can really help in reducing deviations from the planned schedule avoiding time and cost overruns.

**Remedial management techniques:** As it is obvious that all the risk cannot be managed in the planning phase and risks are going to occur during implementation phase for which remedial risk management techniques are required. As per this survey

the 2 techniques which are topping the list are a) Close supervision by subordinates for minimizing unsuccessful work b) Coordinate closely with subcontractors. These two techniques are also pointing towards a single point that good coordination is necessary for successful project may it be with the subordinates or that of subcontractor. So there will be little likely hood of project going out of schedule if close supervision and coordination is adopted and all the parties work as a single team.

*Close supervision by subordinates for minimizing unsuccessful work*, tops the list of remedial risk management techniques securing percentage score of 83 percent. This mean that if competent subcontractors are working and close supervision of work is performed by every party to avoid unsuccessful work can greatly influence the overall project positively and will save a lot of precious time in correcting the unsuccessful work which mean do it correct first time all the time. If there is unsuccessful work, it will take more time to correct it that to do it successful at first go. So it is the responsibility of all the parties to closely supervise all the work to avoid unsuccessful work and avoid wastage of precious time in correcting them.

*Coordinate closely with subcontractors*, is second in the list of remedial risk management techniques getting 79 percent score. A lot of projects are subjected to delays due to the bad coordination involved within the parties involved. So if the lines of communications between the parties to the contract and shortened and simplified, it will give rise to better coordination of the parties involved and any issue arising during the execution phase can be communicated quickly and efficiently and can be resolved at the earliest possible time minimizing its adverse effect on the project. Once there is

better coordination the problems can be discussed openly and brought in front of all the parties timely giving rise to time resolution. So efforts should be made for better coordination and communication with all the parties involved on the project.

*Change the sequence of work by overlapping activities*, obtained third position securing 73 percent score. This is pertaining to the overlapping of the activities within the project that can be to reduce the completion time. If the project is overrunning the schedule, so to cope up with schedule and save some time, different not related activities can be overlapped to be performed at the same time obviously depending on the available resources thus maximizing the use of available resources and saving a lot of time by performing a number of activities simultaneously.

## **5.4 RECOMMENDATIONS**

Following are some recommendations for further study on the subjected topic in the construction industry of Pakistan.

1. As this study is conducted in building construction sector of the Pakistan's construction industry, it can also be conducted in other sectors.
2. Further study can also be conducted on risk management to compare the perception of client's, contractor's and consultant's management.
3. One important topic for further study on the subjected topic may be to investigate risk management practices in the construction industry of Pakistan.

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## **APPENDICES**

# Appendix I

## Questionnaire

General Information (Will Not be Published)	
Name	
Qualification	
Experience in Construction Industry (Years)	
Organization / Department / Firm / Company	
Type of firm (Client/Consultant/Contractor)	
Appointment / Designation / Rank	
Contact Number (Tel / Cell / e-mail)	

**What is the relative importance of each of the following risks on building projects?**

S.N O	RISK	RELATIVE IMPORTANCE (1–LOWEST, 5–HIGHEST)					Risk responsibility		
		1	2	3	4	5	Client	Contractor	Shared
1	Accidents/Safety during construction								
2	Risk of Defective Design								
3	Risk of funding problems for project								
4	Delays in Obtaining Permits								
5	Risk of bad quality Material / Equipment								
6	Risk of Natural Disasters								
7	Inaccurate execution plan/schedule								
8	Delays due to disputes with contractor								
9	Risk of Unforeseen Site Conditions								
10	Risk of Differing site conditions								
11	Inaccurate estimation of quantities of work								
12	Delay in availability of drawings								
13	Risk of Insufficient Technology								
14	Theft/Robbery of material at site								
15	Risk of Change in Codes and Regulations								
16	Inappropriate Risk Allocation in contract								
17	Risk of Exchange Rate Fluctuation and Inflation								
18	Third Party Delays								
19	Risk of Changes in scope of work								
20	Inadequacy of Insurance								
21	Improper Scope of work definition in contract								

S.N O	RISK	RELATIVE IMPORTANCE					Risk responsibility		
		(1–LOWEST, 5–HIGHEST)					Client	Contractor	Shared
		1	2	3	4	5			
22	Risk of Labor, Materials and Equipment availability								
23	Risk of labor disputes and strikes								
24	Poor performance of Sub contractor								
25	Poor coordination with Subcontractor								
26	Terrorism/War threats								
27	Risk of Defective material from supplier								
28	Shortage of plant and equipment								
29	Poor Productivity of plant and equipment								
30	Shortage/Delay of material supply								
31	Lack of qualified staff								
32	Poor competence and productivity of labor								
33	Payment delays								
34	Delays due to lack of availability of utilities								
35	Adverse weather conditions								
36	Political instability								
37	Corruption including Bribery at sites								

**Effectiveness of risk management techniques on building projects**

EFFECTIVENESS OF PREVENTIVE METHOD						
S.NO	PREVENTIVE METHOD	RELATIVE EFFECTIVENESS				
		(1 – LOWEST, 5 – HIGHEST)				
		1	2	3	4	5
1	Utilize different risk analysis techniques for accurate time estimate					
2	Depend on personal judgment to produce a proper program					
3	Produce a proper schedule by getting update project information					
4	Add risk premium to time estimate					
5	Transfer or share risk to/with other party					
6	Refer to previous and ongoing similar projects for accurate program					

<b>EFFECTIVENESS OF REMEDIAL METHOD</b>						
<b>S.NO</b>	<b>REMEDIAL METHOD</b>	<b>RELATIVE EFFECTIVENESS</b>				
		<b>(1 – LOWEST, 5 – HIGHEST)</b>				
		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
1	Increase manpower and/or equipment					
2	Increase the working hours					
3	Change the construction method					
4	Change the sequence of work by overlapping activities					
5	Coordinate closely with subcontractors					
6	Close supervision by subordinates for minimizing unsuccessful work					

## Appendix II

### Respondent's Data for Risk Significance

S/No	Safety	Defective Design	Funding Problem	Permits	Bad Quality Material and Equipment
1	3	2	4	1	5
2	5	5	3	2	4
3	5	5	5	4	4
4	5	5	4	4	5
5	5	5	4	4	4
6	3	2	4	3	2
7	4	5	4	4	4
8	4	5	4	4	4
9	5	5	5	5	5
10	4	2	4	3	3
11	5	5	5	4	3
12	4	4	5	3	2
13	3	5	4	4	3
14	5	5	5	5	5
15	1	3	3	3	3
16	5	5	5	4	4
17	3	2	4	4	3
18	3	3	4	2	2
19	3	5	5	3	3
20	5	4	5	5	5
21	4	3	4	2	3
22	5	5	4	3	5
23	5	5	4	4	5
24	4	3	4	3	2
25	3	4	3	3	2
26	4	5	5	4	4
27	5	4	5	4	3
28	5	4	4	4	4
29	4	3	3	3	2
30	5	3	4	2	1
31	5	3	5	5	5
32	3	2	4	3	3

S/No	Safety	Defective Design	Funding Problem	Permits	Bad Quality Material and Equipment
33	4	4	1	1	3
34	4	3	5	4	4
35	5	4	4	5	5
36	3	2	4	3	1
37	4	5	5	5	4
38	4	5	3	3	4
39	4	3	4	3	2
40	4	5	3	4	4
41	5	3	3	4	5
42	3	2	5	2	2
43	3	3	4	2	2
44	2	3	4	2	2
45	3	2	4	3	2
46	5	4	5	3	5
47	5	5	5	3	5
48	5	3	4	3	2
49	5	5	5	5	5
50	5	5	5	4	5
51	5	3	5	3	4
52	4	3	5	3	5
53	5	5	5	3	4
54	3	3	3	3	4
55	3	4	4	3	4
56	5	5	5	5	5
57	3	3	2	2	3
58	2	4	2	2	4
59	4	4	2	2	4
60	4	4	2	2	4
61	3	4	2	2	4
62	3	3	3	3	3
63	4	4	2	2	3
64	4	5	3	3	3
65	3	4	5	2	2
66	3	2	3	4	3
67	2	2	4	5	3
68	5	4	4	2	4



<b>S/No</b>	<b>Safety</b>	<b>Defective Design</b>	<b>Funding Problem</b>	<b>Permits</b>	<b>Bad Quality Material and Equipment</b>
69	3	5	5	3	5
70	4	3	4	3	3
71	3	2	5	2	3
72	4	2	4	2	2
73	4	3	4	3	2
74	2	3	4	4	3
75	5	5	5	3	4
76	3	2	4	3	3
77	2	2	3	2	2
78	4	2	4	4	3
79	3	2	4	2	3
80	4	3	5	3	5
81	5	5	4	3	3
82	5	5	4	3	4
83	3	5	3	3	2
84	5	5	3	4	4
85	3	5	5	5	5
86	5	5	4	4	3

## Respondent's Data for Risk Significance (Contd.)

S/No	Natural Disaster	Inaccurate schedule	Disputes with contractor	Unforeseen Site Conditions	Differing site conditions
1	3	2	4	5	4
2	4	3	4	5	4
3	4	4	4	3	4
4	3	3	3	3	4
5	3	4	3	3	3
6	3	3	2	2	2
7	3	4	3	4	3
8	5	4	3	3	3
9	2	4	3	3	3
10	2	2	4	3	3
11	2	3	2	3	3
12	2	4	2	4	4
13	2	1	1	1	1
14	4	4	4	5	4
15	2	4	3	3	4
16	4	4	5	5	5
17	2	4	3	2	2
18	2	4	3	4	4
19	4	4	3	3	4
20	3	4	4	4	4
21	3	2	3	2	2
22	3	4	4	4	4
23	4	3	3	3	3
24	2	4	3	4	4
25	3	3	4	4	4
26	2	4	4	3	4
27	3	3	2	4	4
28	4	4	3	3	3
29	3	3	4	2	4
30	2	4	2	2	2
31	5	5	4	4	4
32	4	4	3	4	3
33	2	3	4	3	3

S/No	Natural Disaster	Inaccurate schedule	Disputes with contractor	Unforeseen Site Conditions	Differing site conditions
34	3	4	2	2	2
35	2	5	4	3	3
36	2	4	2	3	3
37	3	4	3	3	3
38	1	3	3	3	3
39	3	4	4	3	3
40	5	3	3	4	3
41	2	3	3	2	2
42	2	4	2	4	4
43	2	4	2	4	4
44	2	4	2	4	4
45	2	4	2	3	3
46	2	4	4	3	3
47	3	5	5	3	3
48	2	3	4	2	3
49	4	4	3	4	4
50	5	5	4	3	3
51	3	5	3	3	5
52	2	4	2	5	5
53	1	3	3	1	1
54	2	4	4	4	4
55	2	4	3	3	4
56	5	5	3	4	3
57	3	4	3	4	4
58	4	4	2	3	3
59	3	4	2	2	3
60	3	4	2	2	4
61	3	4	3	2	3
62	3	4	3	4	4
63	3	3	2	2	3
64	5	3	3	3	3
65	4	3	2	2	2
66	3	4	4	4	3
67	2	3	4	3	3
68	3	4	2	2	2
69	5	4	3	4	4
70	2	4	3	4	5

S/No	Natural Disaster	Inaccurate schedule	Disputes with contractor	Unforeseen Site Conditions	Differing site conditions
71	1	3	2	4	4
72	3	3	4	5	5
73	2	4	3	4	4
74	2	3	3	4	4
75	3	4	4	4	4
76	2	4	3	4	4
77	1	3	3	4	4
78	2	4	4	4	4
79	2	4	3	4	4
80	3	3	5	3	3
81	2	3	4	4	3
82	2	3	3	2	2
83	4	2	3	1	2
84	3	4	3	3	2
85	4	5	5	4	4
86	4	4	4	4	4

## Respondent's Data for Risk Significance (Contd.)

S/No	Inaccurate estimation	Availability of drawings	Insufficient Technology	Theft/ Robbery	Change in Codes and Regulations
1	1	3	1	1	1
2	4	3	3	3	3
3	3	4	4	3	3
4	2	4	3	4	2
5	4	4	4	4	3
6	3	3	2	1	2
7	3	4	4	4	3
8	5	4	5	4	5
9	4	4	2	2	1
10	3	1	2	3	1
11	5	3	5	2	5
12	3	3	2	2	1
13	1	1	1	1	1
14	4	3	5	5	4
15	4	4	3	2	4
16	5	4	4	4	5
17	2	2	2	2	1
18	3	2	2	2	2
19	5	4	4	2	2
20	3	4	3	3	3
21	3	3	3	4	2
22	4	5	4	4	3
23	3	2	2	2	2
24	3	2	3	3	2
25	4	4	3	4	4
26	4	4	4	3	3
27	3	4	3	3	3
28	3	4	3	3	3
29	3	4	4	3	4
30	3	3	2	1	2
31	3	3	3	5	5
32	4	5	4	1	5
33	4	4	3	2	1

S/No	Inaccurate estimation	Availability of drawings	Insufficient Technology	Theft/ Robbery	Change in Codes and Regulations
34	1	2	3	2	2
35	4	3	4	3	2
36	2	2	2	1	2
37	4	4	4	3	4
38	4	3	2	2	2
39	3	4	3	3	3
40	3	4	3	3	3
41	3	4	2	2	2
42	4	2	2	2	2
43	4	2	2	1	1
44	4	3	2	2	2
45	4	3	1	1	1
46	4	5	4	5	2
47	3	5	5	4	4
48	2	3	2	2	2
49	5	4	3	3	3
50	4	5	5	4	4
51	5	5	3	3	3
52	4	5	4	2	2
53	3	3	1	4	1
54	4	4	4	2	2
55	4	4	4	3	3
56	5	5	3	2	3
57	2	3	2	2	2
58	3	4	2	2	2
59	2	3	2	2	2
60	2	3	2	2	2
61	2	4	3	2	2
62	2	2	2	2	2
63	2	3	2	2	2
64	3	3	3	4	4
65	2	3	3	3	2
66	3	4	3	3	1
67	3	3	4	2	3
68	4	2	3	2	3
69	5	3	4	4	3

S/No	Inaccurate estimation	Availability of drawings	Insufficient Technology	Theft/ Robbery	Change in Codes and Regulations
70	3	2	1	1	3
71	2	3	1	1	2
72	2	3	2	2	2
73	4	3	2	2	3
74	3	3	2	2	3
75	3	5	4	2	3
76	3	2	1	1	1
77	3	2	2	1	2
78	4	3	2	2	3
79	3	3	2	2	1
80	5	5	4	3	4
81	4	3	3	1	2
82	3	4	4	3	3
83	2	4	1	1	1
84	3	3	3	3	2
85	4	5	4	3	4
86	5	5	5	3	3

## Respondent's Data for Risk Significance (Contd.)

S/No	Inappropriate Risk Allocation	Exchange Rate Fluctuation	Third Party Delays	Changes in scope of work	Inadequacy of Insurance
1	2	4	2	4	1
2	2	5	3	4	3
3	4	4	4	4	4
4	3	1	4	3	4
5	4	4	4	4	3
6	3	4	3	4	3
7	4	5	4	3	3
8	3	3	3	4	3
9	2	1	2	2	2
10	2	2	3	3	3
11	4	5	3	5	3
12	2	4	3	5	2
13	1	4	2	2	2
14	4	5	4	4	4
15	2	3	4	3	4
16	5	5	4	4	4
17	1	1	3	2	2
18	2	4	2	4	3
19	3	5	4	5	3
20	4	3	4	4	4
21	2	3	2	3	2
22	3	4	4	3	3
23	3	3	3	2	2
24	3	5	3	5	3
25	4	3	4	3	4
26	2	2	3	4	2
27	3	4	4	4	4
28	3	3	2	2	2
29	3	4	3	2	3
30	2	5	3	4	2
31	5	4	4	3	5
32	4	5	2	4	4
33	2	3	4	3	2



S/No	Inappropriate Risk Allocation	Exchange Rate Fluctuation	Third Party Delays	Changes in scope of work	Inadequacy of Insurance
34	3	5	3	2	3
35	1	2	3	3	1
36	2	4	3	4	2
37	5	4	4	4	3
38	3	4	1	3	2
39	3	4	3	3	2
40	3	4	2	4	3
41	3	3	2	2	2
42	3	5	3	4	2
43	2	4	3	4	2
44	3	5	3	4	2
45	2	4	3	4	2
46	5	2	2	4	2
47	4	2	3	5	3
48	3	3	3	3	3
49	3	3	3	4	4
50	4	4	4	4	5
51	3	3	4	4	4
52	2	5	3	2	5
53	1	4	2	4	3
54	3	3	4	4	3
55	3	4	4	4	3
56	4	5	2	5	2
57	2	3	2	3	2
58	2	2	1	3	2
59	2	2	1	2	2
60	2	2	1	3	2
61	2	3	1	2	2
62	3	3	2	2	2
63	2	2	1	2	2
64	4	4	2	3	4
65	4	3	2	3	1
66	3	2	4	4	3
67	4	4	4	5	3
68	4	4	3	4	3
69	4	3	4	4	5

S/No	Inappropriate Risk Allocation	Exchange Rate Fluctuation	Third Party Delays	Changes in scope of work	Inadequacy of Insurance
70	2	4	3	4	3
71	2	4	3	3	2
72	3	4	4	4	2
73	2	4	3	4	3
74	2	4	3	4	2
75	3	3	3	3	3
76	2	4	2	3	2
77	2	4	3	3	2
78	2	5	3	3	3
79	2	4	3	4	2
80	3	5	4	5	5
81	3	4	3	4	3
82	3	4	4	3	4
83	2	1	3	2	1
84	2	2	2	3	2
85	5	5	3	3	4
86	3	5	2	4	3

## Respondent's Data for Risk Significance (Contd.)

S/No	Improper Scope of work definition	Labor, Materials and Equipment availability	Labor disputes	Poor performance of Sub contractor	Poor coordination with Subcontractor
1	2	3	2	3	3
2	4	4	3	3	3
3	4	4	3	4	4
4	5	4	3	5	5
5	5	4	4	4	4
6	3	3	1	4	3
7	5	4	4	5	4
8	4	4	3	3	3
9	1	1	1	1	1
10	1	3	3	4	2
11	5	5	5	5	5
12	4	2	2	5	5
13	2	2	2	3	3
14	4	5	4	4	4
15	2	2	3	5	4
16	4	5	4	4	5
17	2	2	2	3	3
18	5	3	2	3	3
19	5	3	2	3	3
20	4	4	3	4	4
21	2	2	2	3	3
22	3	5	4	5	5
23	3	3	2	3	3
24	5	2	2	4	4
25	4	3	4	4	3
26	5	4	5	4	4
27	3	4	3	4	3
28	3	3	3	3	3
29	4	2	4	3	4
30	5	2	1	3	3
31	2	5	5	5	5

S/No	Improper Scope of work definition	Labor, Materials and Equipment availability	Labor disputes	Poor performance of Sub contractor	Poor coordination with Subcontractor
32	4	4	2	2	3
33	3	3	3	4	4
34	4	2	1	2	1
35	2	3	2	4	5
36	4	2	1	4	3
37	5	4	4	4	4
38	3	4	3	4	3
39	3	3	4	3	3
40	4	4	4	4	4
41	2	3	2	4	3
42	5	3	2	5	5
43	5	2	1	5	5
44	4	2	2	4	4
45	5	2	1	4	4
46	5	5	4	4	4
47	4	4	4	3	3
48	3	4	3	2	2
49	4	4	4	4	4
50	4	2	2	4	3
51	5	4	3	4	4
52	3	5	3	5	4
53	4	2	1	2	2
54	4	4	3	4	4
55	4	4	5	5	5
56	5	5	5	5	4
57	3	4	2	2	1
58	4	4	2	2	2
59	2	2	2	1	1
60	2	2	1	1	1
61	2	1	2	2	1
62	2	3	2	2	2
63	1	1	1	1	3
64	3	4	4	3	2
65	2	2	2	2	1
66	4	2	3	4	4

<b>S/No</b>	<b>Improper Scope of work definition</b>	<b>Labor, Materials and Equipment availability</b>	<b>Labor disputes</b>	<b>Poor performance of Sub contractor</b>	<b>Poor coordination with Subcontractor</b>
67	4	4	3	3	4
68	4	5	4	4	3
69	3	3	4	4	5
70	4	2	1	4	4
71	3	2	2	5	5
72	3	1	1	4	4
73	4	2	2	5	5
74	4	2	2	5	5
75	4	4	3	4	4
76	2	1	1	4	3
77	2	1	1	4	3
78	4	2	2	4	4
79	2	1	1	4	4
80	5	5	4	4	4
81	3	2	3	3	3
82	4	3	3	4	4
83	2	3	1	3	3
84	2	4	4	5	4
85	4	5	5	3	3
86	4	4	3	4	3

## Respondent's Data for Risk Significance (Contd.)

S/No	Terrorism/War threats	Defective material	Shortage of plant and equipment	Poor Productivity of plant and equipment	Shortage/Delay of material	Lack of qualified staff
1	4	5	4	1	3	1
2	2	3	3	3	4	4
3	3	5	5	4	5	4
4	2	5	5	4	4	4
5	3	4	5	4	4	4
6	1	2	3	2	3	2
7	3	4	5	4	4	4
8	4	3	4	3	4	4
9	1	1	1	2	5	5
10	2	2	2	2	4	4
11	5	5	5	4	5	5
12	3	2	3	4	3	3
13	5	2	3	3	3	2
14	5	4	4	3	4	5
15	2	3	4	2	3	3
16	4	4	5	3	4	3
17	1	2	2	2	2	2
18	2	3	4	3	4	2
19	3	2	3	3	3	5
20	3	4	3	3	4	4
21	3	3	3	3	4	3
22	3	5	3	5	5	5
23	2	3	3	3	4	3
24	3	2	4	3	3	3
25	4	4	3	4	4	3
26	3	5	5	4	4	5
27	3	3	3	4	3	3
28	3	3	3	4	3	3
29	3	3	3	3	3	4
30	2	2	2	3	3	2
31	3	5	5	5	5	5

S/No	Terrorism/War threats	Defective material	Shortage of plant and equipment	Poor Productivity of plant and equipment	Shortage/Delay of material	Lack of qualified staff
32	2	1	3	4	4	4
33	2	3	3	2	3	3
34	3	2	2	1	2	1
35	1	5	3	3	5	4
36	1	2	3	2	3	2
37	4	4	4	4	4	3
38	1	3	3	3	3	2
39	3	2	4	3	4	3
40	5	3	3	3	4	4
41	1	4	3	3	3	3
42	2	2	4	4	3	3
43	2	3	4	3	3	3
44	2	2	2	3	2	2
45	2	2	2	2	2	3
46	2	5	5	5	4	4
47	2	5	5	5	5	5
48	5	3	2	2	2	3
49	4	5	4	5	5	4
50	4	5	5	4	4	4
51	3	4	3	4	4	4
52	2	5	5	5	5	3
53	3	3	3	2	4	4
54	2	4	4	4	4	3
55	3	5	5	5	5	5
56	4	4	4	4	5	5
57	3	2	2	3	3	3
58	3	3	2	2	3	2
59	1	1	1	2	2	2
60	3	1	1	2	2	2
61	2	1	2	2	3	2
62	3	2	2	3	3	3
63	1	2	1	3	2	3
64	5	2	3	2	2	5
65	1	2	2	2	2	3
66	2	3	3	3	3	3

S/No	Terrorism/War threats	Defective material	Shortage of plant and equipment	Poor Productivity of plant and equipment	Shortage/Delay of material	Lack of qualified staff
67	2	3	4	3	4	3
68	2	4	4	4	5	4
69	4	4	4	4	3	4
70	2	2	3	3	2	2
71	2	2	4	3	1	2
72	1	2	4	4	3	3
73	1	3	3	4	3	3
74	2	3	3	3	3	2
75	2	4	4	4	4	5
76	1	2	2	2	2	2
77	2	2	3	3	2	2
78	2	3	4	3	3	2
79	1	3	4	4	3	3
80	5	4	4	5	5	5
81	2	2	3	3	3	3
82	1	3	4	3	4	4
83	1	3	2	2	3	4
84	4	4	5	4	4	3
85	4	5	5	4	5	5
86	2	4	5	4	4	4



## Respondent's Data for Risk Significance (Contd.)

S/No	Poor competence and productivity of labor	Payment delays	Availability of utilities	Adverse weather conditions	Political instability	Corruption including Bribery
1	1	3	3	5	5	3
2	4	4	4	5	3	3
3	4	4	4	3	3	4
4	4	5	3	4	3	5
5	4	4	3	3	3	4
6	1	5	3	2	2	3
7	4	4	3	3	4	4
8	4	3	4	4	4	5
9	5	3	2	3	3	4
10	3	3	2	3	3	2
11	5	5	4	4	3	5
12	3	4	2	2	2	1
13	3	5	5	3	5	3
14	4	5	4	4	5	5
15	2	3	4	2	4	2
16	3	5	5	4	5	4
17	2	3	2	2	1	1
18	2	3	3	2	3	2
19	4	5	3	4	2	4
20	4	4	3	4	4	3
21	2	3	2	2	3	2
22	5	5	4	3	4	3
23	3	4	4	2	2	3
24	2	4	2	3	2	1
25	3	2	4	4	3	3
26	4	4	4	3	2	3
27	2	3	2	3	3	3
28	3	4	4	4	3	3
29	4	5	3	4	4	4
30	1	4	2	2	2	1
31	5	5	5	5	5	5

S/No	Poor competence and productivity of labor	Payment delays	Availability of utilities	Adverse weather conditions	Political instability	Corruption including Bribery
32	4	4	3	4	4	4
33	3	2	3	2	2	2
34	2	3	2	1	1	2
35	3	4	3	2	1	1
36	1	5	2	2	2	3
37	4	5	5	4	4	4
38	3	4	3	1	1	2
39	3	4	3	4	4	4
40	4	3	4	4	5	5
41	3	4	2	3	2	3
42	2	4	3	2	2	3
43	2	4	2	1	1	1
44	2	3	2	2	2	1
45	2	4	2	2	2	1
46	5	3	4	2	2	5
47	5	5	4	3	3	5
48	3	5	2	3	4	5
49	4	4	4	4	4	4
50	4	4	4	4	3	5
51	5	5	4	4	4	6
52	5	5	3	2	1	1
53	2	4	3	1	1	3
54	4	4	3	3	3	2
55	5	4	4	3	3	3
56	5	5	5	3	3	5
57	4	4	2	4	4	2
58	2	3	2	4	4	2
59	2	3	2	3	4	3
60	2	3	2	3	4	3
61	2	3	3	2	3	3
62	3	4	3	4	4	3
63	3	3	2	3	3	3
64	3	3	2	5	5	4
65	3	4	1	4	3	5
66	3	4	4	3	4	4

S/No	Poor competence and productivity of labor	Payment delays	Availability of utilities	Adverse weather conditions	Political instability	Corruption including Bribery
67	3	4	4	3	4	3
68	4	4	3	3	4	5
69	4	5	4	5	4	5
70	1	4	2	1	2	2
71	2	3	3	3	2	2
72	3	4	3	2	3	3
73	2	5	3	2	2	2
74	2	4	3	2	2	1
75	4	5	5	3	3	3
76	1	5	3	2	2	2
77	1	4	2	3	3	2
78	2	4	2	2	2	2
79	2	5	3	2	2	2
80	5	5	4	5	5	5
81	3	4	3	3	3	2
82	4	5	4	3	3	5
83	3	4	3	3	1	2
84	4	4	4	2	2	5
85	5	5	4	4	4	5
86	5	3	3	4	4	2

## Appendix III

### Respondent's Data for Risk Responsibility

S/No	Safety	Defective Design	Funding Problem	Permits	Bad Quality Material and Equipment
1	Contractor	Client	Client	Client	Contractor
2	Contractor	Client	Client	Contractor	Contractor
3	Contractor	Client	Client	Contractor	Contractor
4	Contractor	Client	Client	Contractor	Shared
5	Contractor	Client	Client	Client	Contractor
6	Shared	Client	Client	Client	Contractor
7	Contractor	Client	Client	Client	Contractor
8	Shared	Client	Client	Client	Shared
9	Contractor	Client	Contractor	Shared	Contractor
10	Contractor	Contractor	Client	Contractor	Shared
11	Shared	Client	Shared	Contractor	Contractor
12	Shared	Client	Client	Shared	Contractor
13	Contractor	Client	Client	Shared	Contractor
14	Client	Client	Client	Client	Contractor
15	Shared	Client	Client	Shared	Contractor
16	Client	Client	Client	Shared	Contractor
17	Contractor	Shared	Client	Contractor	Contractor
18	Contractor	Client	Client	Shared	Contractor
19	Shared	Client	Client	Shared	Contractor
20	Contractor	Shared	Client	Shared	Contractor
21	Shared	Client	Client	Contractor	Contractor
22	Shared	Client	Client	Contractor	Contractor
23	Contractor	Shared	Client	Shared	Contractor
24	Client	Client	Client	Client	Contractor
25	Shared	Shared	Shared	Shared	Shared
26	Contractor	Client	Client	Client	Contractor
27	Contractor	Client	Client	Client	Contractor
28	Contractor	Client	Client	Client	Contractor
29	Shared	Client	Client	Client	Contractor

<b>S/No</b>	<b>Safety</b>	<b>Defective Design</b>	<b>Funding Problem</b>	<b>Permits</b>	<b>Bad Quality Material and Equipment</b>
30	Contractor	Client	Client	Client	Contractor
31	Contractor	Shared	Shared	Shared	Contractor
32	Contractor	Client	Client	Contractor	Contractor
33	Contractor	Contractor	Client	Client	Shared
34	Contractor	Client	Client	Client	Shared
35	Shared	Client	Shared	Client	Contractor
36	Contractor	Client	Client	Client	Contractor
37	Contractor	Client	Client	Client	Contractor
38	Contractor	Client	Client	Client	Contractor
39	Contractor	Client	Client	Client	Shared
40	Contractor	Client	Shared	Client	Contractor
41	Client	Shared	Shared	Contractor	Client
42	Contractor	Client	Client	Shared	Contractor
43	Client	Client	Client	Client	Contractor
44	Contractor	Client	Client	Client	Contractor
45	Contractor	Client	Client	Client	Contractor
46	Contractor	Client	Client	Contractor	Contractor
47	Contractor	Shared	Client	Client	Contractor
48	Contractor	Client	Client	Shared	Contractor
49	Contractor	Shared	Client	Shared	Contractor
50	Shared	Shared	Client	Client	Contractor
51	Contractor	Client	Client	Shared	Shared
52	Contractor	Client	Client	Client	Contractor
53	Shared	Client	Client	Contractor	Contractor
54	Contractor	Client	Client	Client	Contractor
55	Shared	Contractor	Client	Client	Contractor
56	Shared	Client	Client	Client	Contractor
57	Contractor	Client	Client	Client	Contractor
58	Contractor	Client	Client	Client	Contractor
59	Contractor	Client	Client	Client	Contractor
60	Contractor	Client	Client	Client	Contractor
61	Contractor	Client	Contractor	Client	Contractor
62	Contractor	Client	Client	Contractor	Contractor
63	Contractor	Client	Client	Client	Client
64	Shared	Shared	Client	Client	Contractor
65	Contractor	Client	Client	Contractor	Contractor

<b>S/No</b>	<b>Safety</b>	<b>Defective Design</b>	<b>Funding Problem</b>	<b>Permits</b>	<b>Bad Quality Material and Equipment</b>
66	Contractor	Client	Client	Contractor	Contractor
67	Shared	Client	Shared	Client	Contractor
68	Shared	Shared	Client	Contractor	Contractor
69	Contractor	Client	Client	Client	Contractor
70	Client	Client	Client	Client	Contractor
71	Shared	Client	Client	Client	Contractor
72	Shared	Client	Client	Client	Contractor
73	Shared	Client	Client	Client	Contractor
74	Contractor	Client	Client	Shared	Contractor
75	Shared	Client	Client	Client	Contractor
76	Shared	Client	Client	Client	Contractor
77	Contractor	Client	Client	Client	Contractor
78	Shared	Client	Client	Client	Contractor
79	Shared	Client	Client	Client	Contractor
80	Contractor	Client	Client	Shared	Contractor
81	Contractor	Shared	Client	Client	Contractor
82	Contractor	Shared	Client	Client	Contractor
83	Contractor	Shared	Client	Client	Contractor
84	Contractor	Shared	Client	Shared	Contractor
85	Contractor	Client	Client	Shared	Contractor
86	Contractor	Client	Client	Shared	Client

## Respondent's Data for Risk Responsibility (Contd.)

S/No	Natural Disaster	Inaccurate schedule	Disputes with contractor	Unforeseen Site Conditions	Differing site conditions
1	Shared	Contractor	Contractor	Shared	Contractor
2	Shared	Contractor	Shared	Shared	Contractor
3	Shared	Contractor	Shared	Shared	Client
4	Contractor	Contractor	Shared	Shared	Shared
5	Shared	Contractor	Shared	Shared	Shared
6	Client	Contractor	Shared	Client	Client
7	Shared	Contractor	Shared	Shared	Shared
8	Shared	Shared	Contractor	Contractor	Contractor
9	Shared	Contractor	Contractor	Shared	Shared
10	Shared	Shared	Shared	Contractor	Contractor
11	Shared	Contractor	Contractor	Shared	Shared
12	Client	Contractor	Shared	Client	Client
13	Client	Contractor	Shared	Client	Client
14	Client	Contractor	Shared	Client	Client
15	Shared	Contractor	Client	Client	Client
16	Shared	Contractor	Shared	Client	Client
17	Client	Contractor	Client	Contractor	Contractor
18	Shared	Contractor	Shared	Client	Client
19	Shared	Contractor	Contractor	Shared	Shared
20	Shared	Contractor	Shared	Contractor	Contractor
21	Shared	Contractor	Shared	Contractor	Contractor
22	Shared	Contractor	Shared	Shared	Client
23	Shared	Contractor	Shared	Shared	Shared
24	Client	Contractor	Shared	Client	Client
25	Shared	Shared	Shared	Contractor	Contractor
26	Shared	Contractor	Shared	Contractor	Shared
27	Shared	Contractor	Client	Client	Client
28	Contractor	Contractor	Client	Contractor	Contractor
29	Shared	Shared	Contractor	Shared	Shared
30	Client	Contractor	Shared	Client	Client
31	Shared	Contractor	Shared	Shared	Shared
32	Shared	Contractor	Shared	Shared	Contractor
33	Shared	Contractor	Shared	Shared	Client

<b>S/No</b>	<b>Natural Disaster</b>	<b>Inaccurate schedule</b>	<b>Disputes with contractor</b>	<b>Unforeseen Site Conditions</b>	<b>Differing site conditions</b>
34	Client	Contractor	Client	Shared	Shared
35	Shared	Contractor	Shared	Shared	Shared
36	Shared	Contractor	Shared	Client	Client
37	Client	Contractor	Shared	Shared	Shared
38	Shared	Contractor	Shared	Shared	Client
39	Client	Contractor	Client	Shared	Client
40	Shared	Contractor	Client	Shared	Client
41	Shared	Client	Shared	Shared	Shared
42	Client	Contractor	Shared	Client	Client
43	Client	Contractor	Client	Client	Client
44	Client	Contractor	Shared	Client	Client
45	Client	Contractor	Shared	Client	Client
46	Client	Contractor	Client	Contractor	Contractor
47	Shared	Contractor	Shared	Shared	Shared
48	Client	Contractor	Client	Contractor	Shared
49	Contractor	Contractor	Shared	Shared	Client
50	Client	Contractor	Shared	Contractor	Contractor
51	Shared	Contractor	Shared	Shared	Client
52	Shared	Shared	Shared	Client	Client
53	Shared	Client	Shared	Shared	Shared
54	Shared	Contractor	Shared	Shared	Shared
55	Shared	Contractor	Shared	Client	Shared
56	Client	Contractor	Shared	Shared	Shared
57	Shared	Shared	Shared	Contractor	Shared
58	Shared	Contractor	Shared	Shared	Shared
59	Shared	Contractor	Shared	Shared	Shared
60	Shared	Contractor	Shared	Shared	Shared
61	Shared	Contractor	Shared	Contractor	Shared
62	Shared	Shared	Contractor	Contractor	Contractor
63	Contractor	Contractor	Shared	Contractor	Shared
64	Shared	Contractor	Shared	Shared	Shared
65	Client	Contractor	Shared	Client	Client
66	Client	Contractor	Shared	Client	Client
67	Shared	Shared	Client	Shared	Shared
68	Shared	Client	Shared	Shared	Client
69	Shared	Shared	Shared	Shared	Shared



<b>S/No</b>	<b>Natural Disaster</b>	<b>Inaccurate schedule</b>	<b>Disputes with contractor</b>	<b>Unforeseen Site Conditions</b>	<b>Differing site conditions</b>
70	Client	Contractor	Client	Client	Client
71	Client	Contractor	Shared	Client	Client
72	Client	Contractor	Shared	Client	Client
73	Shared	Contractor	Shared	Client	Client
74	Client	Contractor	Shared	Client	Client
75	Client	Contractor	Client	Shared	Shared
76	Shared	Contractor	Shared	Client	Client
77	Client	Contractor	Shared	Client	Client
78	Client	Contractor	Shared	Client	Client
79	Client	Contractor	Shared	Client	Client
80	Shared	Contractor	Shared	Shared	Shared
81	Shared	Contractor	Shared	Contractor	Contractor
82	Client	Contractor	Contractor	Shared	Shared
83	Client	Contractor	Contractor	Shared	Shared
84	Shared	Contractor	Client	Shared	Shared
85	Shared	Client	Client	Shared	Shared
86	Shared	Contractor	Shared	Client	Client

## Respondent's Data for Risk Responsibility (Contd.)

S/No	Inaccurate estimation	Availability of drawings	Insufficient Technology	Theft/ Robbery	Change in Codes and Regulations
1	Contractor	Client	Contractor	Contractor	Contractor
2	Client	Client	Contractor	Contractor	Shared
3	Client	Client	Contractor	Contractor	Shared
4	Client	Client	Shared	Contractor	Shared
5	Shared	Client	Shared	Contractor	Client
6	Contractor	Client	Contractor	Contractor	Client
7	Shared	Client	Shared	Contractor	Client
8	Client	Client	Contractor	Contractor	Client
9	Contractor	Client	Contractor	Contractor	Client
10	Shared	Contractor	Shared	Contractor	Client
11	Shared	Client	Client	Contractor	Client
12	Contractor	Client	Contractor	Contractor	Client
13	Client	Client	Contractor	Contractor	Shared
14	Contractor	Client	Contractor	Contractor	Client
15	Contractor	Client	Contractor	Contractor	Client
16	Contractor	Client	Contractor	Contractor	Client
17	Client	Client	Contractor	Contractor	Contractor
18	Contractor	Client	Contractor	Contractor	Client
19	Client	Client	Contractor	Contractor	Shared
20	Shared	Client	Contractor	Shared	Shared
21	Shared	Client	Shared	Shared	Client
22	Client	Client	Contractor	Shared	Client
23	Shared	Shared	Contractor	Shared	Shared
24	Contractor	Client	Contractor	Contractor	Client
25	Contractor	Client	Contractor	Contractor	Shared
26	Shared	Client	Contractor	Contractor	Client
27	Contractor	Client	Client	Client	Client
28	Client	Contractor	Client	Client	Client
29	Client	Client	Shared	Contractor	Shared
30	Shared	Client	Contractor	Contractor	Client
31	Client	Shared	Shared	Contractor	Shared
32	Contractor	Shared	Contractor	Contractor	Client
33	Client	Client	Contractor	Shared	Client

<b>S/No</b>	<b>Inaccurate estimation</b>	<b>Availability of drawings</b>	<b>Insufficient Technology</b>	<b>Theft/ Robbery</b>	<b>Change in Codes and Regulations</b>
34	Client	Client	Shared	Contractor	Client
35	Client	Client	Contractor	Contractor	Client
36	Shared	Client	Contractor	Contractor	Client
37	Client	Client	Contractor	Contractor	Shared
38	Contractor	Client	Shared	Contractor	Shared
39	Contractor	Client	Shared	Contractor	Client
40	Client	Client	Shared	Contractor	Shared
41	Shared	Contractor	Shared	Contractor	Shared
42	Contractor	Client	Contractor	Contractor	Client
43	Contractor	Client	Contractor	Contractor	Client
44	Contractor	Client	Contractor	Contractor	Client
45	Shared	Client	Contractor	Contractor	Client
46	Client	Client	Contractor	Contractor	Shared
47	Shared	Shared	Contractor	Contractor	Shared
48	Client	Shared	Contractor	Contractor	Client
49	Shared	Shared	Contractor	Contractor	Contractor
50	Shared	Contractor	Contractor	Contractor	Client
51	Client	Client	Contractor	Contractor	Shared
52	Shared	Client	Contractor	Contractor	Client
53	Client	Client	Client	Contractor	Client
54	Client	Client	Contractor	Contractor	Shared
55	Client	Client	Contractor	Contractor	Shared
56	Client	Client	Shared	Contractor	Shared
57	Contractor	Client	Contractor	Contractor	Client
58	Shared	Client	Contractor	Contractor	Client
59	Contractor	Client	Contractor	Contractor	Client
60	Contractor	Client	Contractor	Contractor	Client
61	Contractor	Client	Contractor	Contractor	Contractor
62	Contractor	Client	Client	Contractor	Shared
63	Contractor	Client	Contractor	Contractor	Contractor
64	Contractor	Client	Contractor	Contractor	Shared
65	Client	Client	Contractor	Contractor	Client
66	Client	Client	Contractor	Contractor	Client
67	Shared	Client	Contractor	Shared	Shared
68	Contractor	Client	Contractor	Contractor	Shared
69	Contractor	Client	Contractor	Contractor	Shared

<b>S/No</b>	<b>Inaccurate estimation</b>	<b>Availability of drawings</b>	<b>Insufficient Technology</b>	<b>Theft/ Robbery</b>	<b>Change in Codes and Regulations</b>
70	Contractor	Client	Contractor	Contractor	Client
71	Contractor	Client	Contractor	Contractor	Client
72	Contractor	Client	Contractor	Contractor	Client
73	Contractor	Client	Contractor	Contractor	Client
74	Contractor	Client	Contractor	Contractor	Client
75	Shared	Client	Contractor	Contractor	Client
76	Contractor	Client	Contractor	Contractor	Client
77	Contractor	Client	Contractor	Contractor	Client
78	Contractor	Client	Contractor	Contractor	Client
79	Contractor	Client	Contractor	Contractor	Client
80	Client	Client	Shared	Shared	Shared
81	Shared	Shared	Contractor	Contractor	Shared
82	Contractor	Client	Shared	Contractor	Shared
83	Contractor	Client	Shared	Contractor	Shared
84	Contractor	Client	Client	Contractor	Shared
85	Client	Client	Shared	Contractor	Shared
86	Client	Client	Shared	Contractor	Client

## Respondent's Data for Risk Responsibility (Contd.)

S/No	Inappropriate Risk Allocation	Exchange Rate Fluctuation	Third Party Delays	Changes in scope of work	Inadequacy of Insurance
1	Contractor	Contractor	Contractor	Contractor	Contractor
2	Shared	Shared	Contractor	Shared	Contractor
3	Client	Shared	Shared	Client	Contractor
4	Shared	Shared	Contractor	Shared	Contractor
5	Client	Shared	Shared	Client	Client
6	Shared	Client	Contractor	Client	Shared
7	Client	Shared	Shared	Client	Client
8	Shared	Shared	Contractor	Shared	Shared
9	Client	Client	Client	Client	Shared
10	Shared	Shared	Client	Shared	Shared
11	Client	Client	Client	Client	Shared
12	Shared	Shared	Contractor	Client	Client
13	Shared	Client	Shared	Client	Contractor
14	Shared	Client	Contractor	Client	Shared
15	Client	Client	Contractor	Client	Shared
16	Shared	Shared	Contractor	Contractor	Shared
17	Shared	Shared	Contractor	Client	Contractor
18	Shared	Client	Contractor	Client	Client
19	Shared	Shared	Shared	Shared	Contractor
20	Shared	Shared	Shared	Client	Contractor
21	Client	Shared	Shared	Shared	Shared
22	Client	Shared	Shared	Client	Contractor
23	Shared	Shared	Shared	Shared	Contractor
24	Shared	Shared	Contractor	Client	Client
25	Client	Shared	Contractor	Contractor	Contractor
26	Contractor	Contractor	Contractor	Shared	Contractor
27	Client	Client	Client	Contractor	Client
28	Client	Contractor	Contractor	Client	Contractor
29	Shared	Client	Shared	Client	Shared
30	Shared	Client	Contractor	Client	Shared
31	Contractor	Client	Shared	Client	Contractor
32	Contractor	Contractor	Client	Contractor	Client
33	Client	Shared	Contractor	Client	Shared

<b>S/No</b>	<b>Inappropriate Risk Allocation</b>	<b>Exchange Rate Fluctuation</b>	<b>Third Party Delays</b>	<b>Changes in scope of work</b>	<b>Inadequacy of Insurance</b>
34	Client	Shared	Contractor	Client	Shared
35	Client	Shared	Contractor	Client	Client
36	Shared	Shared	Contractor	Client	Shared
37	Shared	Shared	Shared	Client	Contractor
38	Shared	Contractor	Shared	Client	Contractor
39	Shared	Client	Contractor	Client	Shared
40	Shared	Shared	Shared	Client	Contractor
41	Shared	Shared	Contractor	Shared	Client
42	Shared	Client	Contractor	Client	Shared
43	Shared	Client	Contractor	Client	Shared
44	Shared	Client	Contractor	Client	Shared
45	Shared	Client	Contractor	Client	Shared
46	Client	Shared	Shared	Client	Contractor
47	Client	Shared	Client	Client	Shared
48	Client	Client	Shared	Client	Contractor
49	Contractor	Shared	Contractor	Client	Contractor
50	Shared	Shared	Shared	Shared	Client
51	Shared	Shared	Shared	Client	Shared
52	Client	Shared	Shared	Client	Shared
53	Shared	Shared	Shared	Client	Shared
54	Client	Shared	Contractor	Client	Contractor
55	Client	Shared	Contractor	Client	Contractor
56	Shared	Client	Client	Shared	Client
57	Shared	Contractor	Contractor	Shared	Shared
58	Shared	Contractor	Contractor	Client	Shared
59	Shared	Shared	Contractor	Shared	Contractor
60	Shared	Shared	Contractor	Shared	Contractor
61	Shared	Shared	Contractor	Contractor	Contractor
62	Contractor	Contractor	Contractor	Shared	Shared
63	Shared	Shared	Contractor	Shared	Contractor
64	Contractor	Client	Contractor	Shared	Client
65	Client	Client	Shared	Client	Client
66	Client	Client	Shared	Client	Client
67	Shared	Shared	Client	Client	Contractor
68	Shared	Shared	Shared	Client	Contractor
69	Client	Contractor	Shared	Shared	Contractor

S/No	Inappropriate Risk Allocation	Exchange Rate Fluctuation	Third Party Delays	Changes in scope of work	Inadequacy of Insurance
70	Shared	Client	Contractor	Client	Shared
71	Shared	Client	Contractor	Client	Shared
72	Shared	Client	Contractor	Client	Shared
73	Shared	Client	Contractor	Client	Shared
74	Shared	Client	Contractor	Client	Shared
75	Client	Contractor	Contractor	Client	Shared
76	Shared	Client	Contractor	Client	Shared
77	Shared	Shared	Contractor	Client	Shared
78	Shared	Client	Contractor	Client	Shared
79	Shared	Client	Contractor	Client	Shared
80	Shared	Shared	Shared	Client	Contractor
81	Client	Client	Shared	Client	Shared
82	Contractor	Shared	Contractor	Client	Client
83	Contractor	Shared	Contractor	Client	Client
84	Shared	Shared	Shared	Shared	Shared
85	Client	Shared	Shared	Client	Client
86	Client	Contractor	Shared	Client	Shared

## Respondent's Data for Risk Responsibility (Contd.)

S/No	Improper Scope of work definition	Labor, Materials and Equipment availability	Labor disputes	Poor performance of Sub contractor	Poor coordination with Subcontractor
1	Shared	Contractor	Contractor	Contractor	Contractor
2	Client	Contractor	Contractor	Contractor	Contractor
3	Client	Contractor	Contractor	Contractor	Contractor
4	Client	Contractor	Shared	Contractor	Contractor
5	Client	Contractor	Contractor	Contractor	Contractor
6	Client	Contractor	Contractor	Contractor	Contractor
7	Client	Contractor	Contractor	Contractor	Contractor
8	Shared	Contractor	Contractor	Contractor	Contractor
9	Client	Contractor	Contractor	Contractor	Contractor
10	Client	Contractor	Shared	Contractor	Client
11	Client	Contractor	Contractor	Contractor	Contractor
12	Client	Contractor	Contractor	Contractor	Contractor
13	Client	Shared	Contractor	Contractor	Contractor
14	Client	Contractor	Contractor	Shared	Contractor
15	Client	Contractor	Contractor	Contractor	Contractor
16	Shared	Contractor	Contractor	Contractor	Contractor
17	Contractor	Contractor	Contractor	Contractor	Contractor
18	Client	Contractor	Contractor	Contractor	Contractor
19	Shared	Contractor	Contractor	Contractor	Contractor
20	Client	Contractor	Contractor	Contractor	Contractor
21	Client	Shared	Contractor	Shared	Contractor
22	Shared	Contractor	Contractor	Contractor	Shared
23	Shared	Contractor	Contractor	Contractor	Contractor
24	Client	Contractor	Contractor	Contractor	Contractor
25	Contractor	Contractor	Contractor	Contractor	Contractor
26	Client	Contractor	Contractor	Contractor	Contractor
27	Shared	Client	Contractor	Client	Contractor
28	Client	Client	Contractor	Contractor	Contractor
29	Shared	Contractor	Shared	Shared	Shared
30	Shared	Contractor	Contractor	Contractor	Contractor
31	Client	Contractor	Contractor	Contractor	Contractor



<b>S/No</b>	<b>Improper Scope of work definition</b>	<b>Labor, Materials and Equipment availability</b>	<b>Labor disputes</b>	<b>Poor performance of Sub contractor</b>	<b>Poor coordination with Subcontractor</b>
32	Contractor	Contractor	Contractor	Contractor	Client
33	Client	Contractor	Contractor	Contractor	Contractor
34	Shared	Contractor	Contractor	Contractor	Contractor
35	Client	Contractor	Contractor	Shared	Client
36	Shared	Contractor	Contractor	Contractor	Contractor
37	Client	Contractor	Contractor	Contractor	Contractor
38	Shared	Contractor	Contractor	Contractor	Contractor
39	Client	Contractor	Contractor	Contractor	Contractor
40	Client	Contractor	Contractor	Contractor	Contractor
41	Shared	Contractor	Contractor	Client	Client
42	Shared	Contractor	Contractor	Contractor	Contractor
43	Client	Contractor	Contractor	Contractor	Contractor
44	Shared	Contractor	Contractor	Contractor	Contractor
45	Shared	Contractor	Contractor	Contractor	Contractor
46	Client	Contractor	Contractor	Contractor	Contractor
47	Shared	Contractor	Contractor	Contractor	Contractor
48	Client	Contractor	Contractor	Contractor	Contractor
49	Client	Contractor	Contractor	Contractor	Contractor
50	Shared	Contractor	Contractor	Contractor	Shared
51	Client	Contractor	Contractor	Contractor	Contractor
52	Client	Contractor	Contractor	Contractor	Contractor
53	Shared	Contractor	Contractor	Contractor	Contractor
54	Client	Contractor	Contractor	Contractor	Contractor
55	Client	Contractor	Contractor	Contractor	Contractor
56	Client	Contractor	Contractor	Contractor	Contractor
57	Client	Contractor	Contractor	Contractor	Contractor
58	Client	Contractor	Contractor	Contractor	Contractor
59	Shared	Shared	Contractor	Contractor	Contractor
60	Shared	Shared	Contractor	Contractor	Contractor
61	Shared	Contractor	Contractor	Contractor	Contractor
62	Contractor	Contractor	Contractor	Contractor	Contractor
63	Shared	Contractor	Shared	Contractor	Contractor
64	Client	Contractor	Contractor	Contractor	Contractor
65	Client	Contractor	Contractor	Contractor	Contractor

<b>S/No</b>	<b>Improper Scope of work definition</b>	<b>Labor, Materials and Equipment availability</b>	<b>Labor disputes</b>	<b>Poor performance of Sub contractor</b>	<b>Poor coordination with Subcontractor</b>
66	Client	Contractor	Contractor	Contractor	Contractor
67	Client	Contractor	Contractor	Contractor	Shared
68	Client	Contractor	Shared	Contractor	Contractor
69	Shared	Contractor	Contractor	Contractor	Contractor
70	Client	Contractor	Contractor	Contractor	Contractor
71	Shared	Contractor	Contractor	Contractor	Contractor
72	Client	Contractor	Contractor	Contractor	Contractor
73	Shared	Contractor	Contractor	Contractor	Contractor
74	Shared	Contractor	Contractor	Contractor	Contractor
75	Shared	Contractor	Contractor	Contractor	Contractor
76	Client	Contractor	Contractor	Contractor	Contractor
77	Shared	Contractor	Contractor	Contractor	Contractor
78	Shared	Contractor	Contractor	Contractor	Contractor
79	Shared	Contractor	Contractor	Contractor	Contractor
80	Client	Contractor	Shared	Contractor	Contractor
81	Client	Contractor	Contractor	Contractor	Contractor
82	Client	Contractor	Contractor	Contractor	Contractor
83	Client	Contractor	Contractor	Contractor	Contractor
84	Shared	Contractor	Contractor	Contractor	Contractor
85	Client	Contractor	Contractor	Contractor	Shared
86	Client	Contractor	Contractor	Contractor	Contractor

## Respondent's Data for Risk Responsibility (Contd.)

S/No	Terrorism/ War threats	Defective material	Shortage of plant and equipment	Poor Productivity of plant and equipment	Shortage/ Delay of material	Lack of qualified staff
1	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
2	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
3	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
4	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
5	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
6	Client	Contractor	Contractor	Contractor	Contractor	Shared
7	Shared	Contractor	Contractor	Contractor	Contractor	Shared
8	Shared	Contractor	Shared	Contractor	Contractor	Contractor
9	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
10	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
11	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
12	Client	Contractor	Contractor	Contractor	Contractor	Shared
13	Client	Contractor	Contractor	Contractor	Contractor	Contractor
14	Client	Contractor	Contractor	Contractor	Contractor	Shared
15	Shared	Contractor	Contractor	Contractor	Contractor	Shared
16	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
17	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
18	Client	Contractor	Contractor	Contractor	Contractor	Shared
19	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
20	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
21	Client	Shared	Contractor	Contractor	Shared	Shared
22	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
23	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
24	Client	Contractor	Contractor	Contractor	Contractor	Shared
25	Contractor	Contractor	Contractor	Contractor	Contractor	Contractor
26	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
27	Contractor	Contractor	Client	Client	Contractor	Contractor
28	Shared	Contractor	Shared	Contractor	Contractor	Contractor
29	Shared	Shared	Shared	Contractor	Contractor	Shared
30	Client	Contractor	Contractor	Contractor	Contractor	Shared
31	Client	Contractor	Contractor	Contractor	Shared	Contractor

S/No	Terrorism/ War threats	Defective material	Shortage of plant and equipment	Poor Productivity of plant and equipment	Shortage/ Delay of material	Lack of qualified staff
32	Client	Client	Contractor	Contractor	Contractor	Contractor
33	Shared	Contractor	Contractor	Contractor	Shared	Shared
34	Shared	Contractor	Contractor	Contractor	Contractor	Shared
35	Shared	Contractor	Contractor	Contractor	Contractor	Shared
36	Shared	Contractor	Contractor	Contractor	Contractor	Shared
37	Client	Contractor	Contractor	Contractor	Contractor	Contractor
38	Shared	Contractor	Contractor	Shared	Shared	Shared
39	Client	Shared	Contractor	Contractor	Shared	Contractor
40	Shared	Contractor	Contractor	Contractor	Contractor	Shared
41	Shared	Client	Shared	Client	Contractor	Shared
42	Client	Contractor	Contractor	Contractor	Contractor	Shared
43	Client	Contractor	Contractor	Contractor	Contractor	Shared
44	Client	Contractor	Contractor	Contractor	Contractor	Shared
45	Client	Contractor	Contractor	Contractor	Contractor	Shared
46	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
47	Client	Contractor	Contractor	Contractor	Contractor	Contractor
48	Client	Contractor	Contractor	Contractor	Contractor	Contractor
49	Client	Contractor	Contractor	Contractor	Contractor	Contractor
50	Shared	Shared	Client	Contractor	Contractor	Contractor
51	Shared	Shared	Client	Contractor	Client	Shared
52	Shared	Contractor	Contractor	Contractor	Contractor	Shared
53	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
54	Shared	Contractor	Contractor	Contractor	Contractor	Shared
55	Shared	Contractor	Contractor	Contractor	Contractor	Shared
56	Shared	Contractor	Contractor	Contractor	Contractor	Shared
57	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
58	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
59	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
60	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
61	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
62	Shared	Contractor	Contractor	Contractor	Contractor	Shared
63	Shared	Contractor	Shared	Contractor	Client	Contractor
64	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
65	Shared	Contractor	Contractor	Contractor	Contractor	Contractor

<b>S/No</b>	<b>Terrorism/ War threats</b>	<b>Defective material</b>	<b>Shortage of plant and equipment</b>	<b>Poor Productivity of plant and equipment</b>	<b>Shortage/ Delay of material</b>	<b>Lack of qualified staff</b>
66	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
67	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
68	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
69	Shared	Contractor	Contractor	Contractor	Contractor	Shared
70	Client	Contractor	Contractor	Contractor	Contractor	Shared
71	Shared	Contractor	Contractor	Contractor	Contractor	Shared
72	Shared	Contractor	Contractor	Contractor	Contractor	Shared
73	Shared	Contractor	Contractor	Contractor	Contractor	Shared
74	Client	Contractor	Contractor	Contractor	Contractor	Shared
75	Client	Shared	Contractor	Contractor	Contractor	Shared
76	Shared	Contractor	Contractor	Contractor	Contractor	Shared
77	Shared	Contractor	Contractor	Contractor	Contractor	Shared
78	Client	Contractor	Contractor	Contractor	Contractor	Shared
79	Client	Contractor	Contractor	Contractor	Contractor	Shared
80	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
81	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
82	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
83	Shared	Contractor	Contractor	Contractor	Contractor	Contractor
84	Shared	Contractor	Contractor	Contractor	Contractor	Shared
85	Shared	Contractor	Contractor	Contractor	Contractor	Shared
86	Client	Shared	Contractor	Contractor	Contractor	Shared

## Respondent's Data for Risk Responsibility (Contd.)

S/No	Poor competence and productivity of labor	Payment delays	Availability of utilities	Adverse weather conditions	Political instability	Corruption including Bribery
1	Contractor	Client	Contractor	Shared	Shared	Shared
2	Contractor	Client	Shared	Shared	Shared	Shared
3	Contractor	Client	Contractor	Shared	Shared	Shared
4	Contractor	Client	Contractor	Shared	Shared	Contractor
5	Contractor	Shared	Shared	Shared	Shared	Shared
6	Contractor	Client	Client	Client	Client	Contractor
7	Contractor	Shared	Shared	Shared	Shared	Shared
8	Contractor	Client	Contractor	Shared	Shared	Shared
9	Contractor	Client	Contractor	Shared	Shared	Shared
10	Contractor	Client	Contractor	Contractor	Shared	Contractor
11	Contractor	Client	Contractor	Shared	Client	Shared
12	Contractor	Client	Shared	Shared	Client	Shared
13	Contractor	Client	Client	Client	Shared	Shared
14	Contractor	Client	Client	Client	Client	Contractor
15	Contractor	Client	Client	Shared	Client	Shared
16	Contractor	Client	Client	Shared	Shared	Shared
17	Contractor	Contractor	Contractor	Shared	Shared	Contractor
18	Contractor	Client	Shared	Shared	Shared	Shared
19	Contractor	Shared	Contractor	Shared	Shared	Contractor
20	Contractor	Client	Client	Contractor	Contractor	Client
21	Contractor	Client	Shared	Shared	Shared	Shared
22	Shared	Shared	Contractor	Contractor	Shared	Shared
23	Contractor	Shared	Shared	Shared	Shared	Shared
24	Contractor	Client	Client	Shared	Client	Shared
25	Contractor	Shared	Shared	Contractor	Contractor	Shared
26	Contractor	Client	Contractor	Shared	Shared	Shared
27	Contractor	Client	Client	Client	Client	Client
28	Contractor	Client	Client	Shared	Shared	Contractor
29	Shared	Client	Shared	Shared	Shared	Shared
30	Contractor	Client	Client	Client	Client	Shared
31	Contractor	Client	Shared	Shared	Shared	Contractor

<b>S/No</b>	<b>Poor competence and productivity of labor</b>	<b>Payment delays</b>	<b>Availability of utilities</b>	<b>Adverse weather conditions</b>	<b>Political instability</b>	<b>Corruption including Bribery</b>
32	Contractor	Client	Contractor	Shared	Shared	Shared
33	Contractor	Client	Client	Shared	Shared	Shared
34	Contractor	Client	Contractor	Shared	Shared	Shared
35	Contractor	Client	Contractor	Shared	Shared	Contractor
36	Contractor	Client	Client	Shared	Shared	Shared
37	Contractor	Client	Client	Client	Client	Contractor
38	Shared	Contractor	Shared	Shared	Shared	Shared
39	Contractor	Client	Client	Client	Client	Contractor
40	Contractor	Shared	Contractor	Shared	Shared	Contractor
41	Contractor	Shared	Shared	Shared	Shared	Client
42	Contractor	Client	Shared	Client	Client	Shared
43	Contractor	Client	Client	Client	Client	Shared
44	Contractor	Client	Client	Client	Client	Shared
45	Contractor	Client	Client	Client	Client	Shared
46	Client	Contractor	Contractor	Shared	Shared	Client
47	Contractor	Shared	Shared	Shared	Shared	Shared
48	Contractor	Client	Client	Client	Client	Client
49	Contractor	Client	Client	Shared	Shared	Shared
50	Contractor	Shared	Shared	Shared	Shared	Shared
51	Contractor	Client	Shared	Shared	Shared	Shared
52	Contractor	Client	Shared	Shared	Shared	Shared
53	Contractor	Client	Shared	Shared	Shared	Shared
54	Contractor	Client	Contractor	Shared	Shared	Shared
55	Contractor	Client	Contractor	Shared	Shared	Shared
56	Contractor	Client	Client	Shared	Shared	Contractor
57	Contractor	Client	Client	Shared	Client	Shared
58	Contractor	Contractor	Client	Shared	Shared	Shared
59	Contractor	Client	Client	Client	Shared	Shared
60	Contractor	Client	Client	Client	Shared	Shared
61	Contractor	Client	Client	Client	Contractor	Contractor
62	Contractor	Client	Client	Shared	Contractor	Shared
63	Contractor	Contractor	Client	Client	Contractor	Shared
64	Contractor	Client	Shared	Shared	Shared	Contractor
65	Contractor	Client	Client	Shared	Shared	Shared

<b>S/No</b>	<b>Poor competence and productivity of labor</b>	<b>Payment delays</b>	<b>Availability of utilities</b>	<b>Adverse weather conditions</b>	<b>Political instability</b>	<b>Corruption including Bribery</b>
66	Contractor	Client	Client	Shared	Shared	Shared
67	Contractor	Client	Client	Shared	Shared	Shared
68	Contractor	Client	Shared	Shared	Shared	Contractor
69	Contractor	Client	Shared	Shared	Shared	Shared
70	Contractor	Client	Shared	Client	Client	Shared
71	Contractor	Client	Client	Shared	Client	Shared
72	Contractor	Client	Client	Shared	Shared	Shared
73	Contractor	Client	Shared	Shared	Shared	Shared
74	Contractor	Client	Client	Client	Client	Shared
75	Contractor	Client	Shared	Shared	Shared	Shared
76	Contractor	Client	Client	Shared	Shared	Shared
77	Contractor	Client	Client	Client	Client	Shared
78	Contractor	Client	Client	Client	Client	Shared
79	Contractor	Client	Client	Client	Client	Shared
80	Contractor	Client	Contractor	Shared	Shared	Shared
81	Contractor	Client	Shared	Shared	Shared	Shared
82	Contractor	Shared	Shared	Shared	Shared	Shared
83	Contractor	Shared	Shared	Shared	Shared	Shared
84	Contractor	Client	Client	Shared	Shared	Shared
85	Contractor	Shared	Shared	Shared	Shared	Contractor
86	Contractor	Shared	Client	Client	Client	Shared



## Appendix IV

### Respondent's Data for PM technique effectiveness

EFFECTIVENESS OF PREVENTIVE METHOD			
S/No	Utilize risk analysis techniques	Personal judgment	Produce a proper schedule
1	3	3	4
2	4	4	4
3	4	4	5
4	4	3	5
5	4	3	5
6	4	4	5
7	4	3	4
8	4	3	5
9	5	4	4
10	4	3	4
11	5	5	5
12	4	4	5
13	3	3	4
14	4	4	4
15	2	4	3
16	3	2	2
17	3	3	5
18	3	4	4
19	3	3	5
20	4	4	3
21	4	2	4
22	4	4	5
23	4	3	4
24	3	4	4
25	3	3	4
26	3	4	4
27	3	3	4
28	3	3	4
29	3	4	3
30	3	3	4
31	5	5	5

<b>EFFECTIVENESS OF PREVENTIVE METHOD</b>			
<b>S/No</b>	<b>Utilize risk analysis techniques</b>	<b>Personal judgment</b>	<b>Produce a proper schedule</b>
32	4	4	4
33	3	3	2
34	4	2	5
35	5	4	5
36	4	4	4
37	3	3	4
38	4	1	4
39	4	3	4
40	2	3	4
41	4	3	4
42	3	4	4
43	4	4	5
44	3	4	5
45	4	4	5
46	4	3	5
47	5	5	5
48	5	3	5
49	5	3	5
50	4	4	5
51	3	3	5
52	4	4	4
53	4	4	5
54	3	2	4
55	3	3	4
56	3	2	4
57	4	2	4
58	4	3	4
59	4	3	4
60	4	3	4
61	4	3	4
62	4	2	3
63	4	3	4
64	3	3	4
65	5	1	5
66	3	2	3
67	3	2	4

<b>EFFECTIVENESS OF PREVENTIVE METHOD</b>			
<b>S/No</b>	<b>Utilize risk analysis techniques</b>	<b>Personal judgment</b>	<b>Produce a proper schedule</b>
68	3	2	4
69	5	4	5
70	4	3	4
71	4	4	5
72	4	4	5
73	3	3	4
74	3	3	4
75	4	5	4
76	3	3	4
77	3	4	4
78	4	4	4
79	4	4	5
80	5	5	5
81	4	4	4
82	4	4	5
83	3	3	4
84	4	3	4
85	4	3	5
86	4	3	5

## Respondent's Data for PM technique effectiveness

(Contd.)

<b>EFFECTIVENESS OF PREVENTIVE METHOD</b>			
<b>S/No</b>	<b>Add risk premium</b>	<b>Transfer or share risk</b>	<b>Refer to similar projects</b>
1	4	2	3
2	4	4	4
3	4	4	5
4	4	2	3
5	4	4	4
6	3	2	4
7	4	4	4
8	4	4	5
9	4	4	5
10	5	4	4
11	5	5	5
12	3	3	5
13	4	4	4
14	4	3	4
15	5	3	2
16	3	3	2
17	4	5	4
18	2	2	4
19	4	5	4
20	5	4	4
21	3	3	3
22	5	4	4
23	4	4	4
24	3	3	5
25	4	3	4
26	4	2	5
27	4	4	4
28	3	3	4
29	3	3	4
30	2	2	5

<b>EFFECTIVENESS OF PREVENTIVE METHOD</b>			
<b>S/No</b>	<b>Add risk premium</b>	<b>Transfer or share risk</b>	<b>Refer to similar projects</b>
31	4	4	5
32	4	4	3
33	3	2	4
34	1	2	3
35	4	2	4
36	3	2	5
37	4	4	5
38	3	2	4
39	3	4	3
40	4	5	5
41	3	3	3
42	3	2	4
43	3	2	5
44	2	2	5
45	3	3	5
46	4	3	5
47	5	5	5
48	4	4	4
49	5	4	3
50	4	5	4
51	4	3	3
52	3	4	2
53	5	3	4
54	4	3	3
55	3	3	3
56	3	1	4
57	3	4	4
58	2	2	4
59	3	3	4
60	3	3	4
61	3	3	3
62	2	2	3
63	3	3	4
64	4	4	5
65	2	3	5
66	3	2	4

<b>EFFECTIVENESS OF PREVENTIVE METHOD</b>			
<b>S/No</b>	<b>Add risk premium</b>	<b>Transfer or share risk</b>	<b>Refer to similar projects</b>
67	4	3	3
68	4	4	3
69	5	4	4
70	3	1	4
71	3	2	5
72	3	2	5
73	3	2	4
74	3	2	5
75	3	4	4
76	2	2	4
77	3	2	4
78	3	2	5
79	3	2	5
80	5	3	4
81	4	4	4
82	5	2	4
83	4	3	4
84	3	4	4
85	5	4	3
86	3	3	4

## Appendix V

### Respondent's Data for RM technique effectiveness

<b>EFFECTIVENESS OF REMEDIAL METHOD</b>			
<b>S/No</b>	<b>Increase manpower and/or equipment</b>	<b>Increase the working hours</b>	<b>Change the construction method</b>
1	4	4	3
2	3	3	4
3	5	4	4
4	3	2	4
5	5	5	3
6	3	3	4
7	5	3	3
8	4	4	3
9	5	3	4
10	3	2	5
11	5	5	5
12	4	4	3
13	3	3	4
14	4	4	4
15	5	3	4
16	3	3	4
17	2	3	4
18	4	4	3
19	2	3	4
20	3	3	4
21	2	3	4
22	5	5	4
23	4	2	3
24	3	3	2
25	3	3	3
26	4	2	3
27	3	4	4
28	3	3	3
29	3	3	4
30	3	3	2
31	4	5	3
32	3	3	2

<b>EFFECTIVENESS OF REMEDIAL METHOD</b>			
<b>S/No</b>	<b>Increase manpower and/or equipment</b>	<b>Increase the working hours</b>	<b>Change the construction method</b>
33	2	1	4
34	2	3	2
35	4	4	3
36	3	3	2
37	4	4	5
38	3	2	4
39	3	2	4
40	2	3	4
41	3	3	2
42	3	3	2
43	4	4	3
44	4	4	2
45	4	4	3
46	5	4	4
47	5	3	3
48	3	4	4
49	5	4	4
50	4	4	4
51	2	2	4
52	5	5	5
53	5	5	4
54	4	4	3
55	5	4	5
56	4	3	3
57	2	2	2
58	3	3	3
59	2	2	2
60	2	2	2
61	2	2	2
62	3	2	2
63	2	3	3
64	2	1	4
65	1	1	2
66	3	4	4
67	3	3	4
68	3	2	4



<b>EFFECTIVENESS OF REMEDIAL METHOD</b>			
<b>S/No</b>	<b>Increase manpower and/or equipment</b>	<b>Increase the working hours</b>	<b>Change the construction method</b>
69	4	4	3
70	3	2	2
71	4	3	2
72	4	3	2
73	3	2	2
74	4	3	2
75	2	2	5
76	2	2	2
77	3	2	2
78	4	3	2
79	4	3	3
80	5	5	5
81	3	3	4
82	4	1	3
83	3	2	3
84	4	2	3
85	3	3	4
86	4	4	3

## Respondent's Data for RM technique's effectiveness

(Contd.)

EFFECTIVENESS OF REMEDIAL METHOD			
S/No	Change the sequence of work	Coordinate closely with subcontractors	Close supervision to minimizing unsuccessful work
1	3	3	3
2	4	4	4
3	4	4	5
4	3	5	5
5	4	4	5
6	5	4	5
7	4	5	5
8	4	4	4
9	3	5	5
10	3	4	4
11	5	5	5
12	4	5	5
13	4	2	2
14	4	4	4
15	3	1	3
16	4	3	4
17	4	4	4
18	4	5	5
19	4	4	4
20	4	5	4
21	3	4	4
22	4	5	4
23	3	4	4
24	4	4	5
25	3	3	3
26	3	4	4
27	3	3	3
28	4	3	3
29	4	5	5
30	3	4	5

<b>EFFECTIVENESS OF REMEDIAL METHOD</b>			
<b>S/No</b>	<b>Change the sequence of work</b>	<b>Coordinate closely with subcontractors</b>	<b>Close supervision to minimizing unsuccessful work</b>
31	4	5	4
32	3	3	4
33	3	4	4
34	4	3	3
35	3	5	5
36	4	4	5
37	4	5	4
38	4	5	5
39	4	4	4
40	3	5	4
41	5	4	4
42	3	4	5
43	4	5	5
44	3	4	4
45	4	5	5
46	5	5	3
47	4	2	5
48	5	4	3
49	5	4	3
50	5	4	4
51	4	4	5
52	5	5	5
53	5	4	3
54	3	4	4
55	4	5	5
56	4	4	5
57	3	2	4
58	3	3	4
59	2	2	3
60	2	2	4
61	2	2	2
62	3	3	4
63	2	3	3
64	4	5	5
65	2	3	3
66	5	4	4

<b>EFFECTIVENESS OF REMEDIAL METHOD</b>			
<b>S/No</b>	<b>Change the sequence of work</b>	<b>Coordinate closely with subcontractors</b>	<b>Close supervision to minimizing unsuccessful work</b>
67	4	4	5
68	4	4	4
69	2	4	5
70	3	4	4
71	4	4	5
72	2	4	5
73	3	4	5
74	4	4	5
75	5	5	4
76	4	4	5
77	3	4	5
78	3	4	5
79	4	4	5
80	5	5	4
81	5	5	4
82	5	4	4
83	3	3	3
84	4	4	4
85	4	5	3
86	2	4	4