RISK MANAGEMENT IN THE CONSTRUCTION INDUSTRY OF PAKISTAN

Thesis of

Master of Science

by

Khurram Iqbal

Department of Construction Engineering and Management

National Institute of Transportation

School of Civil and Environmental Engineering

National University of Sciences and Technology

Islamabad, Pakistan

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Khurram Iqbal

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Dr. Rafiq Muhammad Choudhry, Ph.D

Department of Construction Engineering and Management

National Institute of Transportation

School of Civil and Environmental Engineering

National University of Sciences and Technology, Islamabad

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DEDICATED

TO

MY PARENTS, WIFE

AND

TEACHERS

ACKNOWLEDGEMENT

All thanks and praises to ALMIGHTY ALLAH who gave the opportunity and enabled me to complete my Master Degree. I am extremely grateful to my parents for their sincere prayers and to my family for their support during the entire length of my course and research work.

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ABSTRACT

Risk management is relatively new field in the construction industry of Pakistan and lacks in research but is gaining prominence gradually due to increased construction activity and competitiveness. This study is based on survey of risk management in the construction industry of Pakistan and reports the findings of importance of risks, their current management techniques, the existing status of risk management systems of the organizations and barriers to effective risk management from the perspective of key stakeholders. The results reveal that: financial and economic factors followed by quality are the most important risks and the industry generally relies upon avoiding or transferring the risks. Results indicate that the risk management system and practices of most of the organizations are reactive, semi permanent, informal and unstructured with no or very little committed resources to deal with risks. Nonetheless, the outcome of interviews indicates that there is awareness about the risk management and a desire to learn from the past mistakes. Study concludes that the major barriers to effective risk management are lack of formal risk management system and lack of mechanism for joint risk management by the parties. Insights and discussions are given in the analysis which is valuable to planners, project managers, supervisors and other stakeholders by reviewing their projects and taking remedial measures where appropriate. This research can be used in exploring mechanism for joint risk management by prospective stakeholders.

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INTRODUCTION

1.1 GENERAL

The risk management being relatively new to the construction industry of Pakistan lacks in research as a subject, although the same is being practiced in financial sector, professionally. A study was carried out by Masood and Choudhry (2010), but its scope was limited to perceptions of contractors about risk factors, however, many project risks cannot be controlled by one party (Tang et al. 2007). Therefore, there is a requirement to consider the perceptions of key stakeholders mainly client, consultant and contractor to establish a ranking of risks facing construction industry, their management techniques and barriers to effective risk management which is helpful to explore mechanisms for joint risk management in construction industry of Pakistan. It is becoming increasingly important to adopt joint risk management strategy by all stakeholders to achieve the intended project objectives (Loosemore et al. 2006). However, stake holders may have different project objectives sometimes competing to each other; the joint risk management will ensure achieving project objectives in more transparent and efficient way. As pointed out by Baldry (1998) that, the conflicts among project participants can equally contribute to project failure as technical deficiencies. Chapman (1997) also indicated that clients and contractors necessarily have different objectives, but a contract which leads to confrontation is perhaps the biggest single risk that most projects encounter. To mitigate the risks due to the misalignments between project participants, many researchers raised the strategies of partnering, alliancing, and relationship contracting that adopts cooperative philosophy to seek congruence in objectives (Tang et al. 2006, 2004). Rahman and Kumaraswamy (2004, 2002a,b) concluded that the construction industry is moving towards joint risk management by the application of partnering principles. Tang et al. (2006) revealed the important role of partnering in enhancing risk management, and indicated that partnering helps participants to share added information by the improvement of open communication, which facilitates optimum decision making to reduce lost opportunities dealing with project risks. Risk is a complex phenomenon that has physical, monetary, cultural, and social dimensions (Loosemore et al. 2006). The consequences of risk events go well beyond the direct physical harm to financial or physical assets, people or ecosystems to effect the way a society operates and people think (Loosemore et al. 2006). The objectives of project risk management are to increase the probability and impact of positive events, and decrease the probability and impact of events adverse to the project (American National Standard, 2004). Therefore, avoiding the risks altogether is not always desirable especially if these risks can be turned in to opportunities by proactive identification, structured analysis, timely response and effective monitoring. Risk management is considered a vital tool in the management of projects (Wood and Ellis 2003), and is becoming an essential part of decision making process (Kangari 1995). As pointed out by Flanagan and Norman (1993), there are generally four flawed approaches to tackle the risks on a construction project mainly:-

- The ostrich approach is the one in which one buries his head in the sand against all odds assuming that the crisis is self-destructive and he will sail through it.
- The brute force approach is the one in which one assumes that he can force the outcomes as he desires or can change the course at will, which of course he cannot.
- The umbrella approach is the one in which every risk event is managed by a costly risk premium.
- The intuitive approach is the one in which it is presumed that all these processes of identification, analysis and control measures are futile effort and one should trust his gut feelings or intuition.

Researchers (Loosemore et al. 2006; Smith et al. 2006; American National Standard 2004; Jaafari 2001; Berends 2000; Standards Association of Australia 1999 and Flanagan and Norman 1999) have investigated number of risk management techniques; however, all these techniques may not be applicable in local environments. Risks and opportunity do not respect disciplinary boundaries and occur over the entire life cycle of the project (Loosemore et al 2006). Any system designed and implemented must aim to life cycle approach, from inception to demolition or even beyond that. If seen from this perceptive the risk management gets precedence over project management as the former rarely aims at life cycle approach. Moreover, in companies, the project management methodology established does not readily accommodate the increasing requirements for risk management and many projects are therefore not setup to manage risk (Smith et al. 2006). An efficient risk management system has to be more dynamic in nature than the risk itself otherwise chances are that it may not integrate well to the organizational culture and practices. Any system, regardless of the diligence and care taken in its preparation and implementation, will surely miss the target at first instance and will be requiring steady calibration. This will require leadership, patience, guidance, time and resources on part of management.

1.2 PROBLEM STATEMENT

The construction industry of Pakistan is passing through difficult phase. It had a share of 2.3 per cent in total GDP of Pakistan in 2009-10 and grew by 15.3 per cent in 2009-10 against a negative growth of 11.2 per cent in 2008-09 (State Bank of Pakistan 2010). Risks, if not managed properly may lead to failure to meet intended project objectives resulting in increased cost, time delays, lack of quality and issues related to functionality of facilities. The construction industry possesses both, opportunities and challenges. Pakistan’s population is over 169.94 million as at end Jun 2009, which is world’s sixth largest population and with an annual growth rate of 2.05 percent it will become the fourth largest nation on earth in terms of population by 2050 (Federal Bureau of Statistics 2010, State Bank of Pakistan 2010). There is a shortage of an estimated 7.57 million housing units in 2009 alone (World Bank 2010). Whereas, housing represents only a portion of construction industry, there are huge investment opportunities in the fields like infrastructure, dams, irrigation, power, oil and gas, tourism and industry. Competitive tendering, being generally practiced in public sector in Pakistan may slow or even halt the process of identifying risks dynamically due to increased chances of bid rejection. Effective risk management will provide a competitive edge in bidding process and will increase chances of meeting key projects objectives in more efficient way.

1.3 RESEARCH OBJECTIVE

The main objective of this research is to identify and prioritize common risks, their management techniques, current status of risk management system of the organizations and barriers to effective risk management in the construction industry, with the aim to help stakeholders to take stock of their ongoing and future projects, keeping in mind important risks, their management techniques and barriers to risk management, identified in the study and to take remedial measures where necessary. Research can be used in exploring mechanism for joint risk management by prospective stakeholders.

1.4 SCOPE

The scope of this study is limited to the construction industry of Pakistan and mainly covers key stakeholders i.e. clients, consultants and contractors. An effort has been made to include as many types of projects as possible like highways, buildings, water supply and port. Four main geographical areas of Pakistan, namely Karachi, Lahore, Rawalpindi and Islamabad were selected for a questionnaire survey and interviews.

1.5 ORGANIZATION OF THESIS

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

Chapter 2

LITERATURE REVIEW

2.1 TERMINOLOGIES

2.1.1 Risk

The word "risk" came to English literature from French word "risqué" in mid seventeenth century. The insurance transaction started using Anglicized spelling in second quarter of eighteenth century (Flanagan and Norman 1999) and according to Loosemore et al. (2006) risk is concerned with unpredictable events that might occur in the future whose exact likelihood and outcome is uncertain but could potentially affect their interests / objectives in some way. Standards Association of Australia (1999) described risk as the chance of something happening that will have an impact upon objectives and is measured in terms of consequences and likelihood.

2.1.2 Risk Management

It is the culture, processes and structures that are directed towards the effective management of potential opportunities and adverse effects (Standards Association of Australia 1999). Loosemore et al. (2006) consider it to be the process of proactively working with stakeholders to minimize the risks and maximize the opportunities associated with project decisions.

2.1.3 Risk Management Process

It is the systematic application of management policies, procedures and practices to the tasks of establishing the context, identifying, analyzing, evaluating, treating, monitoring and communicating risk (Standards Association of Australia 1999).

2.1.4 Risk Identification

The process of determining what can happen, why and how (Standards Association of Australia 1999) and as per American National Standard (2004) it is the process of determining which risks might affect the project and documenting their characteristics.

2.1.5 Proactive Risk Identification and Reactive Risk Identification

Proactive involves imagining potential future events that could affect the attainment of decision objectives, either negatively or positively and reactive involves identifying and reporting events, arising as a reaction to a decision that could affect project objectives, either negatively or positively (Loosemore et al. 2006).

2.1.6 Risk Analysis

A systematic use of available information to determine how often specified events may occur and the magnitude of their consequences (Standards Association of Australia 1999) and as per Loosemore et al. (2006) it involves systematically working through each of the risks and opportunities identified and recorded.

2.1.7 Qualitative and Quantitative Risk Analysis

Qualitative involves analysis of risks and opportunities using qualitative / descriptive scales such as high, medium and low and quantitative involves analysis of risks and opportunities using numerical estimates. Quantitative is normally conducted on risks and opportunities which emerge as particularly important from qualitative analysis and where reliable data for analysis is available (Loosemore et al. 2006).

2.1.8 Sensitivity Analysis

The purpose of the sensitivity analysis technique is to answer the, what if question by isolating the key variable(s) and evaluating the effects of incremental changes in the values assigned to the key variable(s). Sensitivity analysis is a quantitative technique, which allows the effect of economic changes in a project to be explored that is one of the best known non-probabilistic risk analysis techniques (Smith et al 2006). According to American National Standard (2004) it helps to determine which risks have the most potential impact on the project. It examines the extent to which the uncertainty of each project element affects the objective being examined when all other uncertain elements are held at their baseline values.

2.1.9 Key Performance Indicator

The measurable criterion for each objective is known as key performance indicator. Since risk management is about achieving decision objectives, these measureable criteria then becomes the targets against which risk management success is measured and judged (Loosemore et al. 2006).

2.1.10 Risk Response

Risk Response Planning is the process of developing options, and determining actions to enhance opportunities and reduce threats to the project's objectives. It follows the qualitative risk analysis and quantitative risk analysis processes. It includes the identification and assignment of one or more persons (the "risk response owner") to take responsibility for each agreed-to and funded risk response. Risk Response Planning addresses the risks by their priority, inserting resources and activities into the budget, schedule, and project management plan, as needed (American National Standard 2004).

2.2 GENERIC SOURCES OF RISK AND THEIR AREAS OF IMPACT

2.2.1 General

Knowledge of generic sources of risks and their areas of impact can be of great value in the process of risk identification, analysis, response and control. The list is not self exhaustive and may provide a guideline in the presence of numerous sources of risks and their areas of impact. Therefore, the process of risk identification, analysis, response and control should not be restricted to this list only and other sources of risks and their areas of impact should be explored, depending upon the nature of the project, to arrive at an efficient risk management plan. According to Loosemore et al. (2006), American National Standard (2004), Standards Association of Australia (1999) and Flanagan and Norman (1999) following are the generic sources of risk and their areas of impact.

2.2.2 Sources of risks

2.2.2.1 Economic

- Inflation
- Taxes
- Price hike
- Exchange rates
- Market competition / demand change

2.2.2.2 Financial

- Interest rates
- Cash flows
- Capital supply
- Pay demands / constraints
- Delayed payments from client or customers

2.2.2.3 Political and social

- Changes in government and its policies
- Permits
- Law and order situation
- Strikes
- Civil war
- Resistance from local population to the project

2.2.2.4 Commercial and legal relationships

- Contract conditions / requirements
- Corruption / Fraud
- Disputes and claims
- Delay in possession of site

2.2.2.5 Human

- Effectiveness of communication
- Skills and staffing issues
- Racism / discrimination

2.2.2.6 Natural events

- Earth quake
- Floods / heavy rain
- Slides / avalanche
- Tornado / hurricane

2.2.2.7 Technology, methods and procedures

- Stability of design / design changes
- Availability of equipment / technology / material
- Equipment reliability

- Material quality
- Sampling / testing

2.2.2.8 Management activities / controls / systems

- Documentation quality
- Quality of planning
- Communication / decision making
- Leadership / monitoring / control

2.2.2.9 Business partners

- Compatibility
- Contract team, management, control and supervision
- Past relationship
- Commercial terms
- Credit ratings

2.2.3 Areas of Impact

- Resources and assets of an organization including personnel
- Direct and indirect costs, budget and estimates
- Time and schedule of the project and activities
- Quality of the project
- Intangibles like goodwill and reputation
- Revenue and entitlement
- People
- Community
- Performance
- Natural environment
- Organizational behavior

2.3 DEVELOPING A RISK MANAGEMENT PROGRAM

An organization can develop a risk management program in following six steps as elaborated by Standards Association of Australia (1999).

2.3.1 Step 1 - Support of Senior Management

The support of top management including all senior executives is necessary to sponsor the initiative. This may be difficult initially but awareness must be developed through education, training, seminars and briefings.

2.3.2 Step 2 - Develop the Organizational Policy

This is the highest level of risk management program and defines the broad parameters of its implementation in the organization. It is the direct reflection of senior management commitment and must be endorsed by them. It may include:-

- Policy objectives and motives for managing risks.
- The linkage between policy and strategic plan.
- The issues covered by the policy.
- The boundary between acceptable and non acceptable risks.
- The responsibilities of all individuals involved in decision making.
- The resources available for risk management.
- The documentation and its extent.
- Monitoring and review of organization performance in the light of policy.

2.3.3 Step 3 - Communicate the Policy

It is imperative that all those involved in risk management process must be fully aware of contents, extent, procedures and coverage of the policy. Build an infrastructure to make sure that, managing risk becomes an integral part of all processes, culture and environment of the organization. This may include:-

- Establishing a team containing senior management personnel to be responsible for internal communications about the policy.
- Raising awareness about managing risks.
- Communication / dialogue throughout the organization about managing risk and the organization’s policy.

- Acquiring risk management skills, e.g. consultants, and developing the skills of staff through education and training.
- Ensuring appropriate levels of recognition, rewards and sanctions.
- Establishing performance management processes.

2.3.4 Step 4 - Manage Risks at Organizational Level

Develop and establish a program for managing risks at the organizational level through the application of the risk management system. The process for managing risks should be integrated with the strategic planning and management processes for the organization. This will involve documenting:-

- The organization and risk management context.
- The risks identified for the organization.
- The analysis and evaluation of these risks.
- The treatment strategies.
- The mechanisms to review the program.
- The strategies for awareness raising, skills acquisition, training and education.

2.3.5 Step 5 - Manage Risks at the Program, Project and Team Level

This is important as ultimate purpose of any risk management program is to manage risks at the program, project and team level. This may be achieved by integrating policy and procedures with each activity of the organization. Documentation is essential as it will keep record of all activities and track any deviation from stated policy for improvement. The process must be kept as simple as possible with easy to use tools, comprehensible documentation and flexible enough to accommodate as many situations / processes as possible. A complex system will only cause difficulties to the already compound situation and will replace the existing risks with new ones.

2.3.6 Step 6 - Monitor and Review

Monitoring and reviewing should be as dynamic in nature as the risks are, maintaining pace with it, otherwise, the chances are that, risks will be overlooked and will become unmanageable with time. To make the process of monitoring and reviewing effective it should be embedded in day to day practices of the organization and should not be restricted to risks and procedures but it should be encompassing the policy and its extent of coverage. This is only possible in the presence of accurate documentation.

2.4 RISK MANAGEMENT PROCESS

The risk management process is shown in Figure 2.1 and according to American National Standard (2004) it consists of five stages. First; the risk management plan which involves deciding how to approach, plan, and execute the risk management activities for a project. Second; risk identification which involves determining which risks might affect the project and documenting their characteristics. Third; risk analysis which is the process of evaluating identified risks and opportunities to discover their magnitude, whether they merit a response, and how responses should be prioritized in the light of limited resources. Fourth; risk control determines the process of developing options and actions to enhance opportunities and to reduce threats to project objectives. It is shown in Figure 2.2. Fifth; risk monitoring and control which involves tracking identified risks, monitoring residual risks, identifying new risks, executing risk response plans, and evaluating their effectiveness throughout the project life cycle.

2.5 RISK MANAGEMENT PLANNING – INPUTS

American National Standard (2004) recommends following inputs to risk management planning:-

2.5.1 Enterprise Environmental Factors

The attitudes toward risk and the risk tolerance of organizations and people involved in the project will influence the project management plan.

2.5.2 Organizational Process Assets

Organizations may have predefined approaches to risk management such as risk categories, common definition of concepts and terms, standard templates, roles and responsibilities, and authority levels for decision making.

2.5.3 Project Scope Statement

Project assumptions are found in the project scope statement. Uncertainty in the project assumptions should be evaluated as potential causes of project risks.

2.5.4 Project Management Plan

The Risk Identification process also requires an understanding of the schedule, cost, and quality plans found in the project management plan.

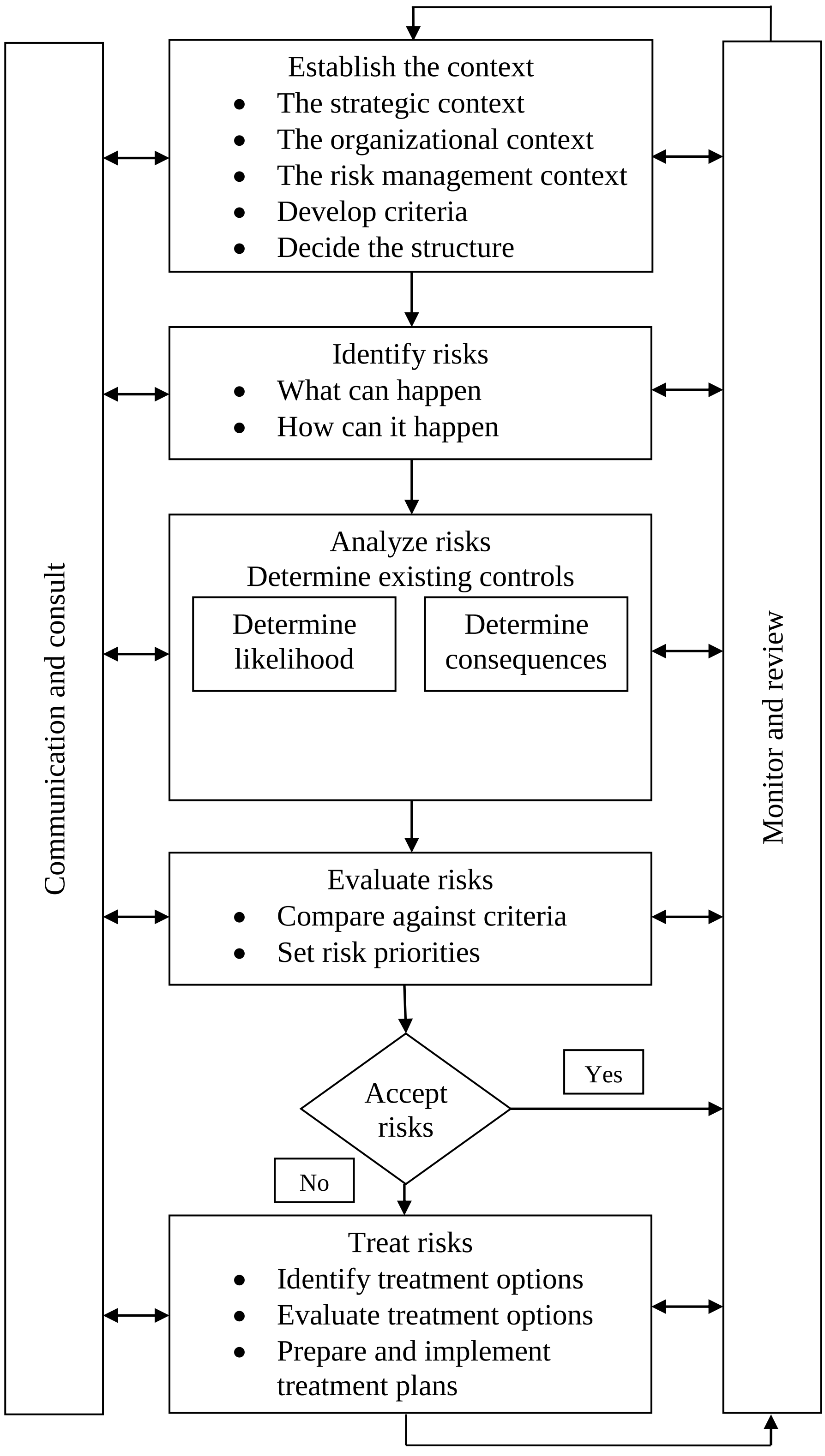

Figure 2.1: Risk Management Process (Standards Association of Australia 1999)

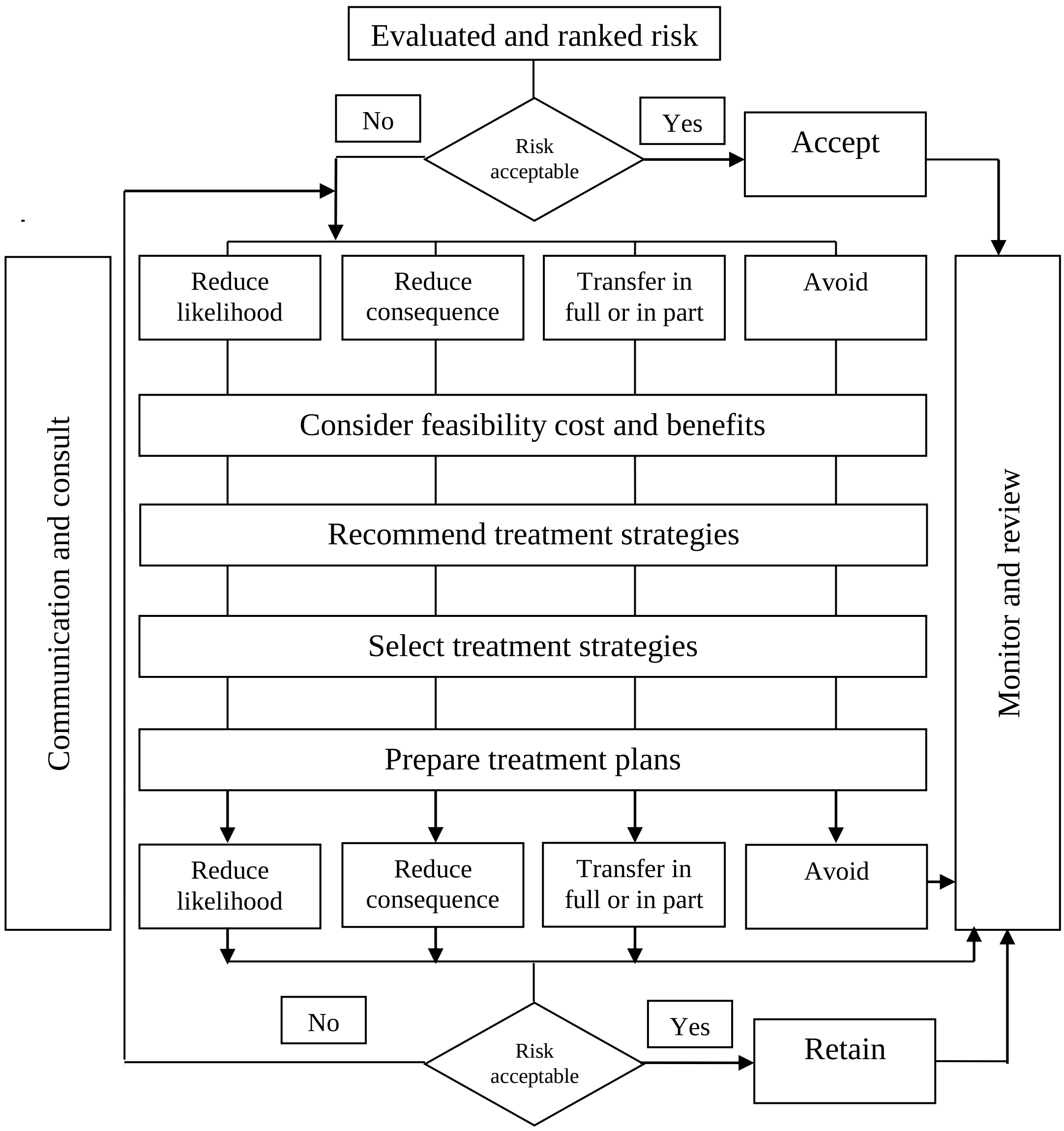

Figure 2.2: Risk Treatment Process (Standards Association of Australia 1999)

2.6 RISK MANAGEMENT PLANNING – TOOLS AND TECHNIQUES

The main tool as described by American National Standard (2004) is "planning meetings" for analysis. Project teams hold planning meetings to develop the risk management plan. Attendees at these meetings may include the project manager, selected project team members and stakeholders, anyone in the organization with responsibility to manage the risk planning and execution activities, and others, as needed. Basic plans for conducting the risk management activities are defined in these meetings. Risk cost elements and schedule activities will be developed for inclusion in the project budget and schedule, respectively. Risk responsibilities will be assigned. General organizational templates for risk categories and definitions of terms such as levels of risk, probability by type of risk, impact by type of objectives, and the probability and impact matrix will be tailored to the specific project. The outputs of these activities will be summarized in the risk management plan.

2.7 RISK MANAGEMENT PLANNING - OUTPUTS

Its output is in the shape of risk management plan. The risk management plan describes how risk management will be structured and performed on the project. It becomes a subset of the project management plan. The risk management plan as described by American National Standard (2004) includes the following:-

2.7.1 Methodology

It defines the approaches, tools, and data sources that may be used to perform risk management on the project.

2.7.2 Roles and Responsibilities

Defines the lead, support, and risk management team membership for each type of activity in the risk management plan, assigns people to these roles, and clarifies their responsibilities.

2.7.3 Budgeting

Assigns resources and estimates costs needed for risk management for inclusion in the project cost baseline.

2.7.4 Timing

Defines when and how often the risk management process will be performed throughout the project life cycle, and establishes risk management activities to be included in the project schedule.

2.7.5 Risk categories

Provides a structure that ensures a comprehensive process of systematically identifying risk to a consistent level of detail and contributes to the effectiveness and quality of Risk Identification. An organization can use a previously prepared categorization of typical risks. The risk categories may be revisited during the risk identification process. A good practice is to review the risk categories during the risk management planning process prior to their use in the risk identification process. Risk categories based on prior projects may need to be tailored, adjusted, or extended to new situations before those categories can be used on the current project.

2.7.6 Definitions of Risk Probability and Impact

The quality and credibility of the qualitative risk analysis process requires that different levels of the risks' probabilities and impacts be defined. General definitions of probability levels and impact levels are tailored to the individual project during the risk management planning process for use in the qualitative risk analysis process. A relative scale representing probability values from "very unlikely" to "almost certainty" could be used. Alternatively, assigned numerical probabilities on a general scale (e.g., 0.1, 0.3, 0.5, 0.7, and 0.9) can be used. Another approach to calibrating probability involves developing descriptions of the state of the project that relate to the risk under consideration (e.g., the degree of maturity of the project design). The impact scale reflects the significance of impact, either negative for threats or positive for opportunities, on each project objective if a risk occurs. Impact scales are specific to the objective potentially impacted, the type and size of the project, the organization's strategies and financial state, and the organization's sensitivity to particular impacts. Relative scales for impact are simply rank-ordered descriptors such as "very low", "low", "moderate", "high" and "very high", reflecting increasingly extreme impacts as defined by the organization. Alternatively, numeric scales assign values to these impacts. These values may be linear (e.g., 0.1, 0.3, 0.5, 0.7, 0.9) or nonlinear (e.g., 0.05, 0.1, 0.2, 0.4, 0.8). Nonlinear scales may represent the organization's desire to avoid high-impact threats or exploit high-impact opportunities, even if they have relatively low probability. In using nonlinear scales, it is important to understand what is meant by the numbers and their relationship to each other, how they were derived, and the effect they may have on the different objectives of the project. Table 2.1 is an example of negative impacts of definitions that might be used in evaluating risk impacts related to four project objectives. It illustrates both relative and numeric (in this case, nonlinear) approaches. The figure is not intended to imply that the relative and numeric terms are equivalent, but to show the two alternatives in one figure rather than two.

Table 2.1: Definition of Impact Scale for Project Objectives

Defined Conditions for Impact Scales of a Risk on Major Project Objectives
(Examples are shown for negative impacts only)

Project Objective	Relative or numerical scales are shown				
	Very low /.05	Low /.10	Moderate /.20	High /.40	Very high /.80
Cost	Insignificant cost increase	<10% cost increase	10-20% cost increase	20-40% cost increase	>40% cost Iincrease
Time	Insignificant time increase	<5% time increase	5-10% time increase	10-20% time iIncrease	>20% time increase
Scope	Scope decrease barely noticeable	Minor areas of scope affected	Major areas of scope affected	Scope reduction unacceptable to sponsor	Project end item is effectively useless
Quality	Quality degradation barely noticeable	Only very demanding applications are affected	Quality reduction requires sponsor approval	Quality reduction unacceptable to sponsor	Project end item is effectively useless

This table presents examples of risk impact definitions for four different project objectives. They should be tailored in the Risk Management Planning process to the individual project and to the organization's risk thresholds. Impact definitions can be developed for opportunities in a similar way.

2.7.7 Probability and Impact Matrix

Risks are prioritized according to their potential implications for meeting the project's objectives. The typical approach to prioritizing risks is to use a probability and impact matrix. The specific combinations of probability and impact that lead to a risk being rated as "high", "moderate" or "low" importance, with the corresponding importance for planning responses to the risk are usually set by the organization. They are reviewed and can be tailored to the specific project during the risk management planning process.

2.7.8 Revised Stakeholders' Tolerances

Stakeholders' tolerances may be revised in the risk management planning process, as they apply to the specific project.

2.7.9 Reporting Formats

It describes the content and format of the risk register as well as any other risk reports required. It also defines how the outcomes of the risk management processes will be documented, analyzed, and communicated.

2.7.10 Tracking

It documents how all facets of risk activities will be recorded for the benefit of the current project, future needs, and lessons learned. It also documents whether and how risk management processes will be audited.

2.8 RISK IDENTIFICATION - INPUTS

As a prelude to risk identification one must understand and identify his objectives. The risk and opportunity identification process should commence while a decision is being made, rather than after it has been made, as is too often the case (Loosemore et al. 1993). The decision objectives must be identified first before the identification of risks and opportunities because risks and opportunities are future events that can affect objectives either positively or negatively. Unfortunately, many decisions are made automatically without a proper understanding of objectives which is one of the main reasons why many potential risks and opportunities are overlooked which can be avoided by following these steps as suggested by Loosemore et al. (2006) and American National Standard (2004):-

- Obtain organizational commitment to risk and opportunity management.
- Conduct a stake holder analysis.
- Consult stakeholders.
- Identify objectives.
- Identify key performance indicators (KPIs).

2.8.1 Enterprise Environmental Factors

Published information, including commercial databases, academic studies, bench marking, or other industry studies, may also be useful in identifying risks.

2.8.2 Organizational Process Assets

Information on prior projects may be available from previous project files, including actual data and lessons learned.

2.8.3 Project Scope Statement

Project assumptions are found in the project scope statement. Uncertainty in the project assumptions should be evaluated as potential causes of project risks.

2.8.4 Risk Management Plan

Key inputs from the risk management plan to the risk identification process are the assignments of roles and responsibilities, provision for risk management activities in the budget and schedule, and categories of risk.

2.8.5 Project Management Plan

The Risk Identification process also requires an understanding of the schedule, cost, and quality management plans found in the project management plan.

2.9 PROACTIVE RISK IDENTIFICATION – TOOLS AND TECHNIQUES

These techniques may be divided in proactive and reactive depending upon the time of their employment. Ideally the risk identification process should begin when the decision is being made using proactive risk identification techniques; however, it is not possible to identify all risks in advance regardless of the effort done to identify them. This entails that, risk identification should continue even after the decision has been made using reactive risk identification techniques. Loosemore et al. (2006) suggest following proactive risk identification techniques:-

2.9.1 Employing and Using Creative People

The most obvious way to increase an organization's creative abilities is simply to employ more creative people or use creative employees more effectively. However, it is not easy to identify creative people. For example, since creative acts demand special mental abilities we might expect that creative people have especially high IQs. However, while psychologists have found that low IQ people do tend to be less creative than high IQ people, the relationship is very weak. Furthermore, it is found that groups of "clever people" generally performed badly, being characterized by destructive debate, intolerance and a lack of coherence; it is also interesting to note that many of history's most creative people, such as Copernicus, Rembrandt and Faraday, are estimated to have had IQs of less than 110. Instead of depending on IQ, there seems to be general consensus that creative acts rely on many mental processes working together in harmony, namely problem finding, idea generation, imagination, simplification, risk taking and motivation to learn. That is, creative people excel at finding problems, at finding new perspectives in their solution and at producing order out of chaos. They are also willing to take risks, to learn from failure and are determined, unconventional, self confident, tolerant of ambiguity and intrinsically rather than extrinsically motivated by things such as money, evaluations, prizes etc. For example, one of Albert Einstein's main motivations in life was to find simplicity and to disseminate his ideas without undue publicity. Indeed, when asked why he used hand soap for shaving instead of shaving cream, he replied that using one bar of soap was less complicated. It is worth noting that a number of psychological tests have been developed to identify creative individuals, some based upon personality measures, some on biographical experiences, some on intellect and others on cognitive skills such as divergent thinking. However, there is controversy surrounding these tests and only inconsistent evidence of their ability to predict real world creative achievement. Consequently, contemporary creativity tests focus upon people's outputs rather than upon their mental abilities. For example, in rating Frank Lloyd Wright as one of the most creative architects of his day, one would tend to cite as evidence, his buildings rather than his personality traits, although, admittedly, he often behaved and wrote eccentrically. Unfortunately, creative individuals like Einstein and Frank Lloyd Wright are rare and most managers need to elicit creative potential from specific combinations of relatively uncreative individuals. Nevertheless, it remains the case that most management teams are created in haste without proper regard to such issues.

2.9.2 Creativity Training

An alternative to recruiting creative people is to train an existing workforce to be more creative. Most creativity training programs are based upon the creative problem solving program developed by Sidney Parnes. This program teaches participants a range of techniques to help them find facts, problems, ideas and solutions to overcome resistance to their implementation. Unfortunately, while creativity training does seem to produce changes in creative ability, the effect is often short lived. Therefore, until there have been more long term studies of its effectiveness, its value to managers remains uncertain and it needs reinforcing with other approaches to learning which can open people's minds to potential risks and opportunities. One learning approach that could facilitate greater risk awareness in projects is project closure reviews. This simply involves spending some time at the end of a project reflecting upon the lessons learned and transferring them to people in future projects. For example, Ernst and Young use this technique by constructing a risk database using a standard set of questionnaires that are completed at the end of every project by different stakeholders. Future project managers can access this database to predict possible risks and develop effective management strategies, based on past company experience. In effect, this is a process of knowledge management. Similarly, British Petroleum has created a post project appraisal unit with the sole mission of helping the company learn from its mistakes and successes. The unit's objective is to improve company performance and help managers formulate investment decisions more accurately, appraise them more objectively and execute them more effectively.

2.9.3 Organizational Characteristics

For recruitment and training strategies to work, the structural and cultural aspects of an organization must also be conducive to creativity. The main organizational characteristics which affect creativity are leadership, organizational structure, organizational climate and culture, and environmental relationships.

2.9.4 Idea Elicitation Techniques

These techniques help individuals structure their thinking so that they more fully understand the risks and opportunities associated with a decision. “It is not enough to have a good mind. The main thing is to use it well”. Following are few idea elicitation techniques as suggested by Loosemore et al. (2006).

2.9.4.1 Checklists

The simplest way to identify risks and opportunities is to use a checklist of them complied from experiences on previous projects. However, such checklists must be updated and reorganized to individual project requirements. It can be reorganized according to the level of decision making affected, the stage of project they arise in and the impact on organizational goals.

2.9.4.2 Decomposition

The simple task of planning a decision or project and breaking it down in to its component parts can help identify the potential risks and opportunities involved. This is a common method of risk identification used in construction projects where work break down statements or method statements are often used to divide an activity in to simple set of steps, operations or activities which can be analyzed in isolation. It is a valuable process that encourages a decision maker to think through a decision in a logical incremental and structured way and provides a useful audit trail for future risk management activities. In creating a work breakdown statement, stakeholders should be consulted. Working alone is always a mistake and will inevitably result in a narrow range of risks and opportunities being identified.

2.9.4.3 Forecasting

Forecasting is widely used to identify quantifiable risks and opportunities. It involves analyzing and evaluating past information and statistically using the results to predict future trends. A good example of forecasting is the life cycle costing of building components using discounted cash flow techniques. There are three main types of forecasting methods:-

- Extrapolative forecasts - based upon the belief that history repeats itself.
- Causal forecasts - based on using cause-and-effect relationships to predict the future.
- Normative forecasts - assume that people take an active role in shaping the future and try to take their goals and values into account when predicting it.

2.9.4.4 Brainstorming

Brainstorming is a group-based process which is valuable when making decisions about new, large, complex and non-standard business activities and relies upon group dynamics to elicit ideas. The success of brainstorming depends upon the breadth of experiences and perspectives within the brainstorming group and the skills of the facilitator in combining them effectively. It also requires careful planning because of the time and resources involved. A typical brainstorming group consists of between 10 and 15 stakeholders in a decision. Ideally, the group should draw from different disciplines, which are key members of a project team and involve any specialists who can bring additional expertise to the process. It is critical to have a range of interests represented to prevent polarization of views, and the inclusion of stakeholders encourages collective responsibility for the identification of risks and opportunities. In particular, when external stakeholders are involved, there are also numerous public relations benefits and the group will gain enormously from an outsider's perspective.

2.9.4.5 The Delphi Technique

It involves a coordinator carefully constructing a series of small multi disciplinary problem solving groups to discuss potential opportunities and problems which could influence the outcome of a decision. The difference between Delphi groups and brainstorming groups is that the former never physically meet but are usually coordinated through e-mail, the worldwide web or in writing. The Asch Effect and the Groupthink effect are therefore minimized due to the lack of interaction between respondents. The Delphi process starts with the coordinator asking group members on an individual basis for their opinions about a certain problem, usually in some form of questionnaire. After a pre specified period, ideas are returned and anonymously summarized by the coordinator and redistributed for further discussion. The important point about this initial session is that outlandish suggestions are encouraged and people are not restricted to their own knowledge domain. Furthermore, ideas are not associated with specific individuals. A second stage of opinions are then sought which are quite different from stage one in that they are more evaluative and based on the ideas generated from stage one. Once again the coordinator summarizes the ideas and after a number of further rounds of discussion when opinions have stabilized, a final consensus list is produced which is a team output rather than an individual one. While overcoming some of the problems associated with traditional brain storming, there are a number of weaknesses with the Delphi technique. For example, people tend to find out who is in the Delphi group and might exert pressure upon each other, beyond a manager's control. Furthermore, it is difficult to ensure the diligence of participants and to maintain their motivation to contribute. Finally, the process takes considerable preparation, is often slow and depends upon the respondents' abilities to express themselves clearly in writing.

2.9.4.6 Influence Diagrams

Influence diagrams (sometimes called "Ishikawa diagrams" or "tree diagrams") can be used to help you discover how a threat or opportunity might arise. It should be used only after you have used another technique to identify what threats and opportunities might occur and when they may occur. Such techniques include checklists, method statements, forecasting, soft systems analysis and brainstorming. Influence diagrams recognize that most threats and opportunities do not occur in isolation but arise from a chain of contributory events (or sub-risks). Most things have one thing wrong with them and, very often, it only takes a second fault to make it a problem. A threat or opportunity cannot be understood fully in isolation from this interdependency and the effective management of a potential threat or opportunity is only possible when you understand this whole process. To this end, influence diagrams are used as a graphical representation of the chain of contributory events which could lead to a risk or opportunity eventuating. An example is provided in Figure 2.3, which reveals the component events that could cause a cost overrun to arise (the horizontal arrow) and how they could combine to do so. The process of constructing an influence diagram is simple and involves dividing the main threat or opportunity into its components and subcomponents until the origins of a risk are identified. This process can be facilitated by working backwards from the eventual threat or opportunity, asking "what could cause?" questions.

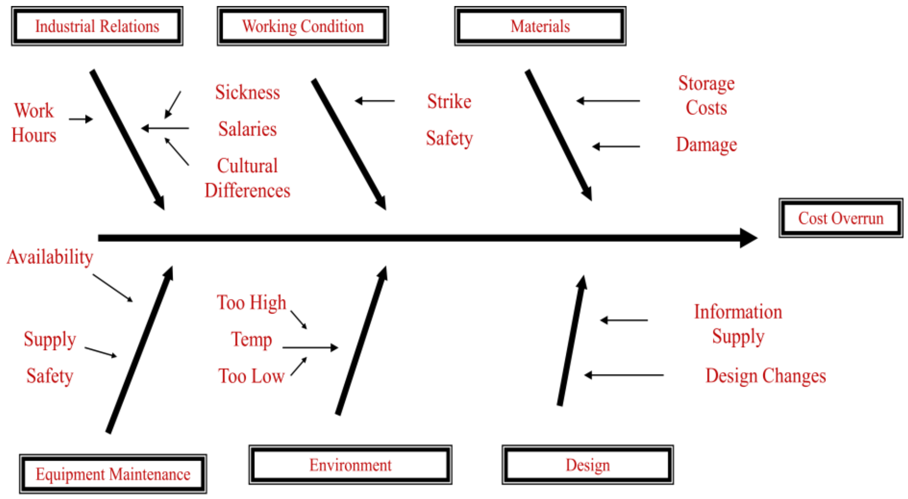

Figure 2.3: Influence Diagram (Loosemore et al. 2006)

2.9.4.7 Fault Tree Analysis

A sophisticated analytical technique which uses tree diagrams to predict risks is Fault Tree Analysis. This was originally developed in the US to prevent the accidental launching of missiles and has been used extensively in safety engineering ever since. Fault Tree analysis involves looking for potential faults in a system that might cause failure and mapping the connections between them. Fault trees can be used to help discover how a threat or opportunity might arise. It should be used only after another approach is used to identify what and when threats and opportunities might occur. A typical fault tree is shown in Figure 2.4.

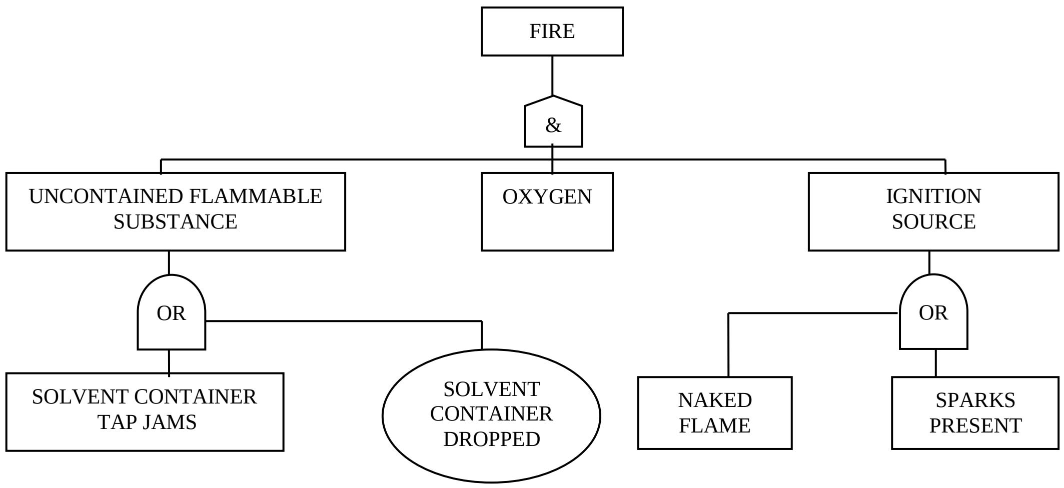

Figure 2.4: Fault Tree Analysis (Loosemore et al. 2006)

2.9.4.8 Simulation

Simulation uses mathematical modeling techniques to help managers artificially experience a situation and thereby identify the potential risks and opportunities associated with it. The advantage of simulation over the largely manual techniques is its ability to handle huge quantities of information and to take into account the interdependence between different risk variables. That is how one risk can create another and how a particular combination of circumstances can impact upon a project variable. Simulations also allow managers to experiment by altering project variables to see what the impact on various risk levels will be. Computers are essential to undertake this process where the computer acts as an experimental laboratory where the project can be "run" over-and-over again using different combinations of input assumptions. The business world has noted the potential value of simulating the business environment in much the same way as one can model an aircraft. The latest development in this field is to link real data from a company's accounts and records so that managers can ask "what if" questions about the future.

2.10 REACTIVE RISK IDENTIFICATION TECHNIQUES

No matter how rigorously a manager applies proactive risk identification techniques, it is inevitable that some risks and opportunities will arise after a decision has been made or after a project has moved forward and is progressing through its implementation stages. It is impossible to identify all potential risks and opportunities in advance and new risks and opportunities often arise as a result of completely unpredictable events. There is therefore a need to have the capacity to effectively and efficiently react to these risks and opportunities when they arise. This can be done by simply encouraging employees to notify their supervisor of potential hazards, when they become aware of them. However, there are also a number of formal techniques that can assist in this process. Loosemore et al. (2006) summarize these techniques as under:-

2.10.1 Risk Inspections

Risk inspections involve inspecting the workplace, employees and / or documents at regular intervals. The aim is to identify new potential threats and opportunities to a decision outcome that arise while it is being implemented.

Regular inspections are particularly important when documents or the workplace is changing continuously.

2.10.2 Bug Listing

The idea behind bug listing is to list things that tend to bother people on a day-to-day basis, which could potentially interfere with decision outcomes. The problem with bugs is that they are so commonplace that they are hard to remember. People tend to miss them by focusing on the larger problems that might arise in their formal inspections. However, the cumulative effect of minor problems can be very important. Bug lists arc best made by carrying a notebook to record the bugs when they arise. These lists can form the basis of risk identification in regular risk review meetings.

2.10.3 Risk Review Meetings

Risk review meetings should be organized regularly with decision stakeholders, the purpose being to:-

- Discuss the results of regular risk inspections.
- Discuss the implementation of a decision with the aim of identifying potential new threats or opportunities.
- Maintain effective communications with decision stakeholders.
- Facilitate cooperation in instigating, developing and implementing measures to minimize threats and maximize opportunities.
- Formulate, review and disseminate standards, rules and procedures to ensure that the decision outcomes are achieved, ideally better than planned.

2.10.4 Industry Information

Ensuring that decision makers keep themselves up-to-date with the latest industry information relating to new research and practice is important in highlighting new threats and opportunities to decision outcomes. This can be done through regular training programs, email lists, websites, risk and opportunity newsletters, and bulletins etc.

2.10.5 Automatic Sensors

It is important to use any technology available to monitor and detect potential physical risks that might arise in the workplace. Such risks include noise, dust, fire, fumes, vapors, gases, temperature, sun, radiation, security etc. Appropriate sensors should be installed which are connected to automatic controls or communication systems that can facilitate a response. Sensors might include, heat sensors, dosimeters, static area monitors etc and control devices might include alarms, sprinklers, ventilation fans etc. It is important that such equipment is inspected, tested, recalibrated and maintained regularly.

2.10.6 Incident Investigations

Incidents are defined as the occurrence of any event which causes actual loss or benefit to business objectives. Thorough investigations of any incidents after they have occurred are important since the lessons learnt can be very useful in preventing a repetition of events and in identifying further potential risks and opportunities to business activities.

2.10.7 Performance Appraisals

Regular performance appraisals should be conducted using the objectives and measurement criteria identified at the start of the risk identification process. Deviations from planned performance levels may indicate new risks or opportunities which will need investigation, analysis and response.

2.11 RISK IDENTIFICATION – OUTPUT

The outputs from risk identification are typically contained in a document known as risk register. The primary outputs from risk identification process are the initial entries into the risk register, which becomes part of the project management plan. The risk register ultimately contains the outcomes of the other risk management processes as they are conducted. The preparation of the risk register begins in the risk identification process and contains list of identified risks, list of potential responses, root causes of risk and updated risk categories as suggested by American National Standard (2004).

2.12 QUALITATIVE RISK ANALYSIS – INPUTS

The input to qualitative risk analysis as suggested by American National Standard (2004) include organizational process assets, project scope statement, risk management plan and risk register.

2.13 QUALITATIVE RISK ANALYSIS - TOOLS AND TECHNIQUES

The tools and techniques as described in American National Standard (2004) include:-

2.13.1 Risk Probability and Impact Assessment

Risk probability assessment investigates the likelihood that each specific risk will occur. Risk impact assessment investigates the potential effect on a project objective such as time, cost, scope, or quality, including both negative effects for threats and positive effects for opportunities. Probability and impact are assessed for each identified risk. Risk probabilities and impacts are rated according to the definitions given in the risk management plan. Sometimes, risks with obviously low ratings of probability and impact will not be rated, but will be included on a watch list for future monitoring.

2.13.2 Probability and Impact Matrix

Risks can be prioritized for further quantitative analysis and response, based on their risk rating. Ratings are assigned to risks based on their assessed probability and impact. Evaluation of each risk's importance and, hence, priority for attention is typically conducted using a probability and impact matrix. Such a matrix specifies combinations of probability and impact that lead to rating the risks as low, moderate, or high priority. Numeric values (Table 2.2) or Descriptive terms (Table 2.3) can be used, depending on organizational preference. The organization should determine which combinations of probability and impact result in a classification of high risk, moderate risk and low risk. These conditions can be denoted by different shades of gray (Table 2.2). Usually, these risk rating rules are specified by the organization in advance of the project, and included in organizational process assets. Risk rating rules can be tailored in the risk management planning process to the specific project.

Table 2.2: Numeric Qualitative Risk Estimation (American National Standard 2004)

Probability and Impact Matrix

Probability	Threats					Opportunities				
0.90	0.05	0.09	0.18	0.36	0.72	0.72	0.36	0.18	0.09	0.05
0.70	0.04	0.07	0.14	0.28	0.56	0.56	0.28	0.14	0.07	0.04
0.50	0.03	0.05	0.10	0.20	0.40	0.40	0.20	0.10	0.05	0.03
0.30	0.02	0.03	0.06	0.12	0.24	0.24	0.12	0.06	0.03	0.02
0.10	0.01	0.01	0.02	0.04	0.08	0.08	0.04	0.02	0.01	0.01
	0.05	0.10	0.20	0.40	0.80	0.80	0.40	0.20	0.10	0.05

Impact (ratio scale) on an objective (e.g., cost, time, scope or quality)

Each risk is rated on its probability of occurring and impact on an objective if it does occur. The organization's thresholds for low, moderate or high risks are shown in the matrix and determine whether the risk is scored as high, moderate or low for that objective.

Table 2.3: Descriptive Qualitative Risk Estimation (Loosemore et al. 1993)

Probabilities	Consequences				
	Insignificant	Minor	Moderate	Major	Extraordinary
Almost certain	Low	Medium	High	High	High
Likely	Low	Medium	Medium	High	High
Possible	Low	Low	Medium	High	High
Unlikely	Low	Low	Low	Medium	Medium
Rare	Low	Low	Low	Medium	Medium

2.13.3 Risk Data Quality Assessment

A qualitative risk analysis requires accurate and unbiased data if it is to be credible. Analysis of the quality of risk data is a technique to evaluate the degree to which the data about risks is useful for risk management. It involves examining the degree to which the risk is understood and the accuracy, quality, reliability, and integrity of the data about the risk. The use of low-quality risk data may lead to a qualitative risk analysis of little use to the project. If data quality is unacceptable, it may be necessary to gather better data. Often, collection of information about risks is difficult, and consumes time and resources beyond that originally planned.

2.13.4 Risk Categorization

Risks to the project can be categorized by sources of risk, the area of the project affected or according to project phases to determine areas of the project most exposed to the effects of uncertainty. Grouping risks by common root causes can lead to developing effective risk responses.

2.13.5 Risk Urgency Assessment

Risks requiring near-term responses may be considered more urgent to address. Indicators of priority can include time to affect a risk response, symptoms and warning signs, and the risk ratings.

2.14 QUALITATIVE RISK ANALYSIS – OUTPUT

Its output is in the shape of updating of risk register which was initiated during the risk identification process. The risk register is updated with information from qualitative risk analysis and the updated risk register is included in the project management plan. American National Standard (2004) recommends that the risk register updates from qualitative risk analysis may include relative ranking or priority list of project risks, risks grouped by categories, list of risks requiring response in the near future, list of risks for additional analysis and response, watch lists of low priority risks and trends in qualitative risk analysis results.

2.15 QUANTITATIVE RISK ANALYSIS – INPUT

The input to quantitative risk analysis includes organizational process assets, project scope statement, risk management plan, risk register and project management plan as suggested by American National Standard (2004).

2.16 QUANTITATIVE RISK ANALYSIS – TOOLS AND TECHNIQUES

Loosemore et al. (2006) suggests following techniques for quantitative risk analysis:-

2.16.1 The Risk Premium

The risk premium is a rather coarse, but widely used, instrument which is also known as the contingency fund. Indeed, in industries such as construction, it would be regarded as negligent if any consultant produced an estimate or project forecast which did not include a contingency fund. This is testimony to the fact that in many industries such as construction, risks have long been accounted for as a matter of course. In these industries, the usual practice is to add a contingency premium to the base estimate to account for downside risks, accepted by the organization which cannot accurately be forecast at the time. However, in practice, the way in which contingency allowances are calculated is often problematic.

Calculations rarely take account of risk attitude, are often arbitrary and are not tailored to the specific project. For example it is found that in the construction industry, many contingency estimates are seen as a routine administrative procedure underpinned by little investigation on the part of the estimator. Not only does this result in highly subjective estimates, there is a tendency to double count risk because some estimators also subconsciously include for them in their base estimates. The result of these deficiencies is all too often the rejection of projects that are economic and the submission of overly conservative bids which are unsuccessful or inflated prices for clients when they are successful. A potentially greater problem is that such allowances can hide poor management and the potential for greater efficiency. So in summary, the risk premium is at best a rather blunt tool that is made less effective because it is also not used very effectively in practice.

2.16.2 Sensitivity Testing

Sensitivity tests measure the effect on a decision output, of certain specified changes in the value of input variables (risks). For example, if the decision is to arrive at a contingency allowance for a tender, one may alter interest rates, energy costs, labor costs, construction period etc as input variables to see what impact various percentage changes in each of these variables would have on project costs. This will reveal what input variables (risks or opportunities) project cost is most sensitive to. For example, a 5 percent change in one variable may produce a 50 per cent increase in costs whereas a 5 percent change in another variable might produce no change in costs. Clearly, the bigger risk variable which merits special attention is the one which produces the 50 per cent change. Furthermore, if costs increase when a variable in changed then it is a risk, but if costs fall then the variable is an opportunity (assuming that the objective is to minimize costs). Nevertheless, sensitivity testing, when interpreted correctly and conducted realistically, can convey an extremely useful picture of a project / investment decision under dynamic real world conditions. There are several advantages to the use of sensitivity testing. It is quick and easy to use. It requires little information and it can usually be carried out by hand. Furthermore, it fully recognizes uncertainty in the input variables and can show how the output will be influenced by changes in input variables either singly or in combination. However, there are also several limitations with this method. For example, it takes no account the likelihood of the range of input and output variables. Therefore, does not give a probabilistic picture of risk exposure and there is no explicit method of allowing for risk attitude. For this reason, it has been argue that the results of sensitivity tests are at best ambiguous and at worst misleading. They are said to be ambiguous because they do not suggest how likely it is that the pessimistic or optimistic results will occur. They can also be misleading when some analysts unrealistically take a number of very low probability worst or best case values of input variables and calculate the effect on the output. Such combinations produce extremely low probabilities, are very unlikely in the real world and such a test would produce exaggerated results.

2.16.3 Expected Monetary Value (EMV)

A simple way of incorporating probability into risk analysis is the EMV method. It is often very useful for companies, in making decisions, to express their risks in dollars. Although this is not always possible with reliable accuracy the resultant value is commonly referred to as the expected monetary value (EMV) of a decision. When calculating EMV, it is important to appreciate that every event has a range of possible outcomes (consequences), each with a different probability of occurring. So far we have simplistically assumed that any event has only one possible outcome with an associated probability of occurring. This range of possible outcomes is called a probability distribution. For example, consider a lottery ticket which gives the owner a 0.75 chance of winning \$5000 and a 0.25 chance of winning nothing. The expected monetary value (EMV) of the ticket is given as:

$$EMV=0.75 \times \$5000 + 0.25 \times \$0 = \$3750$$

This implies that over a large number of transactions, I can expect to make \$3750 from purchasing such lottery tickets. The significance of this EMV calculation is that it tells us there is no risk in spending \$3750. It also tells us that if we spend more than \$3750 then we can expect to lose money and the more we spend over this amount, the more risk we incur. While valuable, it is important to appreciate that EMVs, when based on objectively derived probabilities, are only meaningful in the context of a large number of identical transactions. Unfortunately, it is sometimes used inappropriately to assess decisions of a more unique nature, which change over time. The advantage of the EMV method is that it considers all possible outcomes and avoids simply combining all the best and the worst cases to produce unrealistic extremes of possible outcomes. The EMV method is also suitable for a range of applications - budget figures, tender price forecasts, rates of project return or completion dates. It also overcomes some of the limitations of sensitivity testing by explicitly allowing for the probability of change in input values - producing a risk-adjusted outcome. The limitation of EMV, when based on objective probabilities, is that it is best used consistently over many similar-sized projects. The guidance it provides is helpful, but strictly, only in the very long run.

2.16.4 EMV using a Delphi Peer Group

One of the issues in using any probabilistic technique is how to arrive at the probability values. The Delphi method is named after the oracle at Delphi in ancient Greece. It utilizes a formal Delphi group and is designed to pool the expertise of many professionals in order to gain access to their knowledge and technical skills while removing the influences of seniority, hierarchies and personalities on the derived forecast. It also eradicates the biases of overconfidence which may encroach on expert forecasts. First, a group of experts is identified. The group members are kept separate to prevent any personal interaction, and the coordinator asks each member to make a forecast and a subjective probability estimate for the relevant components of the project or decision under consideration. The coordinator receives and summarizes these estimates and the summary is given back to the members without any names attached. The group members are then asked to amend their forecasts in the light of the summary information. The new forecasts are then revised and communicated to all members. This process of forecast, summary, amendment and feedback continues until there is a consensus or when the members no longer wish to amend their forecasts. The result is the Delphi forecast and there is no doubt that this is a powerful method of assessing important projects at the budget and feasibility stage. In many projects it can easily be conducted using email over the course of one afternoon. The advantage of adding the Delphi group to the EMV method is that it is a well recognized method of getting the best out of a group of experts in a forecasting situation. The limitation is the extra resources and time it takes to undertake. Also, participants may not have a similar window of time in order to undertake the process simultaneously. Therefore risks and size of a project should be sufficient to warrant the effort required.

2.16.5 Expected Net Present Value (ENPV)

The ENPV approach is useful in investment and development appraisal and can be applied in a wide range of situations where future income or cost flows are known. For example, it is used by the Victorian Government in Australia to evaluate tenders for PPP projects covering periods of up to 30 years. ENPV is also the basis of life cycle costing technique. ENPV is based on the combination of probability analysis and the corporate financial technique of discounted cash flows (DCF) which has been developed to convert future income or cost flows back to net present day values. The DCF technique is based on the assumption that the value of money diminishes over time due to a number of factors including inflation, taxation and earning potential. These factors mean that a dollar today is worth more than a dollar in the future. This is reflected in ENPV calculations by using a discount rate (a percentage figure which reflects these factors) to convert future cost or revenue streams back to current day (present) values, thereby facilitating single point comparisons between different investment opportunities or risks. Essentially, an ENPV figure is the amount that would be needed today to purchase an equivalent amount of goods and / or services at some point in the future. So if a building component costs $1000 to repair in 10 years time, the ENPV of that repair cost is the equivalent amount it costs today to carry out that exact repair. Given that inflation will invariably increase repair costs over the 10 year period, the ENPV figure of an equivalent repair today will always be less than $1000. So the discount rate can be based on a number of factors which determine how the value of money changes over time. These include future rates of inflation, taxation rates, affordability rates and investment rates (interest rates, bond rates or equity rates) that determine how a dollar invested now can grow in value over the period being considered. For example, the discount rate used by the UK government and Australian Victorian State Government for the economic appraisal of PF1 and PPP projects respectively has been 6 percent per annum - the average rate of return from government investments. In 2003 the UK changed its PFI discount rate to 3.5 per cent to reflect society's time value of money (inflation). Coincidentally, Australia also changed its discount rate to a flexible one, based on the perceived level of risk on each project (the extent to which costs could escalate and erode the real value of money in terms of the physical assets it buys). The example given here is for investment appraisal but the same approach could be used for the development appraisal of a new building or an infrastructure project.

2.16.6 Risk Adjusted Discount Rate (RADR)

This is an intuitive and very simple method of dealing with risk, which is commonly used in banking and business for investments that produce an income stream over a period of time. The method is not well understood in construction but could be a very useful way of dealing with both risk exposure and risk attitude, especially for life cycle costing decisions and revenue / cost flows in PFI and PPP projects. The RADR works by gradually changing the discount rate to take account of the normal risk encountered in a development. Each increase in the discount rate effectively sets a higher hurdle for the project, making it less desirable by reducing the calculated net present value (NPV) of future income.

2.16.7 Detailed Analysis and Simulation

Simulation is a sampling technique that randomly draws values from the full range of individual probability distributions developed for each decision on a project, providing the systematic evaluation of alternative project strategies and outcomes and the search for the optimum one. Traditionally, the Monte Carlo technique is used as the statistical basis for such analysis. Although many managers have heard of this simulation technique, it conjures up images of a complex analytical tool that is difficult to use. Nevertheless, the Monte Carlo technique is quite simple in principle and recognizes individual variables within a calculation as probability distributions rather than single numbers. By using Monte Carlo simulation, probability distributions for any decision (as defined by the estimator) can be randomly combined using random number to produce a complete judgment about the entire range of potential events. This produces a multi point estimate reflecting the likelihood of each value in that range. Using a simulation program (probably built on the back of a spreadsheet such as Excel) a project is "built" many times, with random variations of the input variables defined in the input probability distributions for each decision in a project. The simulation results in a statistical sample of different project outcomes with identical probabilistic characteristics. Analysis of this sample enables us to attach some numeric evaluation to the degree of risk in an estimate.

2.17 QUANTITATIVE RISK ANALYSIS – OUTPUT

The main output is in the form of updating of risk register. The risk register is initiated in the Risk Identification process and updated in the process of qualitative risk analysis. It is further updated in quantitative risk analysis. The risk register is a component of the project management plan. Updates as suggested by American National Standard (2004) include probabilistic analysis of the project, probability of achieving cost and time objectives, prioritized list of quantified risks and trends in quantitative risk analysis results.

2.18 RISK RESPONSE – INPUT

American National Standard (2004) suggests risk management plan and risk register as inputs to this process. Risk management plan includes Important components of the risk management plan include roles and responsibilities, risk analysis definitions, risk thresholds for low, moderate, and high risks, and the time and budget required to conduct project risk management. Outputs from the risk management planning process that are important inputs to risk response planning can include probabilistic analysis of the project, probability of achieving the cost and time objectives, prioritized list of quantified risks, and trends in quantitative risk analysis results. The risk register is first developed in the risk identification process, and is updated during the qualitative and quantitative risk analysis processes. The risk response planning process may have to refer back to identified risks, root causes of risks, lists of potential responses, risk owners, symptoms, and warning signs in developing risk responses. Important inputs to risk response planning include the relative rating or priority list of project risks, a list of risks requiring response in the near term, a list of risks for additional analysis and response, trends in qualitative risk analysis results, root causes, risks grouped by categories, and a watch list of low priority risks. The risk register is further updated during the quantitative risk analysis process.

2.19 RISK RESPONSE – TOOLS AND TECHNIQUES

2.19.1 Strategies for Negative Risks or Threats

Three strategies typically deal with threats or risks that may have negative impacts on project objectives if they occur. These strategies are to avoid, transfer, or mitigate as suggested by American National Standard (2004).

2.19.2 Avoid

Risk avoidance involves changing the project management plan to eliminate the threat posed by an adverse risk, to isolate the project objectives from the risk's impact, or to relax the objective that is in jeopardy, such as extending the schedule or reducing scope. Some risks that arise early in the project can be avoided by clarifying requirements, obtaining information, improving communication, or acquiring expertise.

2.19.3 Transfer

Risk transference requires shifting the negative impact of a threat, along with ownership of the response, to a third party. Transferring the risk simply gives another party responsibility for its management; it does not eliminate it. Transferring liability for risk is most effective in dealing with financial risk exposure. Risk transference nearly always involves payment of a risk premium to the party taking on the risk. Transference tools can be quite diverse and include, but are not limited to, the use of insurance, performance bonds, warranties, guarantees, etc. Contracts may be used to transfer liability for specified risks to another party. In many cases, use of a cost-type contract may transfer the cost risk to the buyer, while a fixed-price contract may transfer risk to the seller, if the project's design is stable.

2.19.4 Mitigate

Risk mitigation implies a reduction in the probability and / or impact of an adverse risk event to an acceptable threshold. Taking early action to reduce the probability and / or impact of a risk occurring on the project is often more effective than trying to repair the damage after the risk has occurred. Adopting less complex processes, conducting more tests, or choosing a more stable supplier are examples of mitigation actions. Mitigation may require prototype development to reduce the risk of scaling up from a bench-scale model of a process or product. Where it is not possible to reduce probability, a mitigation response might address the risk impact by targeting linkages that determine the severity. For example, designing redundancy into a subsystem may reduce the impact from a failure of the original component.

2.19.5 Strategies for Positive Risks or Opportunities

Some responses are designed for use only if certain events occur. For some risks, it is appropriate for the project team to make a response plan that will only be executed under certain predefined conditions, if it is believed that there will be sufficient warning to implement the plan. Events that trigger the contingency response, such as missing intermediate milestones or gaining higher priority with a supplier, should be defined and tracked. Three responses are suggested by American National Standard (2004) to deal with risks with potentially positive impacts on project objectives. These strategies are to exploit, share, or enhance.

2.19.6 Exploit

This strategy may be selected for risks with positive impacts where the organization wishes to ensure that the opportunity is realized. This strategy seeks to eliminate the uncertainty associated with a particular upside risk by making the opportunity definitely happen. Directly exploiting responses including assigning more talented resources to the project to reduce the time to completion, or to provide better quality than originally planned.

2.19.7 Share

Sharing a positive risk involves allocating ownership to a third party who is best able to capture the opportunity for the benefit of the project. Examples of sharing actions include forming risk-sharing partnerships, teams, special-purpose companies, or joint ventures, which can be established with the express purpose of managing opportunities.

2.19.8 Enhance

This strategy modifies the “size” of an opportunity by increasing probability and/or positive impacts, and by identifying and maximizing key drivers of these positive-impact risks. Seeking to facilitate or strengthen the cause of the opportunity, and proactively targeting and reinforcing its trigger conditions, might increase probability. Impact drivers can also be targeted, seeking to increase the project's susceptibility to the opportunity.

2.19.9 Strategy for Both Threats and Opportunities - Acceptance

It is adopted because it is seldom possible to eliminate all risk from a project. This strategy indicates that the project team has decided not to change the project management plan to deal with a risk, or is unable to identify any other suitable response strategy. It may be adopted for either threats or opportunities. This strategy can be either passive or active. Passive acceptance requires no action, leaving the project team to deal with the threats or opportunities as they occur. The most common active acceptance strategy is to establish a contingency reserve, including amounts of time, money, or resources to handle known or even sometimes potential, unknown threats or opportunities.

2.20 RISK RESPONSE PLANNING – OUTPUTS

The out out is mainly in the shape of updating of the risk register and the project management plan as suggested by American National Standard (2004). The risk register is developed in risk identification, and is updated during qualitative risk analysis and quantitative risk analysis. In the risk response planning process, appropriate responses are chosen, agreed-upon, and included in the risk register. The risk register should be written to a level of detail that corresponds with the priority ranking and the planned response. Often, the high and moderate risks are addressed in detail. Risks judged to be of low priority are included in a "watch list" for periodic monitoring. The project management plan is updated as response activities are added after review and disposition through the integrated change control process. Risk response strategies, once agreed to, must be fed back into the appropriate processes in other knowledge areas, including the project's budget and schedule. Moreover, contractual agreements, such as agreements for insurance, services, and other items as appropriate, can be prepared to specify each party's responsibility for specific risks, should they occur.

2.21 RISK MONITORING AND CONTROL

Planned risk responses that are included in the project management plan are executed during the life cycle of the project, but the project work should be continuously monitored for new and changing risks. Risk Monitoring and Control is the process of identifying, analyzing, and planning for newly arising risks, keeping track of the identified risks and those on the watch list, reanalyzing existing risks, monitoring trigger conditions for contingency plans, monitoring residual risks, and reviewing the execution of risk responses while evaluating their effectiveness. The Risk Monitoring and Control process applies techniques, such as variance and trend analysis, which require the use of performance data generated during project execution and is an ongoing process for the life of the project. It can involve choosing alternative strategies, executing a contingency or fallback plan, taking corrective action, and modifying the project management plan. The risk response owner reports periodically to the project manager on the effectiveness of the plan, any unanticipated effects, and any mid-course correction needed to handle the risk appropriately. Risk Monitoring and Control also includes updating the organizational process assets, including project lessons-learned databases and risk management templates for the benefit of future projects.

2.22 RISK MONITORING AND CONTROL – INPUTS

American National Standard (2004) suggests inputs like risk management plan, risk register, approved change requests, work performance information and performance reports.

2.23 RISK MONITORING AND CONTROL - TOOLS AND TECHNIQUES

2.23.1 Risk Reassessment

Risk Monitoring and Control often requires identification of new risks and reassessment of risks, using the process of risk identification. Project risk reassessments should be regularly scheduled. Project Risk Management should be an agenda item at project team status meetings. The amount and detail of repetition that is appropriate depends on how the project progresses relative to its objectives. For instance, if a risk emerges that was not anticipated in the risk register or included on the watch list, or if its impact on objectives is different from what was expected, the planned response may not be adequate. It will then be necessary to perform additional response planning to control the risk.

2.23.2 Risk Audits

Risk audits examine and document the effectiveness of risk responses in dealing with identified risks and their root causes, as well as the effectiveness of the risk management process.

2.23.3 Variance and Trend Analysis

Trends in the project's execution should be reviewed using performance data. Earned value analysis and other methods of project variance and trend analysis may be used for monitoring overall project performance. Outcomes from these analyses may forecast potential deviation of the project at completion from cost and schedule targets. Deviation from the baseline plan may indicate the potential impact of threats or opportunities.

2.23.4 Technical Performance Measurement

Technical performance measurement compares technical accomplishments during project execution to the project management plan's schedule of technical achievement. Deviation, such as demonstrating more or less functionality than planned at a milestone, can help to forecast the degree of success in achieving the project's scope.

2.23.5 Reserve Analysis

Throughout execution of the project, some risks may occur, with positive or negative impacts on budget or schedule contingency reserves. Reserve analysis compares the amount of the contingency reserves remaining to the amount of risk remaining at any time in the project, in order to determine if the remaining reserve is adequate.

2.23.6 Status Meetings

Project risk management can be an agenda item at periodic status meetings. That item may take no time or a long time, depending on the risks that have been identified, their priority, and difficulty of response. Risk management becomes easier the more often it is practiced, and frequent discussions about risk make talking about risks, particularly threats, easier and more accurate.

2.24 RISK MONITORING AND CONTROL – OUTPUTS

The main output is in the form of updating of risk register and project management plan which contains outcomes of risk reassessments, risk audits, and periodic risk reviews. These outcomes may include updates to probability, impact, priority, response plans, ownership, and other elements of the risk register. Outcomes can also include closing risks that are no longer applicable. American National Standard (2004) suggests following outputs:-

2.24.1 Requested Changes

Implementing contingency plans or workarounds frequently results in a requirement to change the project management plan to respond to risks. Requested changes are prepared and submitted to the Integrated Change Control process as an output of the Risk Monitoring and Control process. Approved change requests are issued and become inputs to the Direct and Manage Project Execution process and to the Risk Monitoring and Control process.

2.24.2 Recommended Corrective Actions and Preventive Measures

Recommended corrective actions include contingency plans and workaround plans. The latter are responses that were not initially planned, but are required to deal with emerging risks that were previously unidentified or accepted passively. Workarounds should be properly documented and included in both the Direct and Manage Project Execution and Monitor and Control Project Work processes. Recommended corrective actions are inputs to the Integrated Change Control process. Recommended preventive actions are used to bring the project into compliance with the project management plan.

2.24.3 Organizational Process Assets Updating

The project risk management processes produce information that can be used for future projects, and should be captured in the organizational process assets. The templates for the risk management plan, including the probability and impact matrix, and risk register, can be updated at project closure. Lessons learned from the project risk management activities can contribute to the lessons learned knowledge database of the organization. Data on the actual costs and durations of project activities can be added to the organization’s databases.

Chapter 3

METHODOLOGY

3.1 GENERAL

It is an empirical study and reports the findings of the questionnaire survey and interviews of key participants of the construction industry and follows with little modification, the methodology adopted by Tang et al. (2007).

3.2 DEVELOPMENT OF QUESTIONNAIRE

From literature review a questionnaire was chosen as the principle survey method. A pilot survey was conducted to check the applicability of questionnaire in local environment. Ten questionnaires were distributed to experts representing different organizations: three; clients, four; consultants and three; contractors, followed by interviews with each participant. Respondents had an experience of more than ten years in their respective fields. This exercise was conducted face to face, ensuring 100 per cent response. From their feedback, the questionnaire was amended and redistributed to same individuals, and a final questionnaire was developed from the feedback of these experts to suit local environments. Final questionnaire (Appendix I) has an introduction of the respondents covering their name, qualification, experience in construction industry, organization, appointment and group (Client, Consultant and Contractor), followed by four sections: first; Importance of Risks, second; application of risk management techniques, third; status of risk management system and fourth; barriers to risk management. In first section, 20 major risks are identified, out of which 13 are adopted from Tang et al. (2007), and rests are adopted from input of experts of pilot survey. In second section, 16 different techniques are identified, out of which 11 are adopted from Tang et al. (2007), and rests are adopted from input of experts of pilot survey. Third section has two questions pertaining to status of risk management system of respective organization adopted from Tang et al. (2007). In fourth section 10 barriers to risk management are identified out of which 6 are adopted from Tang et al. (2007), and the rests are adopted from Loosemore et al. (2006) and from the feedback of pilot survey. The questions are applied a five point likert scale, allowing different statistical techniques for analysis.

3.3 SELECTION OF GEOGRAPHICAL AREAS AND FIRMS

Four main centers of Pakistan (Karachi, Lahore, Rawalpindi and Islamabad) were selected to conduct survey. Karachi is provincial capital of Sindh province and main financial hub of Pakistan with a maximum population of 13.3 million. Lahore is also provincial capital and a financial hub of Punjab province with second highest population of 7.2 million. Rawalpindi and Islamabad are twin cities with combine population of 2.98 million and form third largest concentration of population in Pakistan, besides Islamabad is a capital city. These four areas together represent approximately 13.53 per cent of Pakistan’s total population as of end 2010 (State Bank of Pakistan 2010). In general, districts with population density of more than 600 persons per square km are characterized by industrial development, improved education and health infrastructure and better sanitation facilities, e.g., Karachi, Lahore, Peshawar, Charsadda, Gujranwala, Faisalabad, Sialkot, Mardan, Islamabad, Multan, Swabi, Gujrat and Rawalpindi (Khan 2003). Burki et al. (2010) ranks Lahore, Karachi, Rawalpindi / Islamabad as most developed districts of Pakistan basing on industrial clusters and development ranking. Basing upon the geography of these areas, population, industrial clusters and development ranking, it may be assumed that these districts have significant share in construction industry of Pakistan. Consultants and contractors were chosen from Pakistan Engineering Council’s (PEC) web site representing all categories renewed up to 2010. Respondents were divided in to three main groups’ clients, consultants and contractors. Total 105 questionnaires were distributed out of which 80 (76 percent) valid responses were received. The area wise distribution is: 12 (Karachi), 20 (Lahore) and 48 (Rawalpindi / Islamabad). The category wise distribution is: 32 (Consultant), 28 (Client) and 20 (Contractors). All respondents were approached personally on telephone or e-mail. The fieldwork approach was used to distribute and collect the questionnaire followed by an interview. Seventy (70) percent of all the respondents had 10 or more years of experience and rests had 3-10 years of experience of working in their respective fields in construction industry. Keeping in view the geographical locations of these areas, their population size, industrial development contribution and extensive experience of the respondents to variety of the projects, the data collected was extensive and is categorized to be representative of the construction industry.

3.4 STATISTICAL TERMINOLOGIES

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

3.4.1 Hypothesis Testing and Statistical Hypothesis

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

3.4.2 Null Hypothesis and Alternative Hypothesis

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

3.4.3 Type I and Type II Errors

Rejecting null hypothesis when it is in fact true is type I and accepting null hypothesis when it is actually false is type II error. The probability of committing type I error is denoted by α and that of committing a type II error is denoted by β.

3.4.4 Significance Level and Test of Significance

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

3.5 DATA ANALYSIS TECHNIQUE

Statistical Package for Social Science (SPSS-17) was used to analyze the collected data. The study follows the usual level of significance i.e. 0.05 with 0.01 being highly significant. Following statistical techniques were used to analyze the data:-

3.5.1 Test for Normality

The test is important in deciding the type of statistics to be adopted as normal data is an underlying assumption in many statistical testing. Normality is either assessed graphically or numerically. The graphical methods require experience and are subjective in nature, the numerical methods like, Shapiro-Wilk and Kolmogorov-Smirnov tests are objective in nature and are used in this research. The null hypothesis (Ho) for the test is that the data follows the normal distribution and is rejected if the result is significant. The results are tested against the hurdle of significance of 0.05 with 0.01 being highly significant. In case the data fails the test for normality either it has to be rendered normal by mathematical transformation for parametric testing or nonparametric testing is to be adopted. The mathematical transformation creates doubts about authenticity of data unless proper judgment is applied, therefore, nonparametric testing was adopted in the analysis while keeping in mind their major limitations i.e. less flexible and less powerful hence can draw fewer conclusions.

3.5.2 Sample Population Mean / Relative Index (RI) and Ranking

Ranking may be based on population mean or Relative Index (RI). Holt (1997) summarizes that, when analyzing likert scale data to achieve ordinal sorting of the variables measured, mean response will produce the same results as RI. However, RI will also simultaneously generate relative indices where the maximum RI = 1.0, in contrast to maximum mean = N. Many researchers therefore prefer RI because the relative comparison of variables whose indices are ≤ 1.0 is “easier” to perceive; than where maximum index is > 1.0 (i.e. where mean response is used). In this research the ranking is based on sample population mean as it achieves same results as RI.

3.5.3 Kruskal-Wallis Test

A Kruskal-Wallis is nonparametric measure and is an extension of Mann-Whitney test. It is much less sensitive to outliers and was used for comparison of means of variables to test the perceptions of each group (Client, Consultant and Contractor) about importance of a specific risk, their management techniques and barriers to risk management. The null hypothesis (Ho) for the test is that the means of variables are equal and is rejected if the result is significant. The results are tested against the hurdle of significance of 0.05 with 0.01 being highly significant.

3.5.4 Spearman Rank Correlation

It is a nonparametric measure of the strength and direction of association that exists between two variables measured on at least an ordinal scale and is denoted by the symbol r_s (Rho). It was performed to test the consensus among the various groups (Client, Consultant and Contractor) on the ranking of the importance of project risks, their management techniques employed and barriers to implementation of effective risk management. The null hypothesis (Ho) for the test is that there is no correlation among the variables and is rejected if the result is significant. The results are tested against the hurdle of significance of 0.05 with 0.01 being highly significant. The test is based on the assumptions that:-

- An interval, ratio or ordinal scale is used for measurement of variables.
- Data may not be normally distributed.
- Two variables have monotonic relationship i.e. either they increase in value simultaneously or as one decreases the value of other variable increases.
- Outliers do not have an effect on the correlation.

Chapter 4

RESULTS AND ANALYSIS

4.1 GENERAL

Statistical Package for Social Science (SPSS-17) is flexible and comprehensive statistical tool which can take data from different type of files and uses them to perform intricate statistical analysis including charts, trends, and tabulated reports. SPSS helps in calculations and to produce results, the subsequent part i.e. drawing quality inferences from these results depends upon the degree of knowledge and expertise of the researcher about statistics as a subject. The data was entered in SPSS progressively as all 80 questionnaires were received and were checked for correctness and completeness.

4.2 IMPORTANCE OF RISKS

Respondents were required to provide responses on the importance of 20 risks affecting the construction industry on likert scale 1-5, where 1 represented "insignificant risk" and 5 represented "catastrophic risk". The data does not follow the normal distribution as is evident from the result of Shapiro-Wilk test presented in Table 4.1. Overall ranking of risks basing on their means is: financial factors (mean = 4.31), economic factors (mean = 4.18), quality (mean = 4.15), premature failure of facility (mean = 4.01), lack of planning and management (mean = 3.99), change in design / scope of work (mean = 3.84), corruption (mean = 3.74), claims and disputes (mean = 3.60), inadequate / incorrect design (mean = 3.58), quantity variations (mean = 3.20), unforeseen site conditions (mean = 3.16), delay in supply of drawings (mean = 2.91), political and social factors (mean = 2.61), conflict in contract documents (mean = 2.59), safety (mean = 2.54), feasibility of construction methods (mean = 2.53), insufficient technology / skills / techniques (mean = 2.38), poor coordination / cooperation / relationship among key stake holders (mean = 2.36), non implementation of standard bidding / contract documents (mean = 1.99) and force majeure (mean = 1.94). The result is presented in Table 4.2. All groups i.e. Clients, consultants and contractors have similar perceptions about 14 risks out of 20 and differ on remaining 6 risks as revealed by the result of Kruskal-Wallis test presented in Table 4.3. Perceptions are significantly different about financial factors (p = .000), economic factors (p = .003), quality (p = .024), lack of planning and management (p = .004), corruption (p = .031), inadequate / incorrect design (p = .000). Interviews revealed that financial and economic factors have been given relatively lower ranking by the consultants (mean = 3.88 and mean = 3.81) mainly due to the reason that these risks are generally distributed among client and contractor. Consultants give importance to these risks to the extent of their fundamental responsibility i.e. economic design of facilities. Quality was given relatively lower ranking by contractors (mean = 3.75) conforming to general dissatisfaction of clients and consultants to the works executed by the contractors and the importance which contractors give to the quality. Lack of planning and management was ranked lower by consultants (mean = 3.59) mainly due to the reason that this risk is largely considered the responsibility of client and contractor unless the consultant is awarded the management contract. Corruption was ranked little higher by the clients (mean = 4.07) and interviews revealed that clients have a general perception that at some instances, substandard works of contractor are being approved by consultant unethically. Inadequate / incorrect design was ranked much higher by consultant (mean = 4.06) mainly due to the reason that provision of adequate and correct design is considered the fundamental responsibility of the consultant and most of the works related to alterations, revisions, amendments, cost overrun, time delays and disputes is associated with it. Safety is ranked 18th by clients and 12th by contractors, signifies that clients consider themselves absolve to any responsibility of safety related incident and most of this risk is transferred to the contractors. The overall low ranking of safety i.e. fifteenth (15th) is pointing towards the greater issues of labor laws, their implementation and general plight of the laborers in the country. The result of Spearman rank correlation as presented in Table 4.4 revealed that there is a strong positive correlation between the risk ranking of clients, consultants and contractors, which is statistically significant. The results of Kruskal-Wallis Test and Spearman rank correlation demonstrate that although groups differ to each other on the perceptions of six individual risks out of twenty, they all agree on risk ranking of each other. The statistical and interview results also signify the willingness of the groups for joint risk management mechanism to address these risks collaboratively provided a standard contract /

bidding document, may be of Pakistan Engineering Council or Federation Internationale Des Ingenieurs Conseils (FIDIC) are implemented in all public sector organizations for a specific type of contract. Few of the important risks are discussed below:-

4.2.1 Financial Factors

It is overall ranked first (mean = 4.31) and interviews revealed that in financial factors the major concern is capital supply and cash flows followed by interest rates. The first two i.e. capital supply and cash flows are internal to an organization, interest rates are external factors mostly governed by policies of the State Bank of Pakistan. The policy / discount rate of State Bank of Pakistan is shown in Table 4.5 and reveals that it was as high as 15 percent on Nov 08 and was as low as 9.5 percent on 22 Jul 06, which is presently at 14 percent. There is an increase of 150 basis points in 2010 mainly due to high inflation and government borrowings. As per State Bank of Pakistan (2011), Karachi interbank offer rate (KIBOR) which is a bench mark for corporate lending, has been steadily following the rise in the SBP policy / discount rate. Accordingly, the six month KIBOR had increased by 146 basis points to 13.9 percent till 28 Jan 11, ever since the monetary policy was announced on 29 Jul 10. Most of the corporate loan agreements have floating rates; it means automatic adjustment of interest rate with KIBOR, which may affect project cash flows and capital supply. Changes in cash flows and capital supply may affect the project negatively in many ways including but not limited to delays, cost overruns, poor quality and at times abandonment of the project. Contractors relying on corporate lending to bridge financial gaps become more vulnerable especially, when partial payments on performed work may be delayed by the client due to any reason. Interviews revealed that contractors are concerned about the fate of the ongoing projects in public sector due to Government's decision to reduce funding in the backdrop of recent unprecedented floods in mid 2010. The financial factors assume leading position in the listing of risks for the reason that if not addressed timely, they have the potential to choke the project completely. A financially healthy project is likely to meet its intended objectives more aggressively.

4.2.2 **Economic Factors**

This risk factor which is external in nature, is overall second (mean = 4.18) and interviews revealed that inflation and price hike is the major concern followed by rupee exchange rate and taxes. The principle measure of price variation at retail level is Consumer Price Index (CPI) and generally represents inflation rate in the country. Figure 4.1 shows the month wise year-on-year CPI inflation for the years of 2008, 09 and 10. It may be observed that it is mostly in double digits except for the month of October 09 and is considered on the higher side. According to State Bank of Pakistan (2011), the projected average CPI inflation for current financial year falls in the range of 15-16 percent (revised) and in all probability 2012 is again likely to witness double digit CPI inflation. This rising trend may only be arrested by reduction in both government borrowings and fiscal deficit. Inflation is underlying cause of upward movement of State Bank of Pakistan policy rate and prices of major inputs to construction industry i.e. cement, steel and oil. This amplifies that the fundamental reason of the risks of financial factors is the economic factors and that too mainly inflation. Table 4.6 shows prices of major inputs to construction industry from Jan 2009 to Jul 2010. A closer look to price fluctuation reveals that in a span of 12 months from Apr 09 to Apr 10, the price of cement is reduced by 23.07 percent mainly due to locally available raw material and less demand, the price of steel increased by 24.03 percent, the price of petrol increased by 30.17 percent and the price of diesel increased by 34.36 percent. The cement production stands at 22.8 million tons in 2009-10 against the installed capacity of 44.00 million tons indicating 51.8% capacity utilization (State Bank of Pakistan 2010). According to All Pakistan Cement Manufacturers Association (APCMA), the cement sales dropped by 10.48 percent in first eight months of current financial year (Jul 10 – Feb 11) as compared to sales in previous year during the same period. It is mainly due to reason that the purchasing power of the consumer is eroded by combined effect of low economic activity and inflationary pressures. The devaluation of rupee as presented in Table 4.7, against major currencies of the world is another area of concern as it increases import bill of construction machinery, chemicals, Oil and raw materials for steel, there by escalating the cost of construction. In a span of seven years (2003-10) rupee was devalued by 45.14 percent (83.56 – 57.57 = Rs. 25.99) against US dollar, and by 74.06 percent (119.44 – 68.62 = Rs. 50.82) against Euro, which is unprecedented if compared to other regional currencies. Pakistani currency even depreciated against regional currencies like Indian rupee and Bangladesh Taka in 2001-10. It has been devalued against Indian rupee by 40.16 percent (1.78 – 1.27 = Rs. 00.51) and against Bangladesh Taka by 11.11 percent (1.20 – 1.08 = Rs. 00.12) since 2001. As observed by Ministry of Finance (2010), the problem of inflation was compounded by devaluation of rupee which also posed a serious threat to the economy and society at large during 2008-09. The World Bank (2011) has downgraded Pakistan's ranking from 75th position in 2010 to 83rd position in 2011 in ease of doing business in its annual report of "Doing Business 2011".

4.2.3 Corruption

It is overall ranked seventh (mean = 3.74) and is both internal and external to an organization. Interviews revealed that it is endemic in nature and often leads to wrong selection of contractor / consultant, increased cost, poor quality, time overrun and disputes. The major concern is the procedure to award the contract. Infringement of Public Procurement Rules (2004) for personal gains is very common in the award of the contract. According to world economic forum report (Feb 2011) Pakistan is ranked one hundred and seventeen (117) out of one hundred and thirty nine (139) countries in corruption and described it the major impediment in doing business and increasing cost of production in Pakistan along with inflation. According to Transparency International Pakistan (2010), the corruption in Pakistan has increased from Rs 195 billion in 2009 to Rs 223 billion in 2010 and ranked Pakistan as 42nd most corrupt country out of 180 countries in 2009, a five rank depreciation from previous year rank of 47th most corrupt country out of 180 surveyed. India is ranked 95th most corrupt country in 2009 and 96th in 2008. The performance of Bangladesh on the issue is commendable as it was ranked 1st most corrupt country in 2001 and 42 most corrupt country in 2009, a 41 points improvement in corruption ranking in 8 years.

4.2.4 Political and Social Factors

This factor has been overall ranked 13th (mean = 2.61) and interviews revealed that law and order situation especially in the background of war on terror is foremost concern of all groups. There is a general perception among the respondents that the current law and order situation is a reaction to war on terror which has both human and monetary dimensions and is eroding whatever limited fiscal space is available to the country. Almost 82 percent of the contractors and consultants interviewed, were reluctant to work in federal administered tribal areas (FATA) and Baluchistan, which comprises of more than half of Pakistan's geographical area, mainly due to risks involve to human lives and business. The remaining 18 percent demonstrated their conditional willingness to operate in these remote areas if dedicated security is provided and a risk premium is added in contract by the client. The survey was mainly conducted in the urban centers of the country; therefore, this factor is ranked much below (13th) than what actually its impact is on business environment in Pakistan. This may be judged from the fact that according to State Bank of Pakistan (2010) a total of 8,141 terror related incidents have occurred in Pakistan in a span of eight years (2002-10), which resulted in 8,875 deaths and as much as 20,675 injuries to the people. Figure 4.2 shows year wise human losses and shows an intensification of fatalities in 2008-09. The effects of the war on terror and arising terror activities in reaction have been colossal especially on economic front. As per State Bank of Pakistan (2010) the country has suffered a cumulative (direct and indirect) loss of US$ 43.2 billion (Table 4.8) in the areas of investment, GDP growth, exports, physical infrastructure, budgetary resources, public sector development spending, exchange rates, inflation, rehabilitation of internally displaced people, security and capital flight. Growth and investment have slowed down due to negative effects of the war on terror. Table 4.9 shows changes in foreign direct investment (FDI), large scale manufacturing (LSM), exports and real GDP growth for last nine financial years. The real GDP in 2008-09 was 1.2 percent with large scale manufacturing shrinking to -8.2 percent. It may be observed that average GDP growth was 6.6 percent in 2004-08 and large scale manufacturing grew by average 11.9 percent in that period. The change in FY 2008-09 to five year's average is minus 5.4 percent for GDP, minus 20.1 percent for large scale manufacturing and minus 1.1 percent for exports and the same is supported by surge in human fatalities in 2008-09 (Figure 4.2). The exact impact of this factor on construction industry is difficult to calculate in the absence of reliable data, however, the construction industry is being affected in similar way as any other industry of Pakistan.

Table 4.1: Shapiro-Wilk Normality Test for Importance of Risks

Risks	Significance
Financial Factors (Interest Rate, Cash Flows, Capital Supply)	.000
Economic Factors (Inflation, Price Hike, Taxes, Exchange Rate)	.000
Quality	.000
Premature Failure of Facility	.000
Lack of Planning and Management	.000
Change in Design / Scope of work	.000
Corruption	.000
Claims and Disputes	.000
Inadequate / Incorrect Design	.000
Quantity Variations	.000
Unforeseen Site Conditions	.000
Delay in supply of Drawings	.000
Political and Social Factors (Law and Order, Insurgency, Strikes)	.000
Conflict in Contract Documents	.000
Safety	.000
Feasibility of Construction Methods	.000
Insufficient Technology, Skills and Techniques	.000
Poor Coordination, Cooperation and Relationship among Key Stakeholders	.000
Non Implementation of Standard Bidding / Contract Documents	.000
Force Majeure (Act of God like Flood, Earth Quake)	.000

Table 4.2: Ranking of Important Risks

Risks	Overall		Client		Consultant		Contractor	
	M	R	M	R	M	R	M	R
Financial Factors (Interest Rate, Cash Flows, Capital Supply)	4.31	1	4.61	1	3.88	5	4.60	1
Economic Factors (Inflation, Price Hike, Taxes, Exchange Rate)	4.18	2	4.36	3	3.81	6	4.50	2
Quality	4.15	3	4.39	2	4.19	1	3.75	6
Premature Failure of Facility	4.01	4	4.25	5	4.13	2	3.50	8
Lack of Planning and Management	3.99	5	4.29	4	3.59	7	4.20	3
Change in Design / Scope of work	3.84	6	3.64	8	4.03	4	3.80	5
Corruption	3.74	7	4.07	6	3.47	8	3.70	7
Claims and Disputes	3.60	8	3.68	7	3.38	9	3.85	4
Inadequate / Incorrect Design	3.58	9	3.50	9	4.06	3	2.90	11
Quantity Variations	3.20	10	3.21	11	3.16	10	3.25	9
Unforeseen Site Conditions	3.16	11	3.39	10	2.97	12	3.15	10
Delay in supply of Drawings	2.91	12	3.00	12	3.09	11	2.50	13
Political and Social Factors (Law and Order, Insurgency, Strikes etc)	2.61	13	2.64	14	2.84	13	2.20	16
Conflict in Contract Documents	2.59	14	2.89	13	2.44	18	2.40	14
Safety	2.54	15	2.39	18	2.66	15	2.55	12
Feasibility of Construction Methods	2.53	16	2.43	17	2.75	14	2.30	15
Insufficient Technology, Skills and Techniques	2.38	17	2.50	16	2.56	16	1.90	19
Poor Coordination, Cooperation and Relationship among Key Stakeholders	2.36	18	2.54	15	2.47	17	1.95	18
Non Implementation of Standard Bidding / Contract Documents	1.99	19	1.89	20	2.00	19	2.10	17
Force Majeure (Act of God like Flood, Earth Quake)	1.94	20	2.14	19	1.97	20	1.60	20

Note: M. = Mean; R. = Rank

Table 4.3: Kruskal-Wallis Test for Importance of Risks

Risks	Significance
Financial Factors (Interest Rate, Cash Flows, Capital Supply)	.000
Economic Factors (Inflation, Price Hike, Taxes, Exchange Rate)	.003
Quality	.024
Premature Failure of Facility	.065
Lack of Planning and Management	.004
Change in Design / Scope of work	.185
Corruption	.031
Claims and Disputes	.124
Inadequate / Incorrect Design	.000
Quantity Variations	.870
Unforeseen Site Conditions	.370
Delay in supply of Drawings	.105
Political and Social Factors (Law and Order, Insurgency, Strikes etc)	.087
Conflict in Contract Documents	.142
Safety	.652
Feasibility of Construction Methods	.289
Insufficient Technology, Skills and Techniques	.087
Poor Coordination, Cooperation and Relationship among Key Stakeholders	.116
Non Implementation of Standard Bidding / Contract Documents	.906
Force Majeure (Act of God like Flood, Earth Quake)	.164

Table 4.4: Spearman Rank Correlation for Importance of Risks

Group		Client	Consultant	Contractor
Client	r	1.000	.880 a	.904 a
	p	-	.000	.000
Consultant	r	.880 a	1.000	.806 a
	p	.000	-	.000
Contractor	r	.904 a	.806 a	1.000
	p	.000	.000	-

a = Correlation is significant at the .01 level (2-tailed)

r = Spearman rank correlation coefficient (rho)

p = Significance Value

Table 4.5: State Bank of Pakistan (2010) Policy Rate

Period / Date	SBP Policy (Percent)	Basis Points
22 Jul 06	9.5	-
1 Aug 07	10	+50
2 Feb 08	10.5	+50
23 May 08	12	+150
30 Jul 08	13	+100
13 Nov 08	15	+200
21 Apr 09	14	-100
17 Aug 09	13	-100
25 Nov 09	12.5	-50
29 Jul 10	13	+50
Sep 10	13.5	+50
Nov 10	14	+50
29 Jan 11	14	-

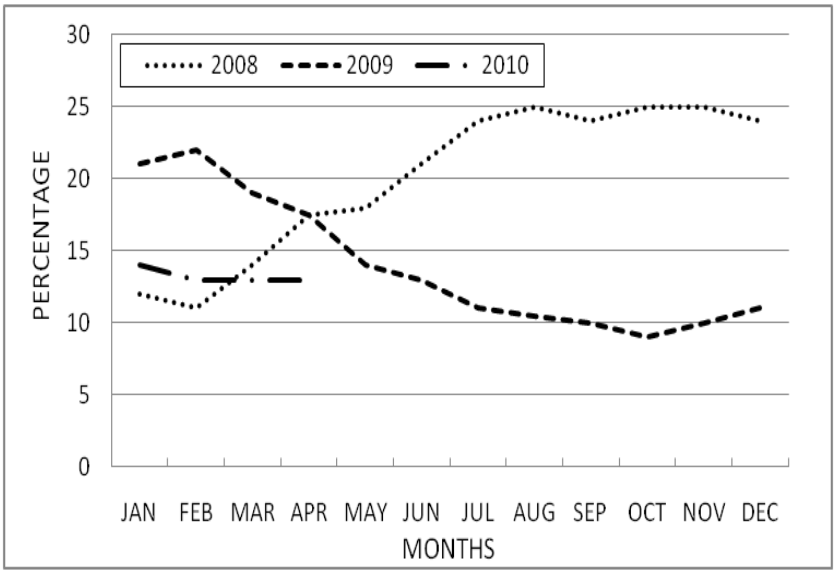

Figure 4.1: Month Wise Year-on-Year CPI Inflation
(State Bank of Pakistan 2010)

Table 4.6: Prices of Construction Input Items (Federal Bureau of Statistics 2010)

Period	Cement Rs per Bag	Steel Rs per Ton	Petrol Rs per Littre	Diesel Rs per Littre
Jan 09	380.00	53000.00	57.76	57.24
Apr 09	357.50	52000.00	57.76	57.24
Jul 09	350.00	55000.00	60.57	61.58
Oct 09	270.00	50000.00	61.74	64.90
Jan 10	255.00	57500.00	71.32	71.97
Apr 10	275.00	64500.00	75.19	76.91
Jul 10	315.00	62000.00	67.86	73.15

Table 4.7: Exchange Rate (State Bank of Pakistan 2010)

Financial Year	Average Open Market Exchange Rate (Pak Rs)			
	US Dollar	Euro	Indian Rupee	Bangladesh Taka
2001-02	61.42	54.99	1.27	1.08
2002-03	58.49	61.30	1.22	1.01
2003-04	57.57	68.62	1.26	0.98
2004-05	59.35	75.53	1.32	0.97
2005-06	59.85	72.86	1.33	0.91
2006-07	60.63	79.17	1.37	0.87
2007-08	62.54	92.17	1.54	0.90
2008-09	78.49	107.43	1.64	1.14
2009-10	83.56	119.44	1.78	1.20
8 Mar 2011	85.36	-	-	-

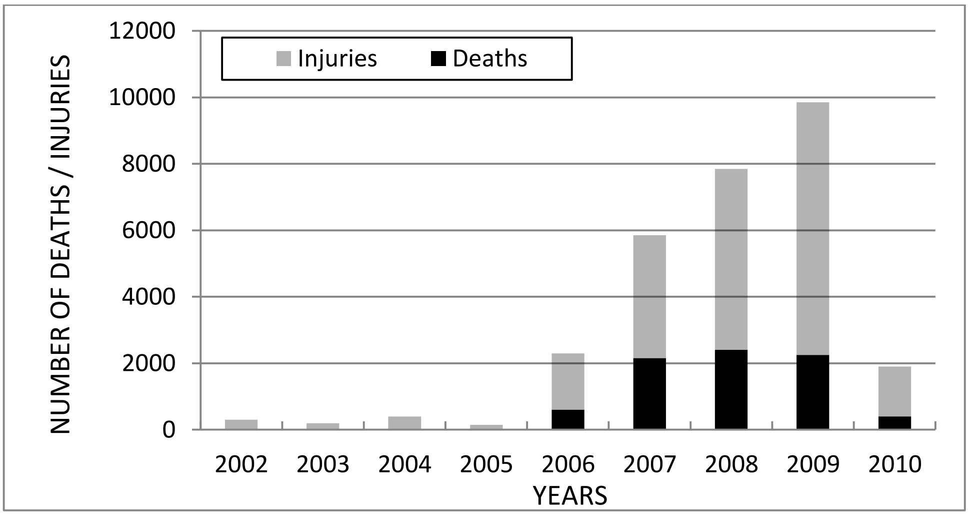

Figure 4.2: Year Wise Human losses (State Bank of Pakistan 2010)

Table 4.8: Estimated Loss to Economy (State Bank of Pakistan 2010)

Financial Year	Indirect Cost (Billion Rs)	Direct Cost (Billion Rs)	Total (Billion Rs)	Total (Billion US $)
2004-05	192	67	259	4.4
2005-06	223	78	301	5.0
2006-07	278	83	361	6.0
2007-08	376	109	485	7.7
2008-09	564	114	678	8.6
2009-10	707	262	969	11.5
Total	2340	713	3053	43.2

Table 4.9: Change in Major Economical Indicators (State Bank of Pakistan 2010)

Year	FDI (Billion US $)	LSM (Percent)	Exports (Billion US $)	GDP (Percent)
2001	0.3	10.2	9.2	2.0
2002	0.5	3.8	9.14	3.1
2003	0.8	0.4	11.1	4.7
2004	0.9	18.5	12.3	7.5
2005	1.5	18.8	14.3	9.0
2006	3.5	9.2	16.4	5.8
2007	5.1	8.8	17.0	6.8
2008	5.2	4.2	19.1	4.1
2009	3.7	-8.2	14.8	1.2
5 Years Average (2004-08)	3.3	11.9	15.8	6.6
Change (5 Years average to 2008/09)	0.5	-20	-1.1	-5.4

FDI = Foreign Direct Investment

LSM = Large Scale Manufacturing

GDP = Gross Domestic Product

4.3 RISK MANAGEMENT TECHNIQUES

4.3.1 Risk Identifications Techniques

Respondents were required to identify frequency of usage of 5 (five) risk identification techniques on the scale of 1-5, where 1 represented “Never Used”, and 5 represented “Always Used”. The data does not follow the normal distribution as is evident from result of Shapiro-Wilk test presented in Table 4.10. An overall ranking of risk identification techniques followed by ranking within each group is calculated basing upon mean responses. The results are presented in Table 4.11. Consulting experts (mean = 3.49) is the most frequently used technique to identify risks, followed by industry information (mean = 3.01), checklists (mean = 2.66), risk review meetings (mean = 2.53) and brain storming (mean = 1.36). The perceptions of the groups do not differ significantly except for the technique of consulting experts (p = .023) as revealed by result of Kruskal-Wallis test presented in Table 4.12. It is ranked low (mean = 3.13) by consultants and high by contractors (mean = 3.85) due to reason that consultants possess in-house expertise whereas, contractors mostly with low qualification in their respective field, consult experts more frequently for guidance. The result of Spearman rank correlation, as shown in Table 4.13, reveals that clients and contractors agree to each other’s ranking whereas both differ significantly (p = .104) to that of consultant’s ranking. This is due to the difference in level of in-house expertise available to a consultant vis-à-vis to both clients and contractors. Interviews revealed that all these techniques are being employed unsystematically without any documentation, mostly relying on personal experience and information extracted from print and electronic media, hence cannot be regarded as a concerted or a formal effort. The respondents were not much familiar about proactive and reactive risk identification techniques and their utility; however, they do recognize that the risks may arise in reaction to a decision taken in the backdrop of an identified risk. Furthermore, using creative people or providing creativity training to employees for risk identification is a rare phenomenon and only idea elicitation techniques are sometimes employed for the purpose.

Table 4.10: Shapiro-Wilk Normality Test for Risk Identification Techniques

Technique	Significance (p)
Consulting Experts	.000
Industry Information	.000
Checklists	.000
Risk Review Meetings	.000
Brain Storming	.000

Table 4.11: Ranking of Risk Identification Techniques

Technique	Overall		Client		Consultant		Contractor	
	M	R	M	R	M	R	M	R
Consulting Experts	3.49	1	3.64	1	3.13	2	3.85	1
Industry Information	3.01	2	3.04	2	3.16	1	2.75	2
Checklists	2.66	3	2.68	4	2.72	3	2.55	4
Risk Review Meetings	2.53	4	2.61	3	2.34	4	2.70	3
Brain Storming	1.36	5	1.36	5	1.31	5	1.45	5

Note: M. = Mean; R. = Rank

Table 4.12: Kruskal-Wallis Test for Risk Identification Techniques

Technique	Significance (p)
Consulting Experts	.023
Industry Information	.397
Checklists	.892
Risk Review Meetings	.416
Brain Storming	.860

Table 4.13: Spearman Rank Correlation for Risk Identification Techniques

Group		Client	Consultant	Contractor
Client	r	1.000	.800	1.000
	p	-	.104	-
Consultant	r	.800	1.000	.800
	p	.104	-	.104
Contractor	r	1.000	.800	1.000
	p	-	.104	-

r = Spearman rank correlation coefficient (rho)

p = Significance Value

4.3.2 Risk Analysis Techniques

Respondents were required to identify frequency of usage of 3 (three) risk analysis techniques on the scale of 1-5, where 1 represented "Never Used", and 5 represented "Always Used". The data does not follow the normal distribution as is evident from result of Shapiro-Wilk test presented in Table 4.14 and an overall ranking of risk analysis techniques basing on mean responses as shown in Table 4.15 is: Qualitative (mean = 2.20), Semi Quantitative (mean = 1.23) and Quantitative (mean = 1.11). The values of low mean signify that analysis is seldom resorted to for already identified risks and groups are not much familiar with their utility. Result of Kruskal-Wallis test as presented in Table 4.16 reveals that perceptions of each group about a specific risk analysis technique do not differ significantly. The result of Spearman rank correlation as presented in Table 4.17 reveals that groups agree to the ranking of each other about frequency of usage of risk analysis techniques. The interviews revealed that there is barely any process of documentation of risks analyzed by any process by all groups, hence can best be regarded as informal and trivial effort. Use of computer and risk analysis software is seldom resorted especially in conjunction with project management software like MS Office Project and Primavera, despite the fact that many project managers do recognize their utility. Furthermore, the advanced techniques for quantitative risk analysis like sensitivity testing, expected monetary values (EMV) and risk adjusted discount rate (RADR) are also seldom employed. An added issue is the availability of reliable data for quantitative analysis, as most of the organizations do not have appropriate system, expertise and capacity to record data of ongoing and completed projects.

Table 4.14: Shapiro-Wilk Normality Test for Risk Analysis Techniques

Technique	Significance (p)
Qualitative	.000
Semi Quantitative	.000
Quantitative	.000

Table 4.15: Ranking of Risk Analysis Techniques

Technique	Overall		Client		Consultant		Contractor	
	M	R	M	R	M	R	M	R
Qualitative	2.20	1	2.14	1	2.13	1	2.40	1
Semi Quantitative	1.23	2	1.21	2	1.19	2	1.30	2
Quantitative	1.11	3	1.07	3	1.16	3	1.10	3

Note: M. = Mean; R. = Rank

Table 4.16: Kruskal-Wallis Test for Risk Analysis Techniques

Technique	Significance (p)
Qualitative	.486
Semi Quantitative	.634
Quantitative	.576

Table 4.17: Spearman Rank Correlation for Risk Analysis Techniques

Group		Client	Consultant	Contractor
Client	r	1.000	1.000	1.000
	p	-	-	-
Consultant	r	1.000	1.000	1.000
	p	-	-	-
Contractor	r	1.000	1.000	1.000
	p	-	-	-

r = Spearman rank correlation coefficient (rho)
p = Significance Value

4.3.3 Risk Response Techniques

Respondents were required to identify frequency of usage of 6 (six) risk response techniques on the scale of 1-5, where 1 represented “Never Used”, and 5 represented “Always Used”. The data does not follow the normal distribution as is evident from result of Shapiro-Wilk test presented in Table 4.18. The overall ranking of risk response techniques basing on means is: avoid the risk (mean = 4.18), transfer the risk completely (mean = 4.08), reduce the likelihood of occurrence (mean = 3.89), reduce the consequences (mean = 3.81), risk sharing (mean = 3.59) and retain the risk completely (mean = 3.59). The result is presented in Table 4.19. Kruskal-Wallis test result as presented in table 4.20 reveals that the perceptions of each group about a specific risk response technique are significantly identical. The spearman rank correlation reveals that clients and consultants have the same opinion about the ranking of risk response techniques, whereas both differ to the ranking of that of contractors. This is mainly due to reason that in most of the cases consultant represents the client and the risks are mostly divided between clients and the contractors. The result of Spearman rank correlation is presented in Table 4.21. “Avoiding the risks” at the top of the ranking suggests that lot of business opportunities may be missed due to over cautious attitude. Organizations make money and increase their value by taking risks; therefore, it is desirable to take informed decisions and take those opportunities which can be managed effectively and avoid those risks which are beyond organizational resources and are intricate to manage properly. Making informed decisions not only require the experience and professional judgment but also the knowledge of risk management process. Essentially risk management is decision making (Kliem and Ludin 1997), therefore, the risk management may be regarded as a function of quality of a decision. Whether a decision is good or poor is largely decided by the efficiency of information obtained by the decision maker, and the information is the main source in the steps of risk identification and analysis (Tang et al. 2007). The efficiency of information can be calculated by dividing value of information to value of perfect information (Buck 1989). This may be expressed mathematically as:-

Risk management = f (Quality of decision)

Quality of decision = f (Efficiency of information) and,

Efficiency (ξ) of information = Value of information / Value of perfect information

Therefore, Risk management = Value of information / Value of perfect information

Further investigation of ranking suggests that the construction industry is far beyond the process of sharing the risks (ranked 5th) and mostly relies on transferring the risks (ranked 2nd). Interviews revealed that insurance, a mean to transfer the risk, is only resorted in public sector contracts where it is a contractual obligation and that no principles are being followed in transferring the risks to some business partner as suggested by Loosemore et al. (2006). Neither the business partner is made fully aware of the risks he is taking nor he has the necessary capacity and resources to to manage it effectively, nor does he possess the right attitude to take the risks. This results in the conflicts which is usually detrimental to project objectives.

Table 4.18: Shapiro-Wilk Normality Test for Risk Response Techniques

Technique	Significance (p) Value
Avoid the Risk	.000
Transfer the Risk Completely	.000
Reduce the Likelihood of Occurrence	.000
Reduce the Consequences	.000
Risk Sharing	.000
Retain the Risk Completely	.000

Table 4.19: Ranking of Risk Response Techniques

Technique	Overall		Client		Consultant		Contractor	
	M	R	M	R	M	R	M	R
Avoid the Risk	4.18	1	4.07	2	4.41	1	3.95	3
Transfer the Risk Completely	4.08	2	4.11	1	4.09	2	4.00	2
Reduce the Likelihood of Occurrence	3.89	3	3.89	3	3.72	4	4.15	1
Reduce the Consequences	3.81	4	3.86	4	3.84	3	3.70	5
Risk Sharing	3.59	5	3.64	6	3.53	5	3.60	6
Retain the Risk Completely	3.55	6	3.79	5	3.19	6	3.80	4

Note: M. = Mean; R. = Rank

Table 4.20: Kruskal-Wallis Test for Risk Response Techniques

Technique	Significance (p)
Avoid the Risk	.414
Transfer the Risk Completely	.902
Reduce the Likelihood of Occurrence	.478
Reduce the Consequences	.801
Risk Sharing	.939
Retain the Risk Completely	.058

Table 4.21: Spearman Rank Correlation Risk Response Techniques

Group		Client	Consultant	Contractor
Client	r	1.000	.829	.771
	p	-	.042 a	.072
Consultant	r	.829	1.000	.371
	p	.042 a	-	.468
Contractor	r	.771	.371	1.000
	p	.072	.468	-

a = Correlation is significant at the .05 level (2-tailed)

r = Spearman rank correlation coefficient (rho)

p = Significance Value

4.3.4 Risk Monitoring Techniques

Respondents were required to identify frequency of usage of 2 (two) risk monitoring techniques on the scale of 1-5, where 1 represented "never used", and 5 represented "always used". The data does not follow the normal distribution as is evident from result of Shapiro-Wilk test presented in Table 4.22. Incident investigation (mean = 3.23) is mostly used for risk monitoring followed by risk audit / inspection (mean = 1.25). The result is presented in Table 4.23. Result of Kruskal-Wallis test as presented in Table 4.24 reveals that groups possess similar perceptions about both the risk monitoring techniques (p = .699, p = .807). All groups agree to the ranking of each other, significantly, as is evident from the result of Spearman rank correlation presented in Table 4.25. Interviews revealed that most of the respondents had no idea of risk audit / inspection and even incident investigation is not from risk management point of view but for fixing the responsibility and in most of the cases, the results of investigation are covered to protect organization from any defamation, litigation and loss. This attitude is counterproductive for the growth and maturity of risk management system and practices of an organization.

Table 4.22: Shapiro-Wilk Normality Test for Risk Monitoring Techniques

Technique	Significance (p) Value
Incident Investigation	.000
Risk Audit / Inspection	.000

Table 4.23: Ranking of Risk Monitoring Techniques

Technique	Overall		Client		Consultant		Contractor	
	M	R	M	R	M	R	M	R
Incident Investigation	3.44	1	3.32	1	3.47	1	3.55	1
Risk Audit / Inspection	1.25	2	1.25	2	1.22	2	1.30	2

Note: M. = Mean; R. = Rank

Table 4.24: Kruskal-Wallis Test for Risk Monitoring Techniques

Technique	Significance (p) Value
Incident Investigation	.699
Risk Audit / Inspection	.807

Table 4.25: Spearman Rank Correlation for Risk Monitoring Techniques

Group		Client	Consultant	Contractor
Client	r	1.000	1.000	1.000
	p	-	-	-
Consultant	r	1.000	1.000	1.000
	p	-	-	-
Contractor	r	1.000	1.000	1.000
	p	-	-	-

r = Spearman rank correlation coefficient (rho)
p = Significance Value

4.4 STATUS OF RISK MANAGEMENT SYSTEM

In section three, respondents were required to answer two questions on likert scale 1-5, where 1 represents "strongly informal" and 5 represents "strongly formal" for first question, and for second question, 1 represents "strongly disagree" and 5 represents "strongly agree". These questions were included to know the current status of risk management system of an organization by acquiring the general perceptions about present formality and adequacy level of their risk management system. The data does not follow the normal distribution as is evident from result of Shapiro-Wilk test presented in Table 4.26. The result of mean responses is shown in Table 4.27. The results show that perceptions of contractors (mean = 2.75) about formality level of their organization's risk management system are comparatively batter than that of clients (mean = 2.61) and consultants (mean = 2.47). However, perceptions of clients (mean = 2.33) are comparatively better about adequacy of their organization's risk management system than that of contractors (mean = 2.20). The reason is that most of the clients represent public sector organizations and although they place formality level of their organizations comparatively lower than contractors still they are more satisfied with its adequacy. Contrary to that contractors mostly represent private sector and have little better perceptions of their risk management system than clients but still feel its inadequacy. As the contract forms the basis for distribution of risks between client and contractor, clients mostly in public sector organizations use a standard contract documents, hence are more confident about its adequacy as for as risk distribution is concern, whereas, contractors work with different type of clients making different type of contracts, feel inadequacy of their risk management system. The single most important influence on any project is whether or not it is carried out by the public or private sectors (Smith et al. 2006). The overall perceptions about formality level (mean = 2.59) are comparatively better than overall perceptions about adequacy level (mean = 2.33). Interviews revealed that overall risk maturity level of surveyed organizations can best be described between level 1 and level 2. Whereas, the highest level is 4, only 2-3 percent organizations may claim to attain it, close to level 2, if measured according to risk management maturity level audit tool of Project Management Institute. The risk management system and practices of most of the surveyed organizations are reactive, semi permanent, informal and unstructured with no or very little committed resources to deal with risks. Nonetheless, there is awareness about the risks and a desire to learn from the past mistakes. Result of Kruskal-Wallis test as presented in Table 4.28 reveals that groups possess similar perceptions of the current status of risk management system of their respective organizations.

Table 4.26: Shapiro-Wilk Normality Test for Status of Risk Management System

Questions	Significance
"Formally" you place your organization's Risk Management System at what level?	.000
Do you consider your organization's Risk Management System as "Adequate"?	.000

Table 4.27: Status of Risk Management System

Questions	Overall M	Client M	Consultant M	Contractor M
"Formally" you place your organization's Risk Management System at what level?	2.59	2.61	2.47	2.75
Do you consider your organization's Risk Management System as "Adequate"?	2.33	2.32	2.41	2.20

Note: M. = Mean

Table 4.28: Kruskal-Wallis Test for Status of Risk Management System

Questions	Significance
"Formally" you place your organization's Risk Management System at what level?	.534
Do you consider your organization's Risk Management System as "Adequate"?	.722

4.5 BARRIERS TO RISK MANAGEMENT

Respondents were required in fourth section to identify from their experience the most important barriers to risk management on likert scale where, 1 represents "strongly disagree" and 5 represents "strongly agree". The data does not follow the normal distribution as is evident from the result of Shapiro-Wilk test presented in Table 4.29. The overall ranking of barriers to risk management is: lack of formal risk management system (mean = 4.06), lack of joint risk management system by parties (mean = 3.89), lack of knowledge / techniques (mean = 3.80), complexity (mean = 3.64), reactive rather than proactive (mean = 3.54), centralized rather than decentralized (mean = 3.44), risk analysis rather than risk identification (mean = 3.20), periodic rather than continuous (mean = 3.04), lack of historical data for risk trend analysis (mean = 2.99) and lack of risk consciousness (mean = 2.95). The results are presented in Table 4.30. Result of Kruskal-Wallis test as shown in table 4.31 reveals that all groups have similar perceptions about individual barriers except for lack of knowledge / techniques which differs significantly ($p = .032$) and is given much higher ratings by the contractors (mean = 4.20) than clients and consultants. The reason is that contractors are relatively less qualified than clients and consultants and hence consider it greater impediment than other groups. Result of Spearman rank correlation as shown in Table 4.32 reveals that there is a strong positive correlation between ranking of clients to that of consultants and to that of contractors and vice versa. This unanimous opinion signifies the degree of conviction to the barriers to effective implementation of risk management system and practices in the construction industry. Interviews and discussions with the respondents revealed that most of them had a vague idea of the aim and purpose of implementing effective risk management system and its practices. They were of the opinion that the motivation behind implementing an effective risk management system is to forestall unfavorable consequences of risk events, rather than the value addition, revenues and opportunities for the organization. It is appropriate to use term “Investment in Risk Management” rather than “Cost of Risk Management”, Loosemore et al. (2006) portrays such attitude as “negative” and considers it counterproductive to the growth of an organization. Lack of formal risk management system is overall ranked first (mean = 4.06) and interviews revealed that although organizations are practicing risk management at some level, with varying degree of expertise, it is mostly unorganized, unsystematic, inconsistent, personalized and informal, resulting risks being overlooked and unmanaged. Loosemore et al. (2006) suggests that risk management is best practiced in the presence of clear aim, sound policies and best practices, like any other managerial activity. In the absence of such policies and practices, the organization is at the mercy of the capabilities of its employees and experiences a gradual downfall in the event of employee leaving the organization. The system is to be mature enough to absorb such shocks by performing adequately with or without replacement of the leaving employee. Lack of joint risk management system by parties is overall ranked second (mean = 3.89) and interviews revealed that construction industry is not much familiar with the term “joint risk management”. As pointed out by Loosemore et al. (2006) that “chain is only as strong as its weakest link”, hence own risks can’t be managed without managing the risks arising from supply chain i.e. from suppliers to customers. It is the contract which distributes risks between the client and the contractor and mostly unevenly. The contract should preferably follow the principle of distributing the risks to the one who is in a best position to manage it, and if it can be best managed jointly by two or more parties then contract should specify such terms and conditions. Negating this principle will result in disputes which is detrimental to project objectives. There is a perception that most of the standard contract documents being implemented in public sector are inclined towards the clients and allocates most of the risks to the contractors or subcontractors, this aspect needs further investigations. Lack of knowledge / techniques is overall ranked third (mean = 3.80) and interviews revealed that although respondents were familiar of risks and their generic sources there is clear deficiency in knowledge and techniques to manage them appropriately. No surveyed organization had dedicated risk manager and most of the project managers were not much familiar with the rudiments of risk management. Interviews revealed that most of the project managers consider that risk management involves complex techniques and procedures; however, to be effective the system needs to be simple both in understanding and implementation. A complicated system will only replace the existing risks with the new forms of risks. Reactive rather than proactive is overall ranked fifth (mean = 3.54) and interviews revealed that many of the project managers were under the impression that they are practicing risk management; whereas, in essence they are practicing crisis management. The fundamental difference being, whereas, the former is proactive; the latter is reactive in nature and entails loss of initiative and opportunities. Construction industry may be capable of crises management but still beyond the boundaries of effective risk management. Centralized rather than decentralized is overall ranked sixth (mean = 3.44) and interviews revealed that most of the construction firms in private sector are owned by individuals and lack in corporate culture and are heavily influenced in their operations by personal uniqueness of these individuals. These firms are aware of the issue and has graded this barrier little higher (mean = 3.60) than clients (mean = 3.32) and consultants (mean = 3.44). As pointed out by Loosemore et al. (2006) that centralize system is generally less responsive, delayed and outshines the capabilities of its workers. Risk management is to be decentralized with easy to use tools and techniques in the field by employees and with affective communication both ways; top to bottom and bottom to top.

Table 4.29: Shapiro-Wilk Normality Test for Barriers to Risk Management

Barriers	Significance (p)
Lack of Formal Risk Management System	.000
Lack of Joint Risk Management System by Parties	.000
Lack of Knowledge / Techniques	.000
Complexity	.000
Reactive rather than Proactive	.000
Centralized rather than Decentralized	.000
Risk Analysis rather than Risk Identification	.000
Periodic rather than Continuous	.000
Lack of Historical Data for Risk Trend Analysis	.000
Lack of Risk Consciousness	.000

Table 4.30: Ranking of Barriers to Risk Management

Barriers	Overall		Client		Consultant		Contractor	
	M	R	M	R	M	R	M	R
Lack of Formal Risk Management System	4.06	1	4.18	1	4.13	1	3.80	3
Lack of Joint Risk Management System by Parties	3.89	2	3.89	2	3.88	3	3.90	2
Lack of Knowledge / Techniques	3.80	3	3.39	5	3.91	2	4.20	1
Complexity	3.64	4	3.68	3	3.53	5	3.75	4
Reactive rather than Proactive	3.54	5	3.50	4	3.59	4	3.50	6
Centralized rather than Decentralized	3.44	6	3.32	6	3.44	6	3.60	5
Risk Analysis rather than Risk Identification	3.20	7	3.14	8	3.13	7	3.40	7
Periodic rather than Continuous	3.04	8	3.11	9	2.81	10	3.30	8
Lack of Historical Data for Risk Trend Analysis	2.99	9	3.21	7	2.84	9	2.90	10
Lack of Risk Consciousness	2.95	10	2.71	10	3.00	8	3.20	9

Note: M. = Mean; R. = Rank

Table 4.31: Kruskal-Wallis Test for Barriers to Risk Management

Barriers	Significance (p)
Lack of Formal Risk Management System	.270
Lack of Joint Risk Management System by Parties	.968
Lack of Knowledge / Techniques	.032
Complexity	.749
Reactive rather than Proactive	.927
Centralized rather than Decentralized	.620
Risk Analysis rather than Risk Identification	.514
Periodic rather than Continuous	.170
Lack of Historical Data for Risk Trend Analysis	.491
Lack of Risk Consciousness	.380

Table 4.32: Spearman Rank Correlation for Barriers to Risk Management

Group		Client	Consultant	Contractor
Client	r	1.000	.855 a	.685 a
	p	-	.002	.029
Consultant	r	.855 a	1.000	.709 a
	p	.002	-	.022
Contractor	r	.685 a	.709 a	1.000
	p	.029	.022	-

a = Correlation is significant at the .01 level (2-tailed)

r = Spearman rank correlation coefficient (rho)

p = Significance Value

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

Survey reveals many aspects of present risk management practices besides providing a guideline to stakeholders about importance of risks and their generic sources in the construction industry of Pakistan. It also provides an opportunity to planners, project managers, supervisors and other key project members to take stock of their ongoing and future projects in the light of barriers to risk management highlighted in the study. Interviews revealed that respondents were under the impression that development and implementation of an effective risk management system in an organization is simple and futile effort. In essence, development of a system is less problematic than its implementation due to the opposition from unexpected quarters. Interviews also revealed that few of the managers who tried to develop and implement risk management system for their respective organizations faced resistance to change as maintaining previous practices are desirable due to their adoptability and acceptability to the culture of an organization. As a first step the risks and existing practices to manage them may be identified followed by their analysis to study their effectiveness in local environment. Thereafter, the standards and framework may be developed for managing risks in the industries of Pakistan including construction, in line to Australian or any other international standards. The change will not come over night as existing culture and practices are well entrenched and are being practiced over a long period of time. Educating all stakeholders for developing and implementing a system for managing risks and opportunities is essential, because ultimately the system has to be implemented and operated by individuals and until they are not convinced of its efficacy it is bound to falter. It is desirable to be flexible and realistic in approach by simply not expecting very high standards in the initial phases of its implementation and progressively increasing the benchmark.

5.2 CONCLUSIONS

5.2.1 Importance of Risks

The ten most important project risks in order of priority are; financial factors, economic factors, quality, premature failure of facility, lack of planning and management, change in design / scope of work, corruption, claims and disputes, inadequate / incorrect design and quantity variations. Project participants share perceptions about majority of the risks. The five most important project risks from the perspective of the clients are; financial factors, quality, economic factors, lack of planning and management, premature failure of facility. The five most important project risks from the perspective of the consultants are; quality, premature failure of facility, inadequate / incorrect design, change in design / scope of work and financial factors. The five most important project risks from the perspective of the contractors are; financial factors, economic factors, lack of planning and management, claims and disputes and change in design / scope of work.

5.2.2 Risk Management techniques

Construction industry often consults experts for risk identification and seldom carries out quantitative risk analysis. Whereas, it often avoids or transfers the risks completely to some business partner and sometimes shares the risks with them. Moreover, it sometimes carries out incident investigation mainly for fixing the responsibility and not for monitoring the risks.

5.2.3 Status of Risk Management System

Overall risk maturity level of surveyed organizations can best be described between level 1 and level 2. Whereas, the highest level is 4, only 2-3 percent organizations may claim to attain it close to level 2, if measured according to risk management maturity level audit tool of Project Management Institute. The risk management system and practices of most of the organizations are reactive, semi permanent, informal and unstructured with no or very little committed resources to deal with risks. Moreover, there is barely any process of documentation at any stage of risk management process by all groups, hence can best be regarded as informal and trivial effort.

5.2.4 Barriers to Risk Management

The main barrier in implementing the effective risk management system is the lack of availability of formal risk management system followed by lack of mechanisms for joint risk management by the parties.

5.3 RECOMMENDATIONS

- Financial and economic factors are the most important risks facing the construction industry followed by quality. A systematic study may be carried out to mitigate the adverse impacts of these risks, individually and collectively on the project objectives.
- Researchers have identified numerous risk management techniques for the identification, analysis, response and monitoring of risks and opportunities in literature. However, the usage and applicability of these techniques in local environment needs further investigations especially in the back drop of an overall low ranking of these techniques by majority of respondents.
- The current status of risk management system, its formality and adequacy level of most of the organizations can best be described between level 1 and 2 if measured according to risk management maturity level audit tool of Project Management Institute (PMI). This may be studied further, to systematically improve the risk maturity level of the local organizations.
- The main barriers to effective risk management are the lack of availability of formal risk management system and lack of joint risk management by parties. A study may be carried out to to improve joint risk management by parties, especially its contractual aspects in local environments.
- The Pakistan risk management standards for industries may be developed in line to Australian or international standards.
- Study to investigate risk management practices of property developers and their efficacy to local environments may be carried out.

REFERENCES

American National Standard. (2004). "*Project management body of knowledge*." ANSI/PMI 99-001-2004, USA.

Baldry, D. (1998). "The evaluation of risk management in public sector capital projects." *Int. J. Proj. Manage*., 16(1), 35–41.

Berends, T. C. (2000). "Cost plus incentive fee contracting-Experiences and structuring." *Int. J. Proj. Manage.*, 18, 165–171.

Buck, J. R. (1989). "*Economic risk decisions in engineering and management*." Iowa State University Press, Ames, Iowa.

Burki, A. A., Munir, K., Khan, M., Khan, U., Faheem, A., Khalid, A., and Hussain, S. T. (2010). "Industrial policy, its spatial aspects and cluster development in Pakistan" *Analysis report to the industrial policy 2010*, Vol. I, Report prepared by Lahore University of Management Sciences, Lahore, Pakistan.

Chapman, C. (1997). "Project risk analysis and management-PRAM the generic process." *Int. J. Proj. Manage.*, 15(5), 273-281.

Chaudhry, S. M., and Kamal, S. (2008). *"Introduction to statistical theory."* Ilmi Kitab Khana, Urdu Bazar, Lahore, Pakistan.

Federal Bureau of Statistics (FBS). (2010). "*Pakistan Statistical Year Book-2010."* Statistics Division, Government of Pakistan.

Flanagan, R., and Norman, G. (1999). "*Risk management and construction*." Blackwell Science Ltd, Oxford, UK.

Jaafari, A. (2001). "Management of risks, uncertainties and opportunities on projects: Time for a fundamental shift." *Int. J. Proj. Manage.,* 19,89–101.

Kliem, R., and Ludin, I. (1997). *Reducing project risk*, Gower Publishing.

Kangari, R. (1995). "Risk management perceptions and trends of U.S. construction." *J. Constr. Eng. Manage.,* 121(4), 422-429.

Khan, R, I, A. (2003). Spatial Distribution of Population with Special Reference to 1998 Population Census. *Population of Pakistan: An Analysis of 1998 Population and Housing Census.* A.R. Kemal, M. Irfan and N. Mahmood (eds.). Institute of Development Economics, Islamabad.

Loosemore, M., Raftery, J., Reilly, C., and Higgon, D. (2006). "*Risk management in projects*." Taylor & Francis, London, UK.

Masood, R., and Choudhry, R, M. (2010). "Identification of risks factors for construction contracting firms – encompassing mitigation stance." *Proc., of Second International Conference on Construction in Developing Countries (ICCIDC-II): Advancing and Integrating Construction Education Research and Practice*, August 3-5, Cairo, Egypt, 251-260.

Ministry of Finance. (2010). *"Fiscal policy statement 2009-10."* Debt Policy Coordination Office, Government of Pakistan.

Rahman, M. M., and Kumaraswamy, M. M. (2002a). "Joint risk management through transactionally efficient relational contracting." *Constr. Manage. Econom.,* 20(1), 45-54.

Rahman, M. M., and Kumaraswamy, M. M. (2002b). "Risk management trends in the construction industry: Moving towards joint risk management." *Eng., Constr., Archit. Manage.*, 9(2), 131-151.

Rahman, M. M., and Kumaraswamy, M. M. (2004). "Contracting relationship trends and transitions." *J. Manage. Eng.*, 20(4), 147-161.

Smith, N. J., Merna, T., and Jobling, P. (2006). "*Managing risks in construction projects*." Blackwell Science Ltd, Oxford, UK.

Standards Association of Australia. (1999). "*Risk management."* AS/NZS 4360, Australia.

State Bank of Pakistan. (2010). "*Economic Survey 2009-10*." Islamabad, Pakistan.

State Bank of Pakistan. (2011). "*Monetary policy statement january 2011*." Islamabad, Pakistan.

Tang, W., Duffield, C. F., and Young, D. M. (2004). "Developing a matrix to explore the relationship between partnering and total quality management in construction." *J. Harbin Inst. Technol.,* 11(4), 422-427.

Tang, W., Duffield, C. F., and Young, D. M. (2006). "Partnering mechanism in construction: An empirical study on the Chinese construction industry." *J. Constr. Eng. Manage.*, 132(3), 217-229.

Tang, W., Qiang, M., Duffield, C. F., Young, D. M., and Lu, Y.(2007). "Risk management in Chinese construction industry." *J. Constr. Eng. Manage.,* 133(12), 944-956.

Transparency International Pakistan. (2010). *"National corruption perception survey 2010."* 5 C, 2nd Floor, Khy-e-Ittehad, Phase VII, DHA, Karachi, Pakistan.

Wood, G. D., and Ellis, R. C. T. (2003). "Risk management practices of leading UK cost consults." *Eng., Constr., Archit. Manage*., 10(4), 254–262.

World Bank. (2010). "*Expanding housing finance to the Underserved in South Asia*" Washington, DC.

World Bank. (2011). *"Doing Business 2011."* Washington, DC.

Appendix I

Major Khurram Iqbal
Department of CE&M
NIT, SCEE, NUST
H-12, Islamabad
Sep 10

To: ______________________________

Subject: Thesis Work-MS Construction Engineering and Management

1. It is submitted that undersigned is conducting a questionnaire based survey and interview on "Risk management in the construction industry of Pakistan" for partial fulfillment of the requirement for the MS. You are requested to take few minutes and fill the questionnaire attached with this letter which will be followed by an interview. The information provided by you will be of high value and will remain confidential.

2. Forwarded for kind consideration please.

MS Student
Khurram Iqbal

Head of Department
Dr. Rafiq Muhammad Choudhry

QUESTIONNAIRE

General Information (Will Not be Published)	
Name	
Qualification	
Experience in Construction Industry (Years)	
Organization / Department / Firm / Company	
Appointment / Designation / Rank	
Group	Client / Consultant / Contractor

IMPORTANCE OF RISKS

S.NO	MAJOR RISKS	IMPORTANCE OF RISKS 1 = Insignificant, 2 = Minor, 3 = Moderate 4 = Major, 5 = Catastrophic				
		1	2	3	4	5
1	Quality					
2	Premature Failure of Facility					
3	Inadequate / Incorrect Design					
4	Financial Factors (Interest Rate, Cash Flows, Capital Supply)					
5	Economic Factors (Inflation, Price Hike, Taxes, Exchange Rate)					
6	Political and Social Factors (Law and Order, Insurgency, Strikes etc)					
7	Safety					
8	Force Majeure (Act of God like Flood, Earth Quake etc)					
9	Lack of Planning and Management					
10	Claims and Disputes					
11	Unforeseen Site Conditions					
12	Feasibility of Construction Methods					
13	Delay in supply of Drawings					
14	Insufficient Technology, Skills and Techniques					
15	Poor Coordination, Cooperation and Relationship among Key Stake Holders					
16	Non Implementation of Standard Bidding / Contract Documents					
17	Change in Design / Scope of work					
18	Quantity Variations					
19	Conflict in Contract Documents					
20	Corruption					

APPLICATION OF RISK MANAGEMENT TECHNIQUES

S.NO	TECHNIQUES	FREQUENCY OF USE 1 = Never, 2 = Seldom 3 = Sometimes, 4 = Often 5 = Always				
		1	2	3	4	5
RISK IDENTIFICATION						
1	Checklists					
2	Consulting Experts					
3	Brain Storming					
4	Risk Review Meetings					
5	Industry Information					
RISK ANALYSIS						
6	Qualitative					
7	Semi Quantitative					
8	Quantitative					
RISK RESPONSE						
9	Avoid the Risk					
10	Reduce the Likelihood of occurrence					
11	Reduce the Consequences					
12	Transfer the Risk Completely					
13	Retain the Risk Completely					
14	Risk Sharing					
RISK MONITORING						
15	Incident Investigation					
16	Risk Audit / Inspections					

STATUS OF RISK MANAGEMENT SYSTEM

S.NO	Perceptions on Formalization of Risk Management System 1 = Strongly Informal, 2 = Moderately Informal, 3 = Barely Formal 4 = Moderately Formal, 5 = Strongly Formal					
		1	2	3	4	5
1	“Formally” you place your organization’s Risk Management System at what level?					
	Perceptions on Adequacy of Risk Management System 1 = Strongly Disagree, 2 = Moderately Disagree, 3 = Barely Agree 4 = Moderately Agree, 5 = Strongly Agree					
		1	2	3	4	5
2	Do you consider your organization’s Risk Management System as “Adequate”?					

BARRIERS TO RISK MANAGEMENT

S.NO	BARRIERS	1 = Strongly Disagree, 2 = Moderately Disagree, 3 = Barely Agree 4 = Moderately Agree, 5 = Strongly Agree				
		1	2	3	4	5
1	Complexity					
2	Reactive rather than Proactive					
3	Risk Analysis rather than Risk Identification					
4	Centralized rather than Decentralized					
5	Lack of Knowledge / Techniques					
6	Lack of Formal Risk Management System					
7	Periodic rather than Continuous					
8	Lack of Risk Consciousness					
9	Lack of Historical Data for Risk Trend Analysis					
10	Lack of Joint Risk Management System by Parties					