RISK MANAGEMENT IN POCUREMENT OF CONSTRUCTION PROJECT- A CONTEXT OF PWD

A DISSERTATION

In partial fulfillment of the requirements for the degree of

MASTERS IN PROCUREMENT AND SUPPLY MANAGEMENT

Submitted By

MD. IMRAN BIN KALAM, MCIPS
ID No.16382027
MPSM Batch-12

January 2017
Masters in Procurement and Supply Management

BRAC Institute of Governance and Development (BIGD)

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BRAC Institute of Governance and Development (BIGD)

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10 January 2017

To

Dr. Md Abu Bakar Siddique MCIPS
Deputy Director
Central Procurement Technical Unit (CPTU)
Ministry of Planning, Sher-E-Bangla Nagar, Dhaka.

Subject: **Submission of Final Dissertation Report.**

Dear Sir,

I have the great pleasure to submit a full and final Dissertation Report on **'Risk Management in Procurement of Construction Project-A Context of PWD.'** as a partial fulfillment of the requirements for the degree of **Masters in procurement and Supply Management (MPSM)** for your kind consideration.

May I, therefore, pray and hope that you would be kind enough to accept my dissertation report and do the needful for awarding me the degree of MPSM.

Sincerely yours,

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Finally, the author would like to express his sincere thanks to all who have helped him by providing suggestion and information throughout this work.

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CERTIFICATE

This is my pleasure to certify that the dissertation entitled **"**RISK MANAGEMENT IN PROCUREMENT OF CONSTRUCTION PROJECT- A CONTEXT OF PWD" is the original work of Md. Imran Bin Kalam and it is completed under my direct guidance and supervision. So far I know, the dissertation is an individual achievement of the Candidate's own efforts and it is not a conjoint work.

I also certify that I have gone through the draft and final version of the dissertation and found it satisfactory for submission to the BRAC Institute of Governance and Development, BRAC University in partial fulfillment of the requirements for the Degree of Masters in Procurement and Supply Management.

(Dr. Mohammed Abu Bakar Siddique, MCIPS)
Deputy Director.
Central Procurement Technical Unit (CPTU).
Ministry of Planning, Dhaka, Bangladesh.

Dedicated
To

The People of Bangladesh
For whom we serve.

ABSTRACT

This thesis deals with Risk Management in Procurement of Construction Project. Procurement of Construction is well known as a high-risk project as it involves in lot of uncertainty at which it must be carefully managed. In risk management it is contractor's job to take the risk or to avoid the risk in their construction project. Some of them also may take some action in order to lessen the risk in their construction project. In construction project we always heard about the project is over schedule, project over budget, low quality of project, problems with the tender, problem with the client, problem with the sub-contractor and etc. Hence, this research is to study the possible risk in construction project, to determine the level of awareness of the procurement risk among contractors and other stakeholder in construction project and lastly to identify the tools and technique used in managing risk of construction procurement process. This method of research is both qualitative and quantitative based. A questionnaire survey was conducted to collect data from Officers of PWD, Bangladesh. Questionnaire surveys were distributed to 54 respondents located in Dhaka and Barisal PWD offices. The data collected is calculated using the percentage analysis.

The result shown that financial, management, time and technical are the risk that involved in construction and the level of awareness of risk among the contractors/client are high. In conclusion, the risk in construction is not small issues in construction and the contractor/client must take quick action in managing the risk in construction.

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CHAPTER - 1

INTRODUCTION

1.1 INTRODUCTION

Construction is defined as the process of building and structures something (Dictionaries, 2014) It may be building of new office block, roads and high way, making provision for supply of potable and palatable water. It is also defined as actions of something are put together from a discrete resource or material to produce something. It also includes the installation or air-conditioning, escalator, elevators, plumbing and electrical works. In construction a project there also certain thing that needs to be carrying out before it such as the need of site preparation of clearing the site or facilities such as streets, utility connections, water supply, sewers and others. In order to start a specific project in the construction there are some step such as construing, interpreting or explaining all the work to the team members, fellow workers and also the stakeholder of the project so that all the people who involve in that construction project clearly understand what the project is all about and their roles and responsibilities in that project.

Public Works Department (PWD), is a pioneer government organization in construction industry under the Ministry of Housing and Public Works. It is one of the major public organizations that deal with the construction of different infrastructure/ physical facilities under delegated procurement from different ministries. It has started its journey at 1854. Since the beginning, it carried the responsibility of forging an architectural framework for the sub-continent, the PWD has experience dating back two centuries. The organization's construction work is directly connected to the national program of development and reconstruction. The Public Works Department is responsible for the construction of infrastructure along with providing service to 24 ministries. It is also the Government's biggest construction agency. A strong base of standards and professionalism has been developed in the PWD over the years of experience. It has prestigious accomplishment in the field of building construction. PWD constructed huge number of land mark buildings and structures that have architectural beauty (http://www.pwd.gov.bd).

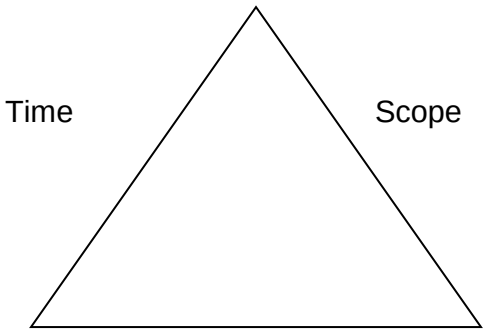
As discussed earlier, PWD has construction experience for more than 150 years. What is the risk associated with construction in PWD and How PWD manages all risk and its construction

management activities will be a representative measure of impact on procurement of works for nation as a whole. For this reason, PWD has been chosen for conducting the research work.

1.2 PROBLEM BACKGROUND

There is nothing which contains high-risk other than construction due to the involvement of lot of uncertainty and it must be carefully managed. There are two things that need to address and to deal with In construction project. They are, understanding what type of task that been undertaking and also what are be working on. Risk especially in procurement starting from early design process in which supplier may involve early lessening the risk and ends at the end of the project.

Risk may be defined as known and unknown danger that might cause positively impact or negatively impact for a project (Dictionaries, 2014). Three things are important in construction industry. Those are time, quality and cost. This triple constrains shows that cost also plays an important part in the construction project at which it involves the procurement process. Risk must be focused on starting point of each project construction risk is something that must be focus on especially during the starting point of each project as each stage have their own unexpected situation that might occur.



Cost = f (scope, time)

Figure 1.1: The Classical Triple Constrain

Besides, procurement is something that is most comment before the project start and also for the ongoing project in construction. Procurement in construction includes several processes. They

are select and determine the project criteria, set the contractual framework, invite and select the tenders and lastly awarding the contract.

Risk in construction procurement is something that usually faced by the contractor &/or procuring entity in PWD. In today global business environment, stakeholder of construction industry facing internal risk and also the external risk from community pressures, client pressure and also competitive pressures.

Besides, numerous problems are detected in the procurement processes that involve the risk for both contractor and the procuring entity. Late of delivery of good from supplier, the exchange of market price for goods and the quality of the product from the supplier as well the outsource will also affect the construction process.

1.3 PROBLEM STATEMENT

There are many risks that being faced by the procuring entity especially in order to finish a certain project. But many stakeholders not realize too much on the risk in especially in this procurement. Procurement indeed the most important things that need to be prioritize in the project starting from the early stage of the process.

In construction project we always heard about the project is over schedule, project over budget, low quality of project, problems with the tender, problem with the procuring entity, problem with the sub-contractor and etc. Generally, there is no construction project without risk and it may affect the project negatively. Besides, the effects of the risk are usually very difficult to predict.

There are many project cannot completed in allocated time. In addition, there also project that been abandoned by the contractor and the complete project but not in the form of exceed the quality needed. This problem is due to the weak in management, non-systematic risk management, non-systematic organizational management and also not has the right method to handle problem that arise. In order to complete in the right time, quality and cost, it is important to make a proper and good management of risk and cooperate among each other. Besides,

analyze of risk is also very important and know a right method to handle the risk is a must. This is because there is no construction project that except from risk.

1.4 RESEARCH OBJECTIVES

Below are the research objectives of this study:

1. To study the possible risk in construction project.
2. To determine the level of awareness of the procurement risk among stakeholder in construction project.
3. To identify the tools and technique used in managing risk of construction procurement project.

1.5 RESEARCH QUESTIONS

The following research objectives were used for this study in order to accomplish all the objectives of this study:

1. What are the possible risk in construction industry?
2. What is the level of awareness of the procurement risk among contractor in construction project?
3. What is the tools and technique used in managing risk of construction procurement process?

1.6 RESEARCH SCOPE

In Bangladesh, there are several government departments who are engaged in construction are listed below:

- Roads & Highways Department (RHD)
- Public Works Department (PWD)
- Department of Public Health Engineering (DPHE)
- Local Government Engineering Department (LGED)
- Education Engineering Department (EED)
- Health Engineering Department (HED)
- & Others

Every organization perform different construction project in different manner. This research is only deals with the risk management in procurement of construction project of Public Works Department.

Besides there are different project actors in the project. Among them Client, Contractor and Design engineer plays vital role in management of construction project risk. Questionnaire survey is mainly done from client perspective.

1.7 RESEARCH HYPOTHESES

According to the objectives, there were a few hypotheses that can be found. Below are the lists of the research hypothesis of this study:

1. Risk in construction

H_0: The stakeholder of PWD in Bangladesh knows the possible risk in construction procurement process.

H_1: The stakeholder of PWD in Bangladesh does not know the possible risk in construction procurement process.

2. Awareness

H_0: The stakeholder of PWD in Bangladesh aware about risk in construction procurement.

H_1: The stakeholder of PWD in Bangladesh does not aware about risk in construction procurement.

3. Tools and technique

H_0: The stakeholder of PWD in Bangladesh is known the tools and technique used in managing risk of construction procurement process.

H_1: The stakeholder of PWD in Bangladesh do not know the tools and technique used in managing risk of construction procurement process.

1.8 OPERATIONAL DEFINITION

Construction.

Construction can be defined as a complex in industry, volatile one and responsive, for the temporary relationship it is so essence according to one-off projects (Smith, J. et al.,2004). Constructions are complex contractual relationships which involve many stakeholders and can be tangible that are of finite duration.

Project.

Project is defined unique that become evident when a discrete event is combined with several element such as environmental, temporal, and managerial variations. A project has starting and also ending point that require resources.

Procurement.

Procurement is the purchasing of product which involve the value of money and is supported by the transparency, ethics, effectiveness and accountability in core principle governing public procurement.

Risk.

Risk is the uncertainty that might face by certain project and can be controlled to some certain extent at which risk can be transferred or share with other project entities.

CHAPTER -2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter it reviews the related article and research literature about risk in construction procurement in order to support this study. This chapter consists of two parts. First, it starts with the review of the risk in general that faced by internal stakeholder. Then, it followed by the risk in construction.

2.2 RISKS IN GENERAL

2.2.1 Risk Definition

Risk may be defined as a situation that involves exposure to danger for example the pecuniary loss. According to this definition, the risk will occur when both the possible exposure has to impregnate inside the project which causes pecuniary losses. Financial is a cardinal issue to achieve the success in every project. Besides, the main use of the financial is to procure something as well as to outsource something

Risk can be anything at which it multi-facet. Risk could be the likelihood of occurrence of an event or the combination of events at which it happened during the overall process in the context of construction project. Risk also may occur if in the decision making or planning situation, there are the lack of predictability about the structure outcome or the possible consequences that might happen. In that case, risk is actually needed to be managed. However, this management of risk is not only to secure the work but also in the context of making the profit in construction.

Most of the project will involve risk and any project which did not have risk is actually not worth pursuing (Chapman, C. and Ward, S. 2003). This is because for him any project at which involve risk will eventually give the good benefit in return. Risk also may become both treat and also opportunity in a project. If the organization has comprehensive concept about the nature of the risk, Risks can also be managed in easy and effective way. For some organization they believe that risk cannot escape from unforeseen disasters. However it can work with higher margins and less contingency.

Risks have on the finance with the lowest cost. That is why risk management will involves in the appropriate handling process after evaluation and analysis in order to minimize the negative outcome of risk. The real risk in the construction project is from a lack of consideration. In other hand the risk come from the conflict by various numbers of situations. The contractor also not supposed to only focus on the success of the design and build project but also in the context of identify and analyze the risk that occur during the design and build the project. For effective risk management, proper allocation of resource is fundamental which is very difficult.

Risk in project is complex just like the project itself. It also is having broad scope of possible effect on the project as it arises from a wide range of sources. Risk also act as key factor for project success for every project. For understanding and managing risk in a project, there are two structural methods i.e. Work Breakdown Structure (WBS) and Risk Breakdown Structure have been used.

Definition of risk is very broad. It involve not only with lot of people as well with the finance but also the profitability, the scope and also the willingness to accept the risk or not. All the stakeholder related to the projects including contractor faces the various types of Risk in construction project. Some of the Risk can be easily avoided if these risks are assessed properly and take apposite steps timely. For these reason Contractors as well as stakeholders should be very careful and handle those risk meticulously from the starting point to end of the project. And if possible try something that can avoid the risk.

2.2.2 Risk Management

Organizations have been practicing risk assessment and risk management since 17th century. However risk management plan is not validated by most of the companies. In real world, project risk actually need to be managed according to the process of identify, analyze, treat and also monitor all the possible risk. These processes are the fundamental steps but there are so many different descriptions of this systematic process. If this process can be done throughout the life cycle of the project, this could be a key factor to a successful risk management plan. Risk management plan also includes the appropriate handling of risks after evaluation and analysis which can minimize the negative impacts associated with the project. Risk management is applied to obtain key indices for successful design and also to establish the necessary strategies. To ensure that risk not impede the success of the project, it is important for contractor to identify

and analyze the risks that occur. In other word, we need to prioritize the risk process then the risks with greatest loss are handled first whereby the lower probability of occurrence loss is handled later. When we need to balance both high and low risk in one time, risk management process could be very difficult. Moreover, Proper allocation of risk is very hard task in a project.

Risk management gives a clear framework for identify, analyze, evaluate, treat, monitor and lastly communicate the risk (CIDB, 2004). It is also essential to understand the risk that to be managed. Risk management contributes a big insight of impact especially in the process of defining the steps, the sequence and in decision making process. It is recognized that a good management practice is the most integral part of risk management. Risk management also must be part of the organizational family as it always comes without being asked for. However, due to the risk management, continual improvement, also called Kaizen in Japanese language, in every aspects as well as decision making in an organization is enabled.

Risk management is a theory of ancient time. At first risk is managed traditionally by judgment that been informed by someone experience. The new concept of systematic approach changes the risk to become clearer and make it easy to manage. This risk management is practically required experience and training in order to use the techniques. To identify and rank the risks of the project, systematic risk management can helps a lot. Besides, project team also required to focus the major types of risk of the project to minimize the potential damages in that project. If risk of the project is well managed then project team can control the uncertainty aspect of risk. Risk management also known as tools that is created to reduce the uncertainty occurring when conducting the risk.

2.2.3 Risk Management Process

A systematic process of identifying, assessing and responding to project risk is termed as Risk management (PMI 2000). The overall goal of the risk management process is to maximize the opportunities and minimize the consequences of a risk event. A variety of risk management models with different numbers of stages can be found in the literature. An RMP described by Smith *et al*. (2006) has been chosen for the purpose of this paper. This section will further explain the RMP, its four stages and how it can be used in managing risks.

2.2.3.1 Risk identification

Winch (2002) claims that the first step in the RMP is usually informal and can be performed in various ways, depending on the organization and the project team. It means that the identification of risks relies mostly on past experience that should be used in upcoming projects. In order to find the potential risks, an allocation needs to be done. This can be decided and arranged by the organization. In this case, no method is better than another, since the only purpose is to establish the possible risks in a project.

It is approximately impossible to get rid of Risks and other threats. The best way to treat the risk is to identify those with great care and taking actions to control over them. Risk Management will be more effective if those risks are identified and allocated before they happens (PMI, 2004). RM is not only solving problems in advance, but also being prepared for potential problems that can occur unexpectedly. Handling potential threats is not only a way to minimize losses within the project, but also a way to transfer risks into opportunities, which can lead to economical profitability, environmental and other advantages (Winch, 2002).

Obtaining a list of most probable risk to manage in a project is the primary purpose of Risk Identification. Different techniques can be applied to find the potential risk. Those methods should be selected in such a way that it not only familiar to the project team but also brings benefit to the project. Secondary purpose of the Risk Identification is to aware the project team about the risks. There are many probable alternative methods of Risk Identification which is described by the Author in this dissertation. In the literature of this dissertation, all the methods has been found and put together in Table 3. (Smith *et al.* 2006; Lester, 2007; PMI, 2004)

Table 2.1 Risk identification techniques

Information gathering methods	Workshop
	Brain storming
	Interviews
	Questionnaire
	Benchmarking
	Consulting Experts
	Past Experience
	Delphi Technique

	Risk Breakdown Structure
	Visit locations
Documentation	Database, historical data from similar project.
	Templates
	Checklists
	Study Project Documentation (Plans, files etc.)
	Study Specialist Literature
Research	Stakeholder Analysis
	Research Assumptions
	Research Interfaces

Lists with potential problems are created on different bases and are tailored for a certain project individually. In the literature, examples of risks can be found which can be used in creating those compilations. There are some risk which are mostly found in the literature are combined in Table 4 ((Smith *et al.* 2006; Potts, 2008; Lester, 2007; Bing, et al, 2005; Webb, 2003; Darnall and Preston, 2010; Edwards, 1995; Jeynes, 2002)

Table 2.2 Risk categories divided into groups

Risk Catagories	
Groups:	Risks:
Monetary	Financial
	Economic
	Investment
Political	Political
	Legal
Environment	Environmental
	Natural, Physical
Technical	Technical
Project	Contractual, Client

	Project Objectives
	Planning, Scheduling
	Construction
	Design
	Quality
	Operational
	Organizational
Human	Labor, Stakeholder
	Human factors
	Cultural
Market	Market
Safety	Safety
	Security, Crime
Materials	Resources
	Logistics

2.2.4 Assessment/analysis

The Second stage of RMP is the Risk analysis. Data collected from Risk Identification stage are analyzed here. In this stage short listing risks are categorized according to the impact in the Project (Cooper et al. 2005). There are a distinguished opinion among the researchers about risk assessment and risk analysis. Although some of them describe these two processes as a separate two process, but for the purpose of this dissertation, this part of Risk Management Process will be consistent with the model provided by Smith et al (2006) and described as one process. There are two categories of methods –Qualitative and Quantitative which has been used in analysis of identified risks. Risk, that is placed somewhere on descriptive scale from high to low level, is mainly analyzed by Qualitative method. On the other hand, Quantitative analysis methods are based on numeric estimation in which probability of risk occurrence and impact of that risk are determined. (Winch, 2002) Due to the inconvenience to quantity the risk, Companies tend to use qualitative approach. Moreover, there is also one approach called semi-quantitative analysis, which combines numerical values from quantitative analysis and description of risk factors, the

qualitative method (Cooper *et al.* 2005) However, this approach will not be further addressed in this paper.

Within the quantitative and qualitative categories, a number of methods which use different assumptions can be found, and it may be problematic to choose an appropriate risk assessment model for a specific project. Each project should use different risk analysis methods. It depends on various factors such as type of the risk, scope of the project as well as specific methods requirements and criteria. Desired outcome of such assessment should be meaningful and reliable regardless of the methods chosen. Perry (1986) mentions that the selection of the right technique often depends on past experience, expertise, and nowadays it also depends on the available computer software.

According to Lichtenstein (1996), Selection of the most appropriate methods in the risk assessment can be influenced by a number of factors. It depends on the particular organization that decide which of these factors are the most critical for them. That particular organization has to assess those factors accordingly. In a survey conducted by Lichtenstein (1996), many factors were discovered, and the most important ones are listed below.

- Cost of using the method, both the employment cost and the method itself
- Adaptability, the need of adapting to the organization's requirement
- Complexity, how limited and simple the method is
- Completeness, the method needs to be feasible
- Usability, the method should be understandable to use
- Validity, the results should be valid
- Credibility

Below is a brief description of various risk analysis methods. All of these methods are used in the construction industry.

2.2.4.1 Quantitative methods

Quantitative methods need a lot of work for the analysis to be performed. The effort should be weighed against the benefits and outcomes from the chosen method, for example smaller projects may sometimes require only identification and taking action on the identified risks, while larger projects require more in depth analysis. The quantitative methods estimate the impact of a risk in

a project (PMI, 2009). They are more suitable for medium and large projects due to the number of required resources such as complex software and skilled personnel.

Scenario technique - Monte Carlo simulation

The Monte Carlo method is based on statistics which are used in a simulation to assess the risks. The simulation is used for forecasting, estimations and risk analysis by generating different scenarios. Information collected for the simulation is, for instance, historical data from previous projects. The data represent variables of schedule and costs for each small activity in a project, and may contain pessimistic, most likely and optimistic scenarios. The simulation can be presented as a basket with golf balls, explains the process. Data (the golf balls) are mixed and one of them is picked each time the simulation is done. The chosen unit is an outcome which is recorded and the ball will be put back into the basket. The simulation is then redone a number of times and all outcomes are recorded. After completing the simulations required number of times, the average is drawn from all of the outcomes, which will constitute the forecast for the risk. The result from this method is a probability of a risk to occur, often expressed in a percentage (Darnall and Preston, 2010).

Probability of risk occurs, which is often expressed in a percentage, is the outcome of this method. This analysis can be also done in Microsoft Excel where a special function is used to pick the data randomly, but the results can be very limited.

Modeling technique - Sensitivity analysis

The purpose of a sensitivity analysis is to establish the risk events which have the greatest impact or value. Those events are later weighed against the objectives of the project. The higher the level of uncertainty a specific risk has the more sensitive it is concerning the objectives. In other words, the risk events which are the most critical to the project are the most sensitive and appropriate action needs to be taken.

The result from the analysis can be presented in a spider diagram, Figure 4 that shows the areas in the project which are the most critical and sensitive. Moreover, one disadvantage with this analysis is that the variables are considered separately, which means that there is no connection between them (Perry, 1986 and Smith *et al.* 2006).

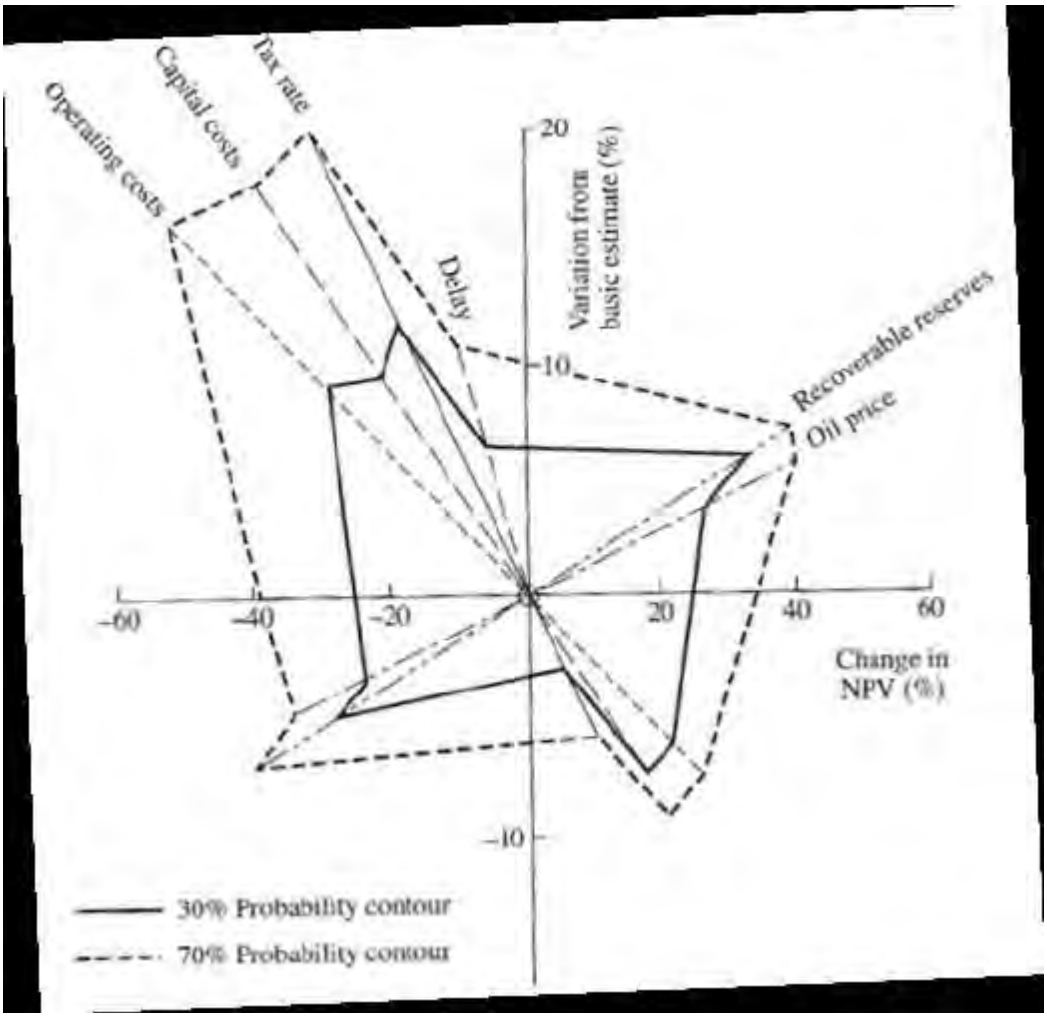


Figure 2.1 This figure shows how a sensitivity analysis can look like. (Smith et al. 2006)

The method requires a model of project in order to be analyzed with computer software. According to Smith *et al.* (2006), the project will benefit if the method is carried out in the project's initial phases in order to focus on critical areas during the project.

Diagramming technique

When certain risks have an exceptionally high impact on the two main project objectives i.e. time and cost, Decision tree analysis are widely used (Heldman, 2005). Decision trees are mainly two types: Fault tree analysis (FTA) and Event tree analysis (ETA). The FTA method of analysis is used to determine the probability of the risk and is used to identify risks that can contribute or cause a failure of one event (Cooper *et al.* 2005). The purpose is to find the underlying causes to this event. It is usually drawn up as a sketch of a tree. The branches are the causes to the problem, and the starting point of the tree is the problem itself. Each branch has its own sequence of events and possible outcomes. The problem could depend on some causes that are interrelated

with each other, or simply random causes (Cooper *et al.* 2005). By having many branches, the tree provides an opportunity to choose which branch to follow and base decisions on,
see Figure 2.2.

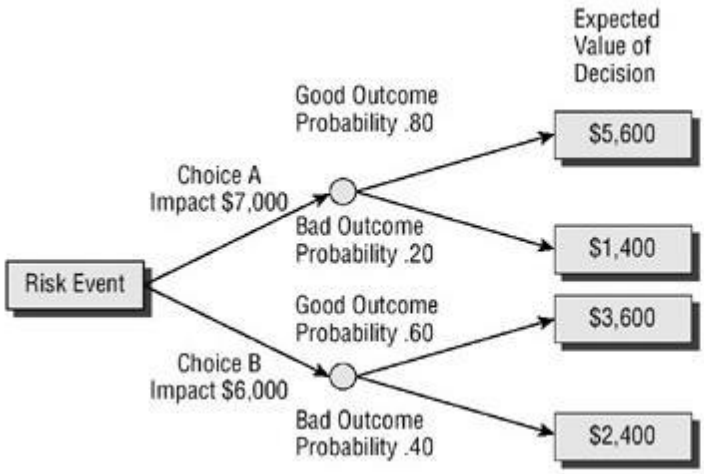


Figure 2.2 An example of a decision tree.

There are two similar analysis i.e. Fault tree analysis (FTA) and Event tree analysis (ETA), are simple methods which can be used as a structured model to identify causes and effects of a single event, but present different approaches.

As explained, ETA is very similar to the FTA, but what differentiates the methods is the outcome. ETA is also drawn as a tree but in an opposite approach than the FTA. Failure generally does not have its roots in a single cause. It is rather described as a chain of causes and consequences in a sequence which can end up in major damage for the project. The tree consists of branches which represent the consequences that can be followed by that main event that this method is analyzing. Every branch has its own focus on a specific type of causes, which is why the importance is so great to create a risk assessment.

In both FTA and ETA, cause-effect skills are required including the possibility to understand how failure could occur and see which failure modes can arise from the situation respectively. Therefore it is preferable to have an analyst within the field of risk management in the project team.

2.2.4.2 Qualitative methods

For describing the likelihood and the impact of a risk, Qualitative methods for risk assessment are widely used. This assessment is primarily based on descriptive scales and this technique is

applicable when quick assessment is required (Cooper *et al*. 2005) and the project size is small or medium. Moreover, this method is often used in case of inadequate, limited or unavailable numerical data as well as limited resources of time and money (Radu, 2009). The main aim is to prioritize potential threats in order to identify those of greatest impact on the project (Cooper *et al*. 2005), and improves the overall performance of the project in account of those threat (PMI, 2004) Risk may change in any phase of PLC and for this reason continuous risk assessment should be done which helps to establish actual risk status (Cooper *et al*. 2005). Limitations of qualitative methods lie in the accuracy of the data needed to provide credible analysis. In order for the risk analysis to be of use for the project team, the accuracy, quality, reliability, and integrity of the information as well as understanding the risk is essential.

Qualitative methods are related to the quantitative methods, and in some cases constitute its foundations (PMI, 2004).

According to PMI (2004) there are four qualitative methods for risk assessment: Risk probability and impact assessment, Probability/impact risk rating matrix, Risk Categorization and Risk Urgency Assessment. These methods are briefly discussed below.

Risk probability and impact assessment

The likelihood of a specific risk to occur is evaluated through applying the risk probability and impact matrix. By applying the method called risk probability and impact assessment, the likelihood of a specific risk to occur is evaluated. Risk impact on a project objectives are assessed regarding not only its positive effects for opportunities but also consider the negative effects arouses from the threat. Probability and impact must be defined for this reason and should be tailor for a particular projects (PMI, 2004). This also depends on the nature, criteria and objectives of the projects (Cooper *et al*. 2005). PMI (2004) identifies exemplary range of probability from 'very unlikely' to 'almost certain'; however, corresponding numerical assessment is admissible. The impact scale varies from 'very low' to 'very high'. Moreover, as shown in Figure 6, assessing impact of project factors like time, cost or quality requires further definitions of each degree in scale to be drawn up. According to probability and the impact of risk occurrence, each risk is listed in the identification phase (PMI, 2004).

Defined Conditions for Impact Scales of a Risk on Major Project Objectives (Examples are shown for negative impacts only)					
	Relative or numerical scales are shown				
Project Objective	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 lincrease
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.					

Figure 2.3 Definitions of Impact Scales for Four Project Objectives (PMI, 2004)

Potential effect on a project objective such as time, cost, scope, or quality is investigated through risk impact assessment. Risk probability assessment investigates the likelihood of each specific risk to occur. The level of probability for each risk and its impact on each objective is evaluated during an interview or meeting. Assumptions which express justification of the level of risk are also recorded as explanatory details. There is some risk which is of low rating and this is not problematic in present situation, but will be include on a watch list for future monitoring (Ritter, 2008).

Probability/impact risk rating matrix

Probability and impact, which were assessed in the previous step, are used as basis for quantitative analysis and risk response which will be explained further in the study. For this reason findings from the assessment are prioritized by using various methods of calculation which can be found in the literature (PMI, 2004). According to Westland (2006) priority score can be computed as the average of the probability and impact. Importance of each risk can be indicated by a range of priority score, the rating and color. Impact is multiplied by probability in order to set priorities. The compiled results are shown in the matrix in Figure 2.4 (PMI, 2004). Such combination of factors indicates which risks are of low, moderate or high priority.

Regardless of the calculation method chosen, such a combination of data shows priority of previously identified risks by use of i.e. corresponding colors or numerical system and helps to assign appropriate risk response. For example, low priority risk can be monitored with action being taken only if, or when required, while high impact and likelihood risk is identified as high-risk.

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.

Figure 2.4 Probability and Impact Matrix (PMI, 2004)

Risk categorization, and Risk Urgency Assessment

These two methods which are mentioned in PMI (2004) not widely used as probability and impact. Risk categorization is defined as the way to systematizing project threat according to their sources and it involves to identify the areas of the project which are mostly exposed to those risks. In this method, Work breakdown structure (WBS) or risk break down structure (RBS) can be used as a tool to develop effective risk response (PMI, 2004). WBS breaks down large activities into small, manageable units and creates linked, hierarchical series of independent activities (Maylor, 2005). RBS categorizes risks and shows their dependencies (Dallas, 2006). Risk Urgency Assessment is used to prioritize risks according to quick response they require.

List of risks which are prioritize through qualitative methods, can be used to draw attention. Because these risks causes significant problem for the project. Low impact risks are placed on a watch list and monitor regularly. More important issue can be focused by the project team for this reason.

2.2.5 Risk response

Risk response is the third step of RMP which describes what action should be taken towards the identified risks and threats according to risk assessment methods. The response strategy and approach chosen depend on the kind of risks concerned (Winch, 2002). Other requirements are that the risk needs to have a supervisor to monitor the development of the response, which will be agreed by the actors involved in this risk management process. (PMI, 2004)

Winch (2002) claims that if the risk has lower impact, it is easy to manage the risk. Most common strategies for risk response are: avoidance, reduction, transfer and retention (Potts, 2008). Beyond those types of responses, Winch (2002) describes that when there is too little information about a risk, it would be difficult to take decision. This may be avoided by waiting until the appropriate information is available in order to deal with the risk. This way of acting is called "Delay the decision" but this approach is not appropriate in all situations, especially when handling critical risks. Those need to be managed earlier in the process.

2.2.5.1 Avoidance/prevention

When the risk which is classified as the risk causes negative consequence to the whole project, review of project's aim should be done as important matter. In other words, the risk which brings negative effects for the projects, should be avoided by changing the scope of the project or if possible cancelling the scope in worst case. Many potential risks which can harm to project success (Potts, 2008). For this reason, Risk management is essential at the beginning stages of the projects rather than dealing with the damages after the occurrence of the risk (PMI, 2004).

The avoidance can be defined as looking alternative options in the projects which can eliminate many risks. According to Darnall and Preston (2010) if major changes are required in the project in order to avoid risks, well developed and known strategies can be applied instead of new ones. It is only applicable when this can be more efficient. Thus, risk can be avoided and perform the task smoothly because strategy is less stressful to the users.

There are some activities which can help to avoid potential risks are listed below (Cooper et. Al, 2005)..

- More detailed planning
- Alternative approaches
- Protection and safety systems
- Reviews of operation. Operation reviews
- Frequent inspection. Regular inspections
- Enhancement of Training and skills. Training and skills enhancement
- Permits to work
- Procedural changes
- Preventive maintenance

2.2.5.2 Reduction/mitigation

It is very easy to identify problems that can causes damages by having a thorough overview over the whole project. The exposed are which can create significant damages should be changed in order to reduce the level of risk (Potts, 2008). By this, potential risk can be minimized through mitigating their likelihood (Thomas, 2009). Adding expenditure is a single way to reduce the risks in a project and it provide long term benefit for the project. Some projects invest in guarantees or hire experts to manage high-risk activities. Those experts may find solutions that the project team has not considered (Darnall and Preston, 2010).

Mitigation strategies can, according to Cooper *et al.* (2005), include:

- Contingency planning
- Quality assurance
- Separation or relocation of activities and resources
- Contract terms and conditions
- Crisis management and disaster recovery plans

Those risks which should be reduced can also be shared with parties that have more appropriate resources and knowledge about the consequences (Thomas, 2009). As an alternative, sharing can also play vital role which is cooperating with other parties. Through this one project team can have access to resources and experiences of others. This is the easiest way to share responsibilities concerning risk in the project (Darnall and Preston, 2010)

2.2.5.3 Transfer

If a risk can be managed by another actor who has a greater capability or capacity, the best option is to transfer it. Potts (2008) states that the risk should be transferred to those who know how to manage it. The actors are those to whom risks can be transferred, for example, the client, contractor, sub-contractor, designer etc. on the character of the risk. This could enhance the project cost or additional work which is usually called risk premium (Potts, 2008). In this way, risk is not eliminated; it is only transfer of risk to the party who is expert to manage it (PMI, 2004). When risks are outside of the project management's control, shifting risk and negative impact is also an option. This type of risk may be related to labor strikes or political issue. (Darnall and Preston, 2010). The situation may also consist of catastrophes that are rare and unpredictable in a certain environment. (Winch, 2002) Such risks that are beyond the management's control should be transferred through insurance policies.

2.2.5.4 Retention

If there is no option for transfer or avoid to a risk, the best possible solution is to retain the risk. In this case the risk must be controlled, in order to minimize the impact of its occurrence (Potts, 2008). Retention can also be an option when other solutions are uneconomical (Thomas, 2009).

2.2.6 Monitoring

Monitoring is the final step of RMP which includes collection and monitoring of all information about the identified risks (Winch, 2002). New risk can be discovered through the continuous monitoring and supervision over RMP. This process also can be helpful to keep track of identified risks and eliminate past risks from the risk assessment and project (PMI, 2004). PMI (2004) also states that the assumptions for monitoring and controlling are to supervise the status of the risks and take corrective actions if needed.

Tools and techniques used to risk monitor and control may be (PMI, 2004):

- Risk reassessment – identification of new potential risks. This is a constantly repeated process throughout the whole project.
- Monitoring of the overall project status – are there any changes in the project that can effect and cause new possible risks?
- Status meetings – discussions with risk owner, share experience and helping managing the risks.

 Updating risk register.

By managing the whole RMP, the process can be evaluated. In this method a risk register is created and all risks and their management can be allocated in pursue to facilitate future projects. As all the advantages and disadvantages will be brought up, for this reason this is also a way to ameliorate the work of the project. The international standard "Project risk management – Application guidelines" (IEC 2001) offers a model with four steps: risk identification, risk assessment, risk treatment, and risk review and monitoring.

PMBOK's model (PMI 2000) is similar but divides risk assessment into two processes of qualitative risk analysis and quantitative risk analysis. Baloi and Price (2003) include an additional step of risk communication. SHAMPU (Shape, Harness, and Manage Project Uncertainty) framework which is presented by Chapman and Ward (2003) involves nine stages: Define the project, focus the project, identify the issues, structure the issues, clarify ownership, estimate variability, evaluate implication, harness the plans, and manage implementation.

2.3 CONSTRUCTION

2.3.1 Construction Definition

According to the Oxford Advanced Learner's Dictionary, 2008 the process or method of building or making sth, especially roads, building or bridges etc.

As this research deals with risk management in the construction project context, it is reasonable to start with a discussion of the nature of projects.

A project is an endeavor in which human, material and financial resources are organized in a novel way; to undertake a unique scope of work of given specification, within constraints of cost and time, so as to achieve unitary, beneficial change, through the delivery of quantified and qualitative objectives. The definition suggests three key targets of the project, i.e. time, cost and quality, which are to be in focus when undertaking the project. It also highlights the importance of efficient organization of available resources in order to achieve a good final result.

According to Flanagan and Norman (1993) there are two aspects of any construction project: the process, i.e. project phases, and the organization, i.e. project actors. From the process perspective, any construction project comprises a number of sequential phases. Different authors suggest a different number of project phases (Chapman and Ward 2003, Flanagan and Norman

1993,Harris et al. 2006, PMI 2000, Smith et al. 2006). The simplest approach identifies two main phases – project development and project implementation. These two can be further detailed and developed into a larger number of phases, e.g. feasibility, design, procurement, construction, commissioning, and operation. The model adopted in this research comprises four phases - programme, design, procurement and production. In the programme phase the client has an idea about the project and analyses conditions for its execution. During the design phase the architects and engineers produce construction drawings according to the client's requirements. In the procurement phase the client appoints the contractor to carry out the project.

Another important aspect of the construction process is project organization. Different stakeholders are usually involved in a construction project. They may be clients or owners, contractors, sub-contractors, manufacturers and suppliers, architects, engineers, consultants, local authorities, funding organizations etc. The more stakeholders that are involved, the more complex the task of project management becomes. There are three main groups of construction industry actors are normally in focus: clients, contractors and consultants. According to PBL (1987), a *client* is a party that carries out or assigns others to carry out construction, demolition or land work. There are two main groups of construction clients: public and private. The main objective of the privately owned companies is to maximize it's profit. On the other hand, the public sector may comprise of the central government and local authorities and undertakes the projects to provide a public service and/or benefit to the citizens. A *contractor* is an organization that provides a service for the client, i.e. executes the construction works. The contractor organizations have different complexities and provide different ranges of services – from ground works to electrical installations and telecommunications. The role of *consultants* is to assist clients and contractors and provide architectural and engineering services. Due to their dynamic nature, projects change continuously. Thus a great amount of risk and uncertainty is involved in construction activities (Chapman and Ward 2004). This uncertainty may have a significant impact on the project objectives and, therefore, has to be properly managed by the project actors during the whole project life cycle.

2.3.2 Risk in Construction Procurement

The research literature offers different definitions of project risk (Baloi and Price 2003, Chapman and Ward 2002, Flanagan and Norman 1993, IEC 2001, Jaafari2001, PMI 2000, Smith et al. 2006). Several of these definitions have a common feature: they define risk in terms of uncertain events and their impact on a project's objectives. The international standard "Project risk management – Application guidelines" uses the terms probability and consequence and defines risk as a combination of the probability of an event occurring and its consequences for project objectives (IEC 2001). As this research discusses risks in the project context, a formal definition from "A Guide to the Project Management Body of Knowledge" is used (PMI 2000). The risk is defined as "an uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives". Wardand Chapman (2003) discusses the concept of risk in greater detail and suggests using a more general concept of uncertainty. They argue that the term 'risk' is often associated with adversity and focus on threats, not opportunities.

According to Smith et al. (2006) all project risks can be divided into three main categories: known risks, known unknowns and unknown unknowns. The difference between the categories is the decreasing ability to predict or foresee the risks. Taking into account the probability of the occurrence and the consequence for project objectives, those events that have high probability and high impact are subject to risk management.

There are a large number of risks in a construction project. Project team should visualize those risks during the risk identification process. The risks may vary rather widely from one project to another. However, the variety of project related risks, the key risk sources will basically be the same (Smith et al., 2006). In the identification process the project team can use the risk sources as a checklist, to ensure comprehensive risk identification. Risk that may be arisen in construction related projects are listed below (Smith et al. 2006).

-Financial Risk

-Health & Safety risk

-Force Majeure

-Contractual Risk

-Quality Risk

-Supply Risk

-Quality Risk

-Demand Risk

-Environmental Risk

-Political Risk

-Supply Risk

The abovementioned construction risks can be too detailed to efficiently create a base for risk categorization in any projects. Therefore, a frequently used approach is to select a number of risk sources that characterizes the specific project and then separate them into more detailed risk elements. The risk source allocation technique can often be difficult to realize and is often associated with a high degree of personal subjectivity. Additionally, risk register can be generated by the method where some of the risk risks are counted twice as an effect of attributing a specific risk to more than one risk source (Smith et al. 2006)

2.3.3 Risk allocation in Construction Project

It is not possible to abolish all potential risks in a construction project. But, an apposite allocation of risks among project actors is very important. Risk allocation influences the behavior of project actors and, therefore, has a significant impact on the project performance in terms of the total cost. Unclear allocation of the project risks leads to disputes between the client and the contractor. One of the problems identified in the literature is the actors' different perceptions of to whom a specific risk or group of risks should be allocated. Normally, Contractors acknowledges that they bear the majority of project risk and this risks are accommodated through the contingency impregnated in the bid price (Andi, 2006). Researchers and practioners identify the contingency fund as a significant source of the project's cost increase (Zaghloul and Hartman, 2003). By decreasing contingency funds, bid price can be reduced. It also lower the total cost of projects. A number of models providing a framework for risk allocation decisions can be found in the literature (Lam et al. 2007, Li et al. 2005, Olsen and Osmundsen 2005). Smith et al. (2006) highlight the importance of considering the following issues when making risk allocation decision:

- who has the best ability to control risk events;
- who has the best conditions to manage risks;
- who should carry the risks that cannot be controlled;
- how much does it cost to transfer the risks.

2.4 COLLABORATIVE RELATIONSHIPS IN CONSTRUCTION PROJECTS.

In the construction industry, adversarial and opportunistic behavior is common (Cox and Thompson 1997, Zaghloul and Hartman 2003). Project stakeholders are mainly focusing on the short-term relationship and economic results rather than on long-term cooperation. In response to this behavior, many researchers try to find the concepts for more collaborative relationship between the project actors. There are two concepts in this regards: relational contracting and joint risk management. Both of this concept focus on improvement of contractual relationships, better risk allocation, and, therefore, on more effective risk management.

2.4.1 Relational contracting and partnering

Over the last decade, it is recognized by the researchers and practitioners that the relationships between the client and the contractor play a significant role for successful project implementation. In relational contracting (RC), concentrations on the relationship between the contract parties are exist. It is recognized that, mutual benefits and win-win scenarios are the outcome of collaborative relationship in relational contracting (Rahman and Kumaraswamy 2002). A study by Akintoye and Main (2007) shows that UK contractors are positive about collaborative relationships and believe they lead to cost and risk reduction. Some other study (Drexler and Larson 2000) shows that, relationships in partnership projects are much more stable than in other types of projects.

The collaborative form of partnering is based on the RC principles. The concept of partnering is variously defined in the research literature (Drexler and Larson 2000, Kadefors2002, Rahman and Kumaraswamy 2004a, Rhodin 2002). To summarize, for effective collaboration between the project's actors partnering can play most vital role. The concept of partnering is formed by some various types of components such as common goals, continuous improvement and structures for problem solving. There are some merits such as fewer disputes, lower construction costs and a better quality product can be the positive outcome of effective collaboration. Positive experiences of partnering in the USA, UK, Norway and Denmark have led to the partnering concept being adopted in many countries.

One of the goals of partnering is better utilization of the overall qualifications of the project actors. The concept of trust is the one of the main determinant for successful partnering. Trustful relationships between project actors result in a more effective risk allocation process, decrease of

contingency funds and, finally, to project cost reduction (Zaghloul and Hartman 2003). Furthermore, transfer of knowledge and experience between the project actors also an outcome of partnering. It is important to note that the partnering concept demands high professionalism and very good knowledge of the project on the part of the client and the contractor.

2.4.2 Joint risk management

If all the identified risks are allocated according to apposite steps during the procurement phase, yet there are always possibilities to occur any type of conflict in the project. Any types of new risk can be arisen or identified risks may change during the entire project life cycle. Sometimes new risks may require joint efforts to manage them effectively. Joint risk management (JRM) is about working together at mitigating unforeseen project risks at the post contract stage.

CHAPTER - 3

METHODOLOGY

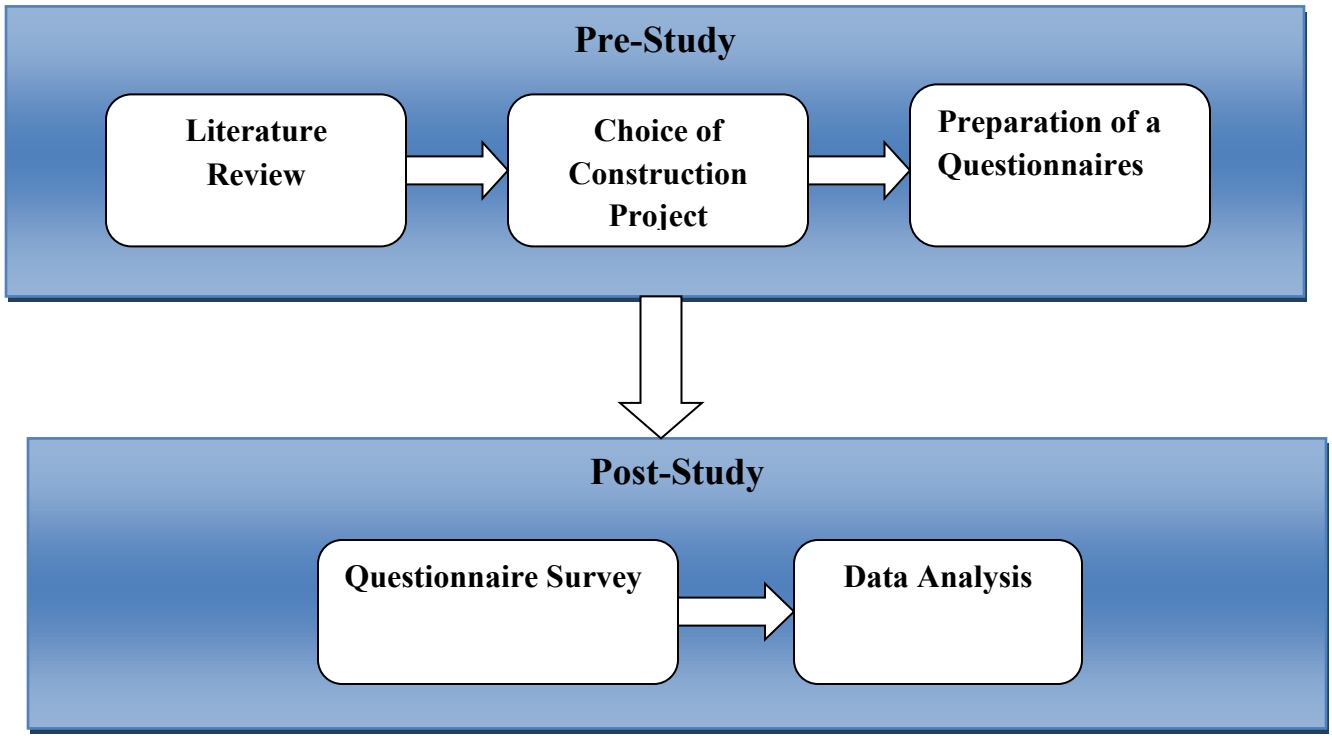
3.1 INTRODUCTION

This Chapter includes the methodology of data collection from the participants and the process of research design. It includes formation of questionnaire, sampling technique, sample size, study period and place of study.

3.2 THE RESEARCH DESIGN

Research design is about turning research questions into the research project (Robson 2002). It means that in order to answer research questions, the appropriate strategies, methods and techniques should be chosen. Yin (1994) proposes that the types of research questions determine the most suitable strategy. The research questions in this study focus mainly on "what" questions. To answer this type of question, a survey strategy is suggested (Yin 1994). Fellows and Liu (2003) describe several types of research, e.g. instrumental, descriptive, exploratory, explanatory and interpretive. The research presented in this thesis is of a descriptive type. Descriptive research aims at identifying and recording a phenomenon, process or system and may be conducted using surveys (Fellows and Liu 2003). Thus, as both references suggest, survey technique was chosen for data collection.

The work on the project was divided into two main parts as illustrated in Figure 3.1



1. Pre-study aimed at defining the theoretical basis, formulating more clearly the research questions and consisted of three steps:

- Literature review including an inventory of existing research and theory formation in the relevant areas. The purpose was to obtain a theoretical basis for further work and clarify in greater detail the research questions and delimitations.
- Selecting a number of construction projects to be included in the main study. At this stage the reference group connected to the project helped to find the projects.
- Preparation of a questionnaire survey, using the results of the literature review.

2. Main study involving some recently finished construction projects. The main study aimed at finding out how the risk management process worked in the projects and consisted of two main stages:

- A questionnaire survey. The purpose was to get a picture of the risk management process from the different actors' perspectives. The involvement of the actors in the project phases, their roles in the risk management process in particular and their influence on risk management were analyzed.
- Analysis of the gathered data and presentation of the results.

3.3 DATA COLLECTION METHODOLOGY

3.3.1 Questionnaire survey

Survey is a suitable method of data collection for descriptive purposes (Robson 2002). As one of the study's objectives was to analyze how risk management worked in the projects, a questionnaire survey was chosen as one of the methods of data collection.

lists seven main steps in performing a questionnaire survey:

1) *Determine the general purpose and specific requirements.* The purpose of the questionnaire survey was to obtain the points of view of different actors on the issues of project risk management.

2) *Develop the kinds of questions and sub-questions that need to be asked.* When developing the survey, questions were formulated so that they could help to answer the research questions. A draft questionnaire was developed consisting of five sections. The first section contained general questions about the respondent. In the second section, the aspects of the risk management

process through the different phases of the project were covered. The third section investigated relationships between the actors in the project. The fourth section focused on software management systems, which the company uses in the risk management process. The fifth section was a concluding one for miscellaneous comments regarding the risk management process in the project.

3) *Construct the questionnaire.* To construct a questionnaire that would be easy for respondents to answer is a difficult process. The potential respondents wanted to have the questionnaire in electronic form, fill it in and send back by e-mail. On the other hand, the researcher has to ensure that there will not be any problems with software and lost data due to the respondents' unfamiliarity with advanced computer tools. Thus the questionnaire was constructed in MS Excel and consisted of three sheets. The first one was a covering letter with information about the research project, questionnaire disposition, and general instructions and how the answers would be used. The second sheet was the questionnaire. The last sheet provided the basic technical instructions on how to fill in information, save and return the questionnaire.

4) *Determine the population and sample to be selected.* The survey sample comprised clients, contractors and consultants. Within each group those persons who worked with risk management in a particular project were identified. The following categories, representing the main actors in the construction project were defined:

- Client
- Contractor
- Procuring Entity (PE)
- Representative of PE
- Design Engineer
- Sub-Contractor etc.

5) *Pilot the questionnaire.* In order to test the questionnaire a workshop was arranged to which all potential respondents were invited. During the workshop the aim of the study and the structure of the questionnaire were presented. The respondents were given the opportunity to fill in the questionnaire and discuss possible changes or reformulations. In total, about 50% of the potential respondents participated in the workshop.

6) *Finalize the questionnaire, making any necessary adjustments.* After the meeting with the respondents the questionnaire was adjusted. Some questions were excluded, some reformulated and completed.

7) *Conduct the survey.* Totally 54 questionnaires were sent out by e-mail (Table 3). 32 respondents or 59% replied to the survey. Of those 32 replies 22 were fully completed questionnaires and seven persons explained the reasons for non-participation. Therefore, 22 usable questionnaires formed the response rate of 40%. Amongst persons who attended our workshop the response rate was 100%. This shows that those who were aware of the research project's objectives were more interested in taking part in the study.

Table 3. Questionnaire distribution and respondents profile.

	Procuring Entity	Representative of PE	Project Manager	Site Engineer	Design Engineer	Total
Number of questionnaire sent	12	18	14	3	7	54
Number of usable response received	3	12	3	0	4	22
Response rate (%)	25	67	21	0	57	40
Average Age (Yrs)	45	30	31	30	30	-
Average Experience (Yrs)	15	5	7	5	7	-

3.3.2 Sampling

3.3.2.1 Sample Size

The sample size for this study was determined to be 22 as the scope and time frame of the study was limited. Employees designated from the Assistant engineer up to the Executive Engineer of the organization are considered for this survey.

3.3.2.2 Population Size

There are approximately 500 personnel who hold the position from Assistant Engineer to Executive Engineer in this organization. Hence the population size of the organization has been considered as 500. A sample of 22 out of 500 means around 5% of the population, hence the sample may be considered statistically significant.

3.3.2.3 Sampling Technique

For the collection of data Non-probability convenient sampling methods are used in this study, **Non-probability sampling** is defined as a **sampling** technique where the samples are gathered in a process and this process does not give all the individuals in the population equal chances of being selected

3.3.2.4 Place of Study & Study Period

Survey was conducted from 25 September, 2016 to 10 October, 2016 at different offices of the Public Works Department (PWD). The offices situated in Dhaka and Barisal were visited for this Survey.

CHAPTER -4

DATA COLLECTION & ANALYSIS

4.1 INTRODUCTION

This chapter analyzes the collected data using the methodology previously explained in chapter three. The data is presented in graphical form for easy understanding. The interpretation of the data has also been presented in this chapter.

4.2 DATA ANALYSIS

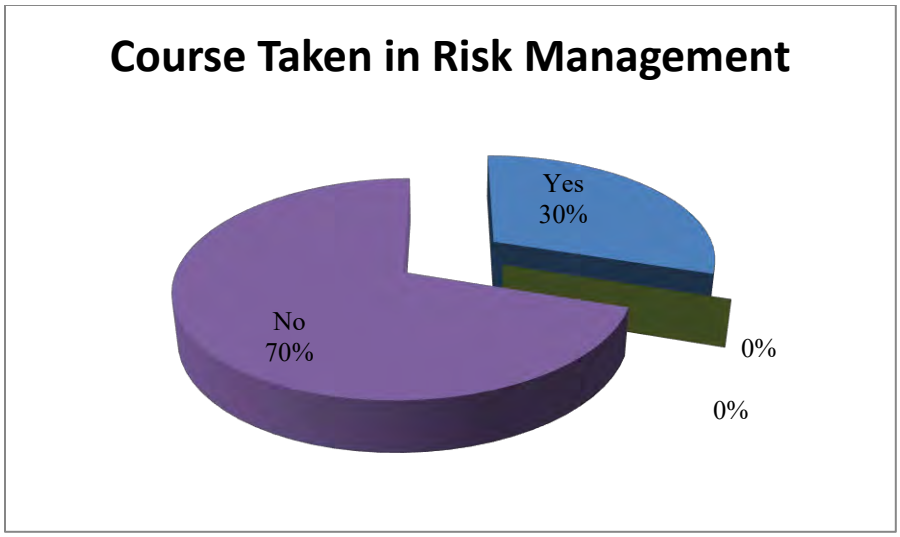
The data collected was analyzed using descriptive statistical methods. This was to describe the Risk Management process in Public Works Department in Bangladesh. Data was mainly analyzed by Microsoft Excel Software (version 2010). Analyzed data was presented using graphs (bar chart), Pi-Chart etc. and conclusion and recommendations were made. The questionnaires implemented on selected respondents are presented in later section.

4.3 GRAPHICAL & DEMOGRAPHIC PRESENTATION

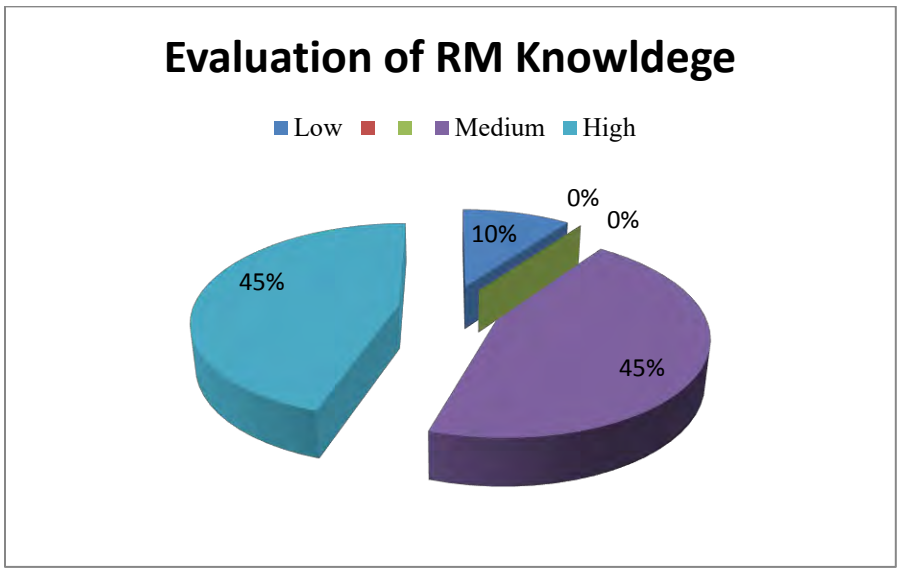
4.3.1 General Information

- Name of the Participants.
- Organization to where Participant is involved.
- Age of the Participants.
- Experience in construction industry of the participants.
- Educational level of the participants.
- Percentage of participant's who studies with Risk Management.

Major portion of Participants who involved in assessing the questionnaire supplied by the author did not taken any risk management courses. Some are CIPS qualified and taken courses of risk management.



- Evaluation of the knowledge of Risk Management by the Participants.
  Major Portion of Participants has evaluated highly the knowledge of risk management in projects.

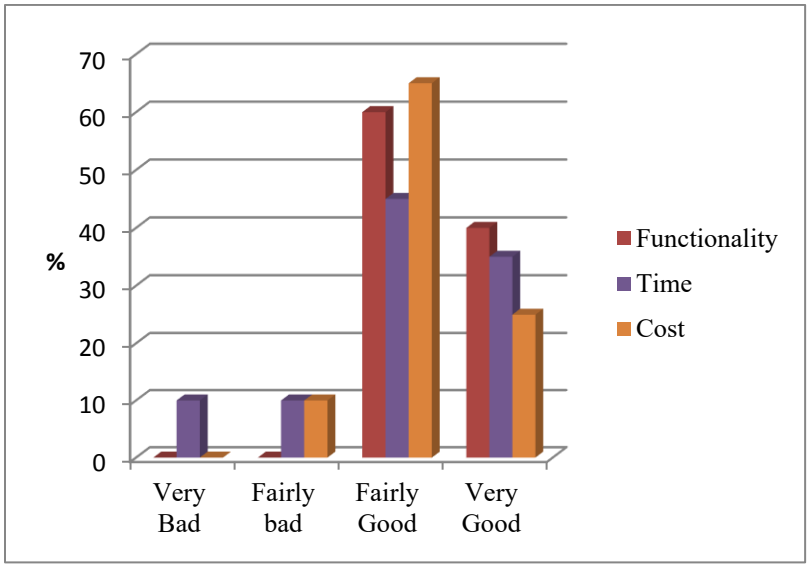


- Name of the Project where participant worked.
- Role of the participant in that project.

4.3.2 Risk Management in different Phases of the Project.

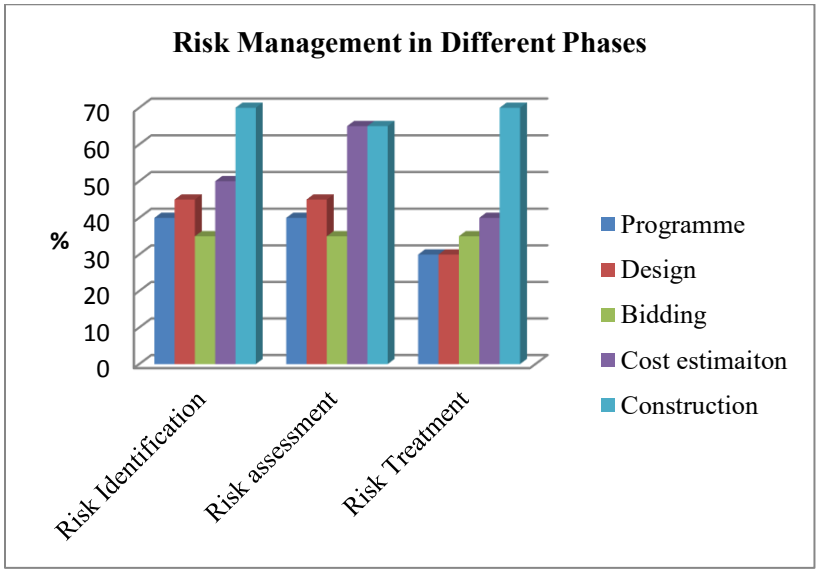
- evaluation the project implementation in terms of the cost, functionality & time parameters.

  Majority of the participants assessed fairly good in evaluating the project implementation in terms of cost, functionality & time.



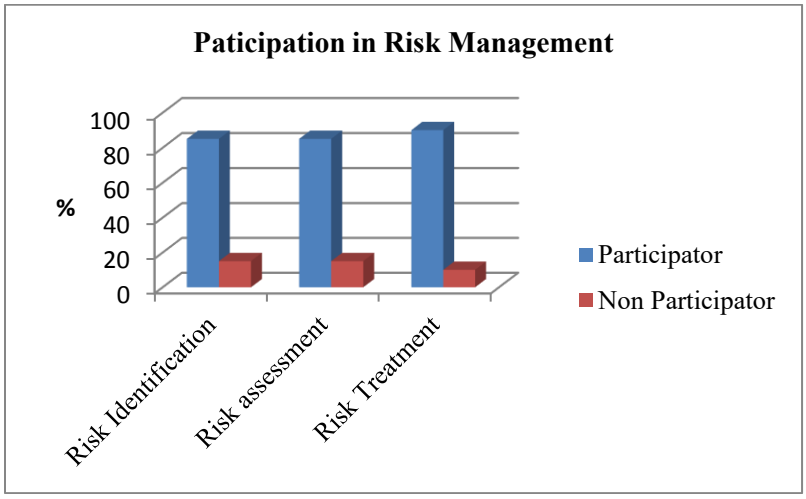
- phases of the project in which participant's participate.

  Participants has participate all the steps of risk management in different phase of the projects. But Among them they have participate largelyin construction phase of the project.



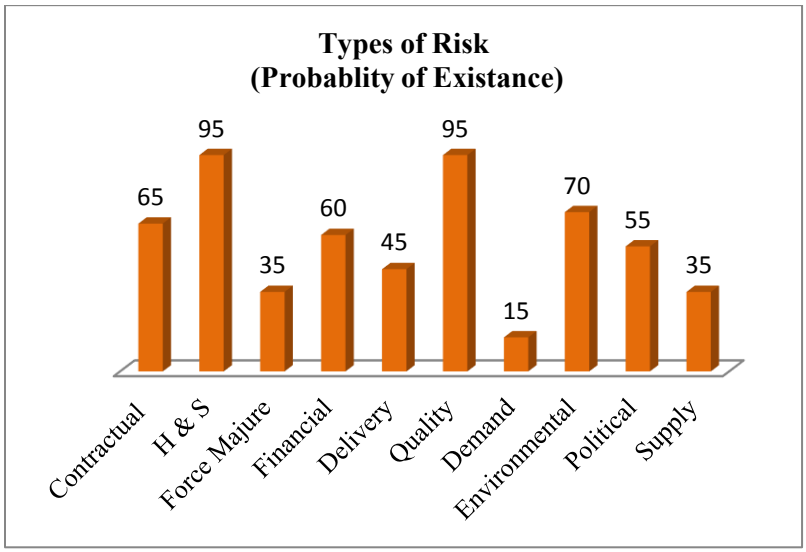
- Were the following risk management processes carried out systematically in the project?

  Many Participants participate in All the steps (Risk Identification, Risk Assessment, Risk Treatment) of Risk Management.



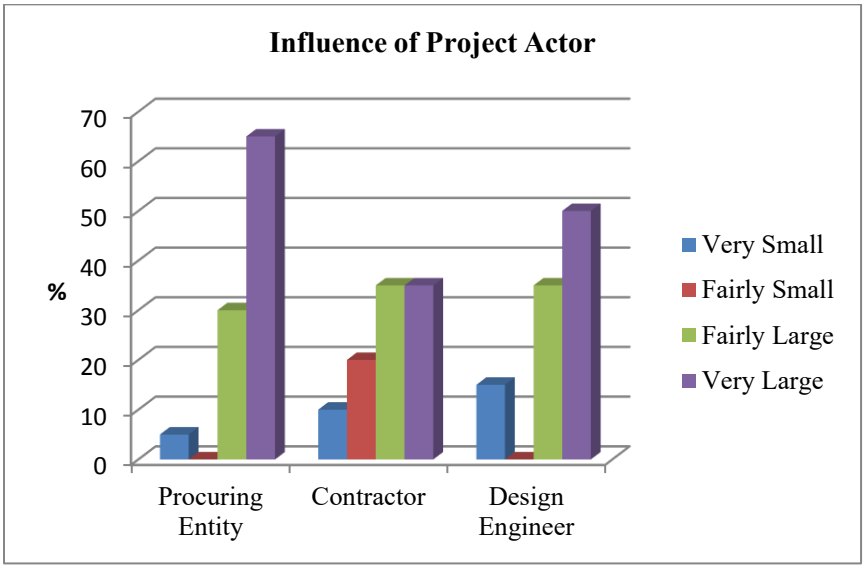
- What types of risk did you assess in the construction project?

  There are some possible risk that is Contractual risk, Health & Safety (H&S), Force Majeure, financial etc. has been assessed by the participants. Among them Quality and H & S Risk is considerable for PWD.



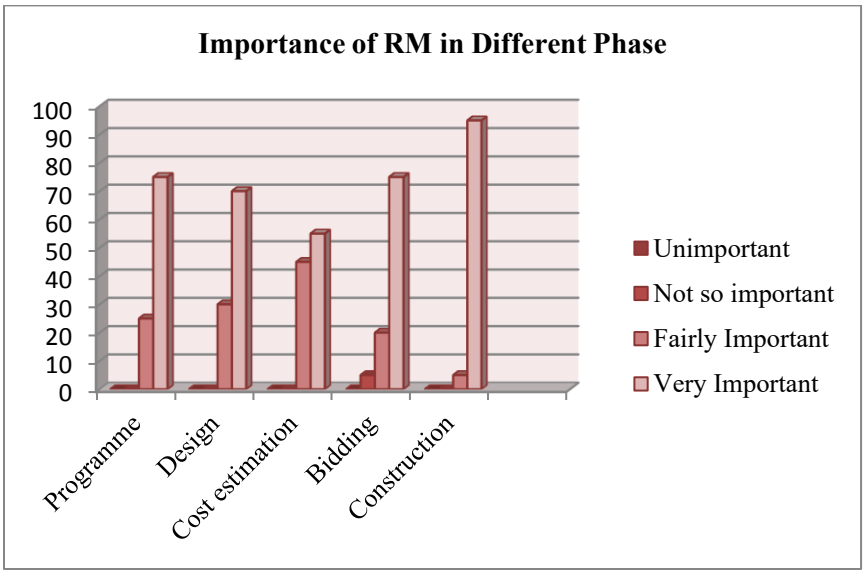
- Influence of the projects actor's have on risk management?

  Procuring Entity, contractor and design engineer has greater influence on risk management.



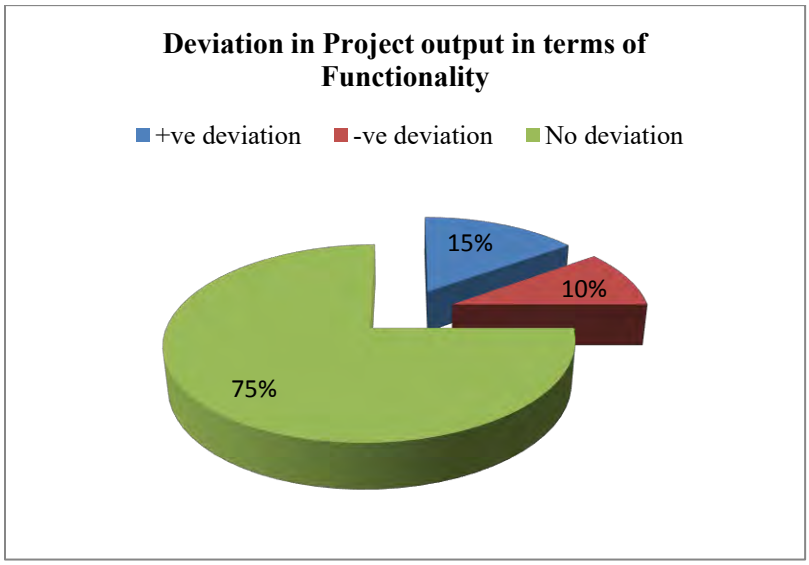
- Importance of risk management in the different phases of the project.

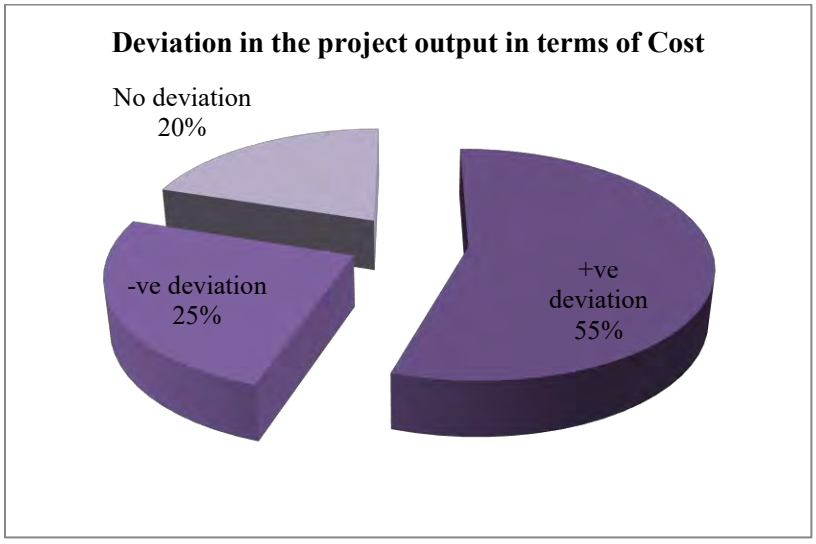
  Risk Management is very important in each of the phases of the project.

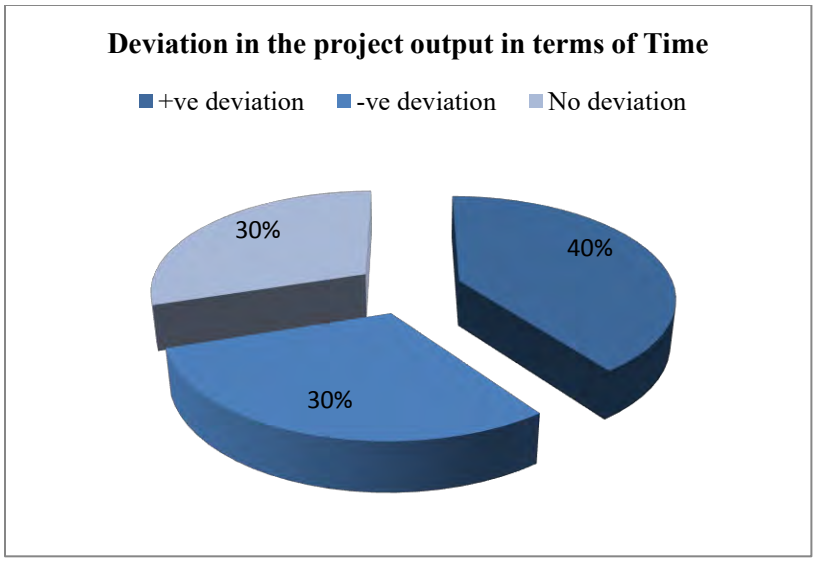


- Deviations in the project in terms of the functionality/cost/time parameters**.**

  In PWD deviation in functionality of the project is very rare. This can be done only according to the demand of requiring body related to the projects. Positive deviation in terms of cost is very usual to the projects. Most of the projects are subjected to variation order to complete the projects. Some Projects has completed timely according to project proposal. But Now a days PWD is trying hard to complete all the projects in scheduled time.

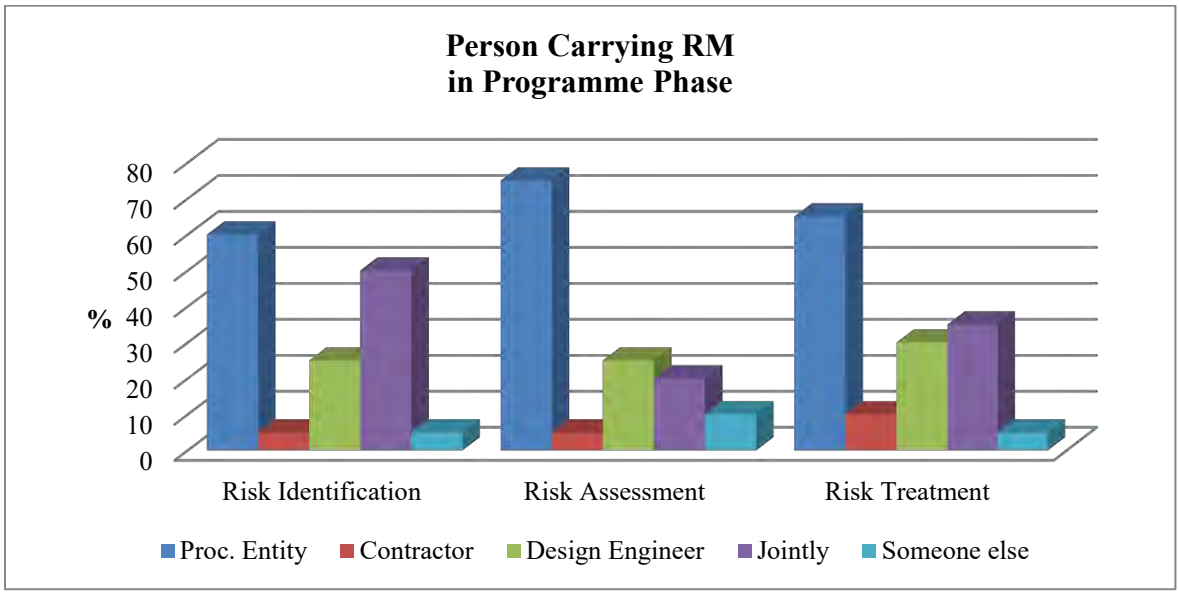


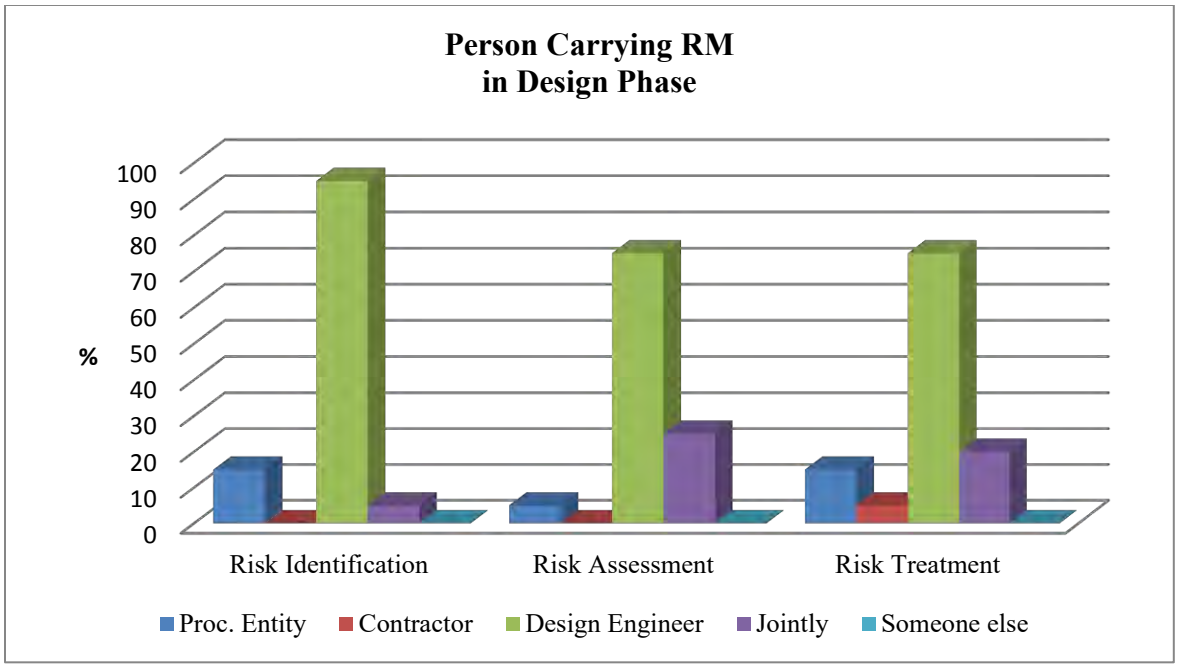


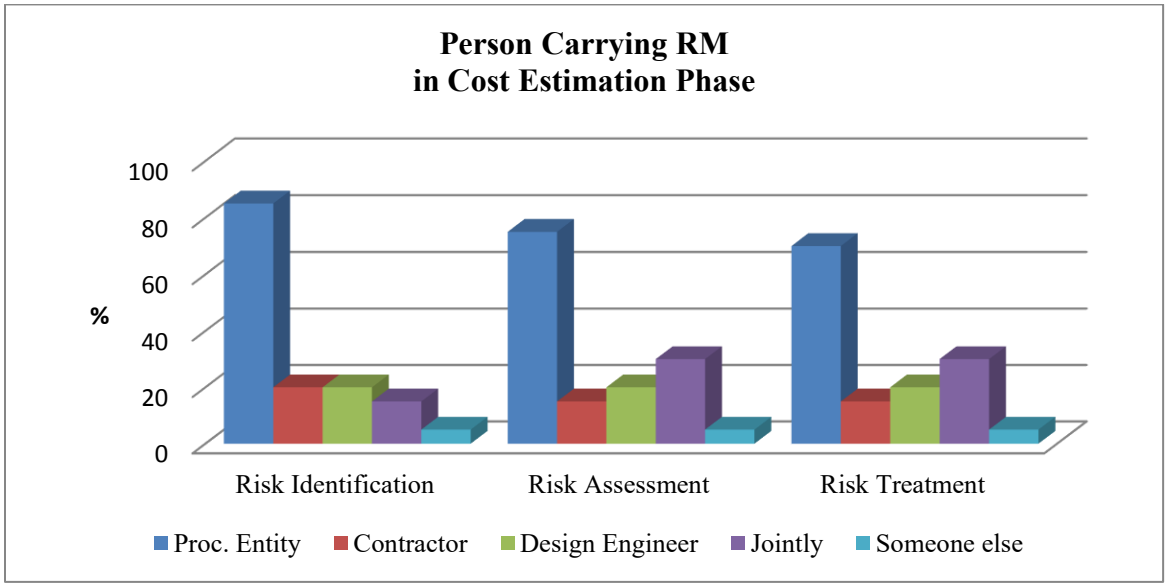


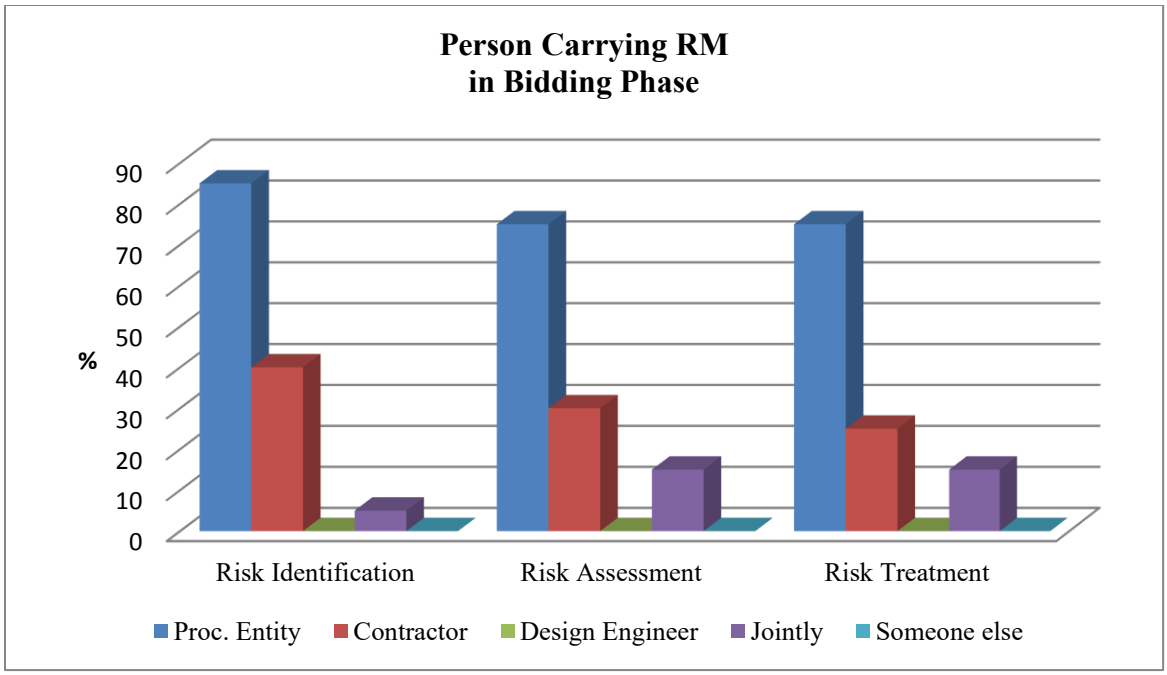
- Who did carry out the following risk management processes in the project's different Phases? Procuring Entity/Contractor/Design Engineer/Someone else,

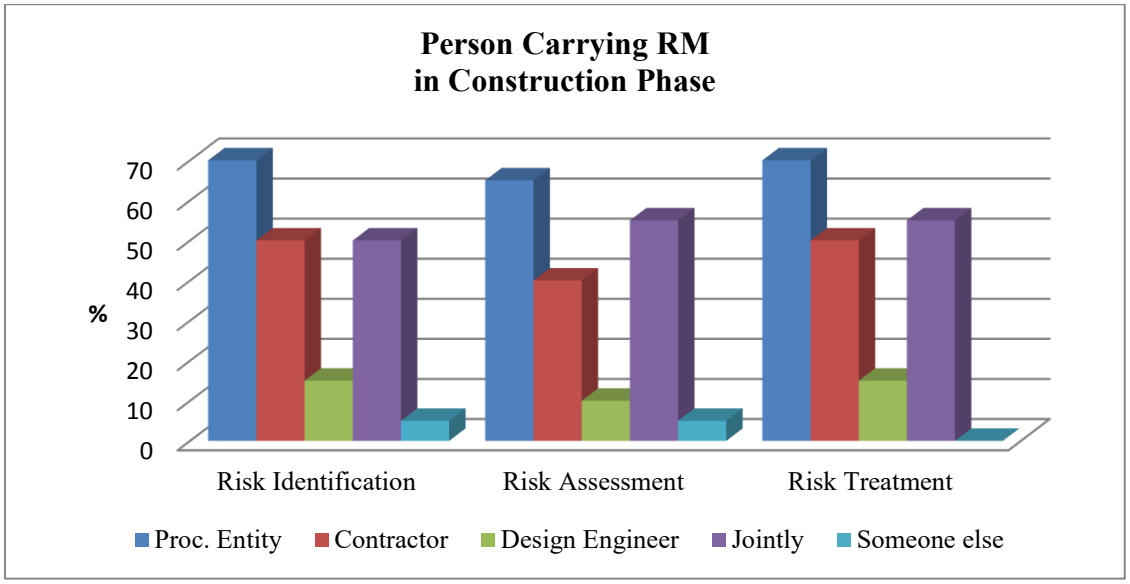
  In Programme, Cost Estimation & Bidding Phase of the projects Procuring Entity carry out the all the steps of risk management. Design Engineer carry out the RMP in Design Phases. In construction phase both procuring Entity and the contractor carry out the risk management of the project.




Person Carrying RM
in Design Phase
100
90
80
70
60
50
40
30
20
10
0
%
Risk Identification
Risk Assessment
Risk Treatment
Proc. Entity
Contractor
Design Engineer
Jointly
Someone else


Person Carrying RM
in Cost Estimation Phase
100
80
60
40
20
0
%
Risk Identification
Risk Assessment
Risk Treatment
Proc. Entity
Contractor
Design Engineer
Jointly
Someone else

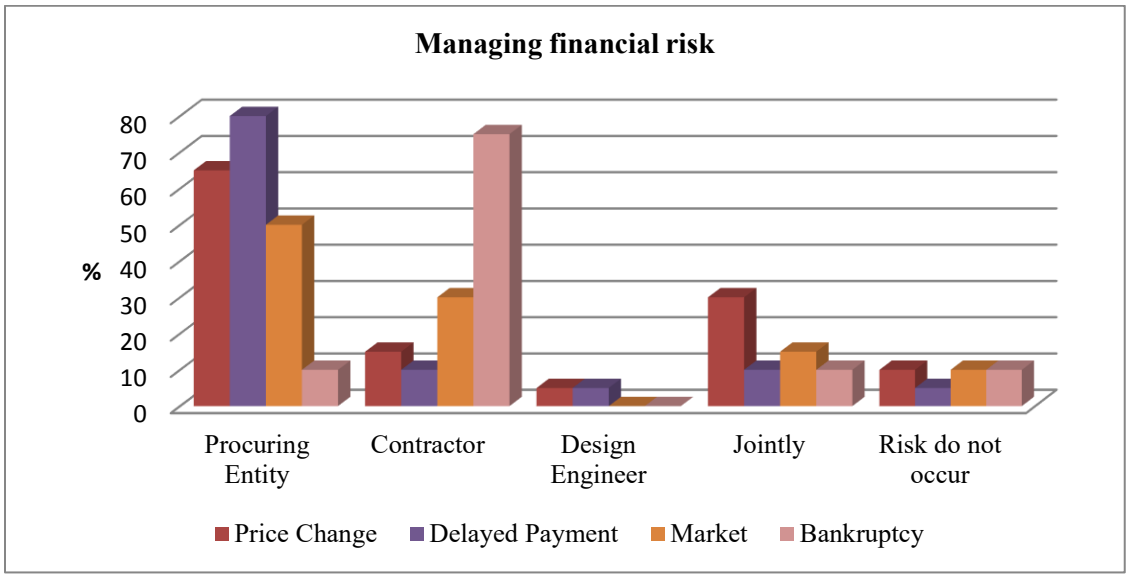


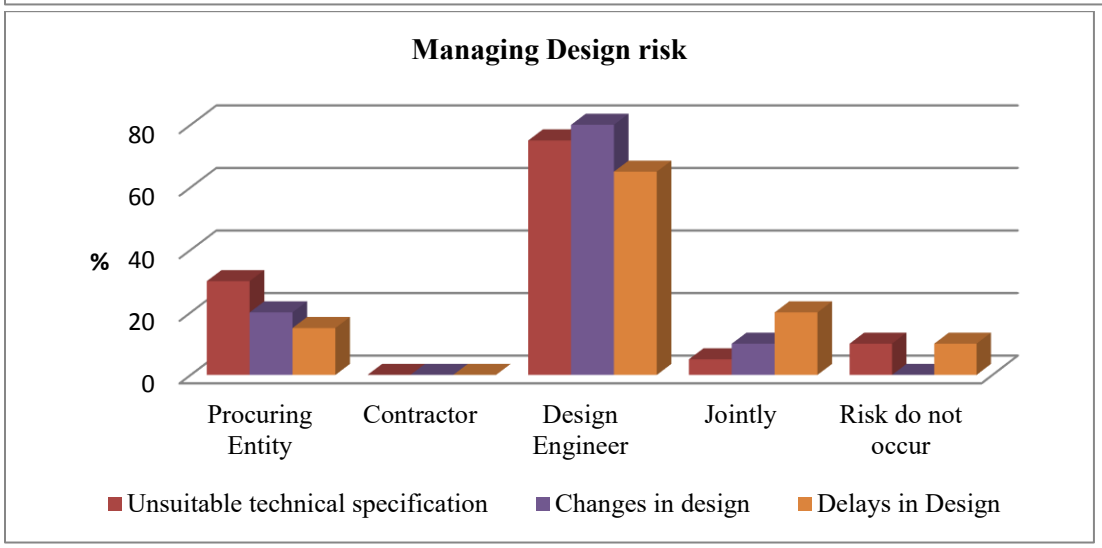


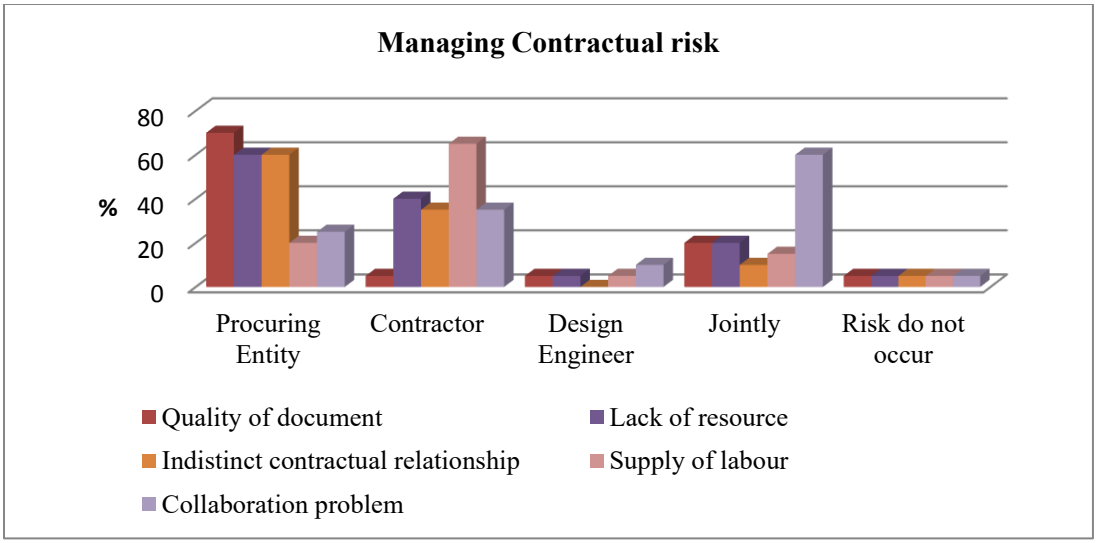
- Who did have the best conditions to manage the following risks in the project? Procuring Entity/Contractor/Design engineer/Jointly/someone else.

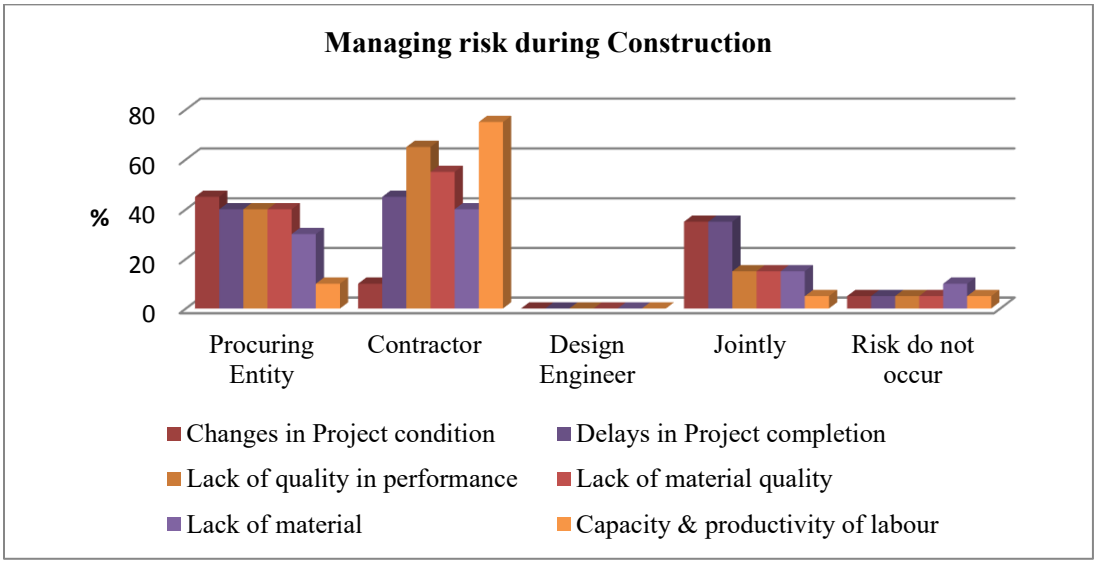
  In PWD risk of Price change, delayed payment, quality of tender document, indistinct contractual relationship etc. of the projects is mainly managed by Procuring Entity. Contractor has great contribution in managing risk associated with bankruptcy of the subcontractor. Design Engineer can manage the risk of changes in design, delays in

design and unsuitable technical specification of the material. During Construction of the projects Procuring Entity and contractor both can manage some risk regarding quality in performance of the work or materials, changing the project condition, delays in project completion etc.



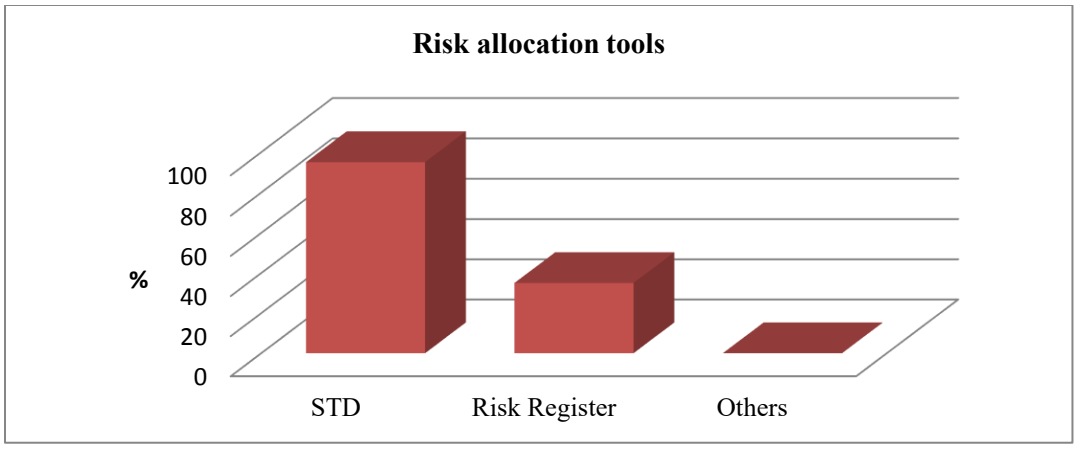






- How were risks allocated in the project? Through STD/Risk Register/Others.

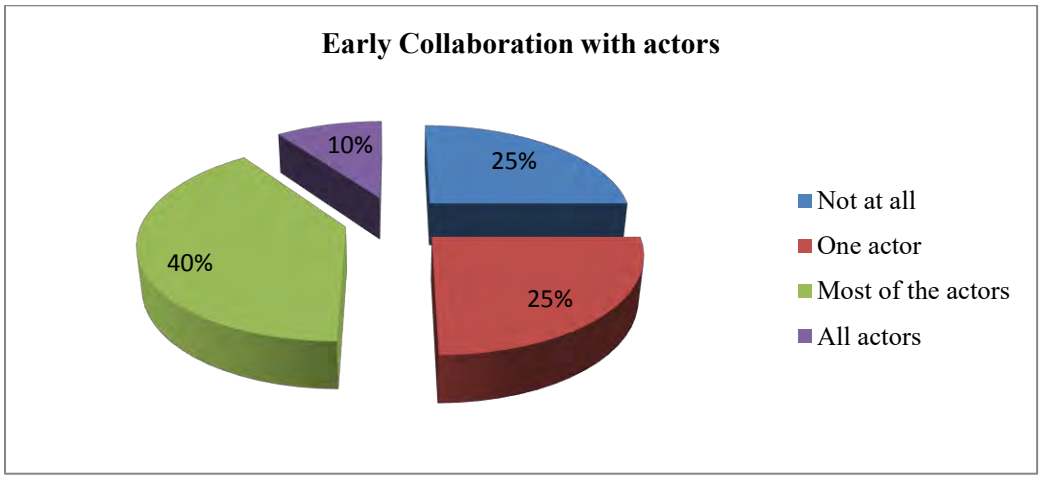
  According to Public Procurement Regulation and Standard Tender Document published by Central Procurement Technical Unit (CPTU), Ministry of Planning, Bangladesh risk of the projects are allocated mainly by Particular Condition of Contracts (PCC) and General Condition of Contracts (GCC) furnished in STD. Risk Register may be used by the participants in major projects.



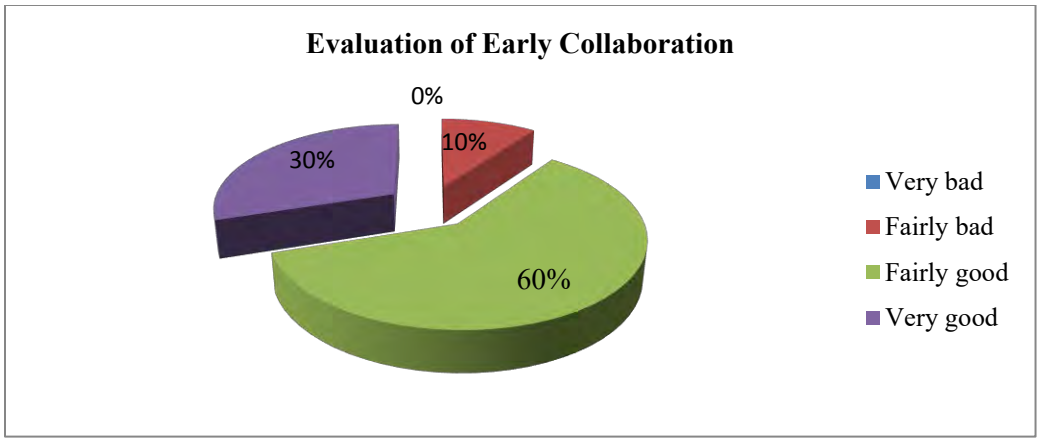
4.3.3 Relationship between Project actors

- Did you earlier collaborate with other actors in the project?
  No one/one actor/Most of the actors/All actors.

  In PWD early collaboration with all the project actors are very unfamiliar. Management of PWD just collaborates with the client in need identification phase of the procurement cycle. For this reason client or one actor is mostly found to be engaged in the early phase of the projects. Yet participants now trying collaborate with most of the project actors in recent time. And they found it fairly good to execute the projects.

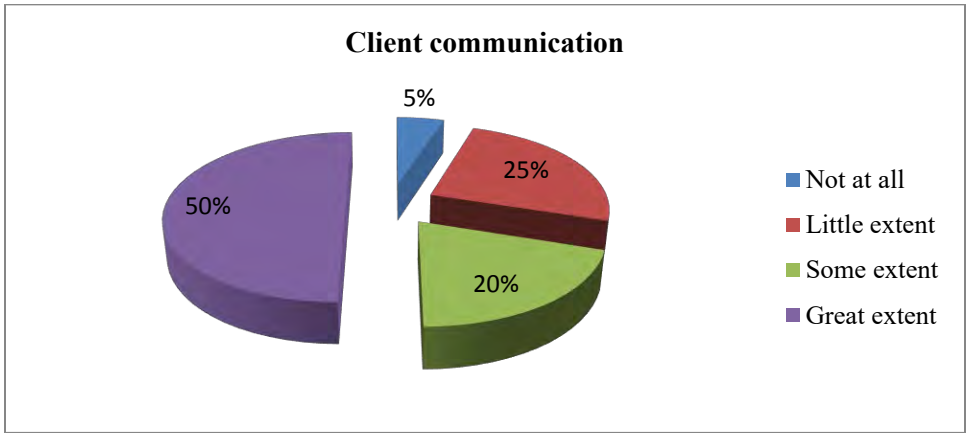


- How do you evaluate collaboration between the actors in the project?
  Very Bad/Fairly bad/ Fairly Good/ Very Good.



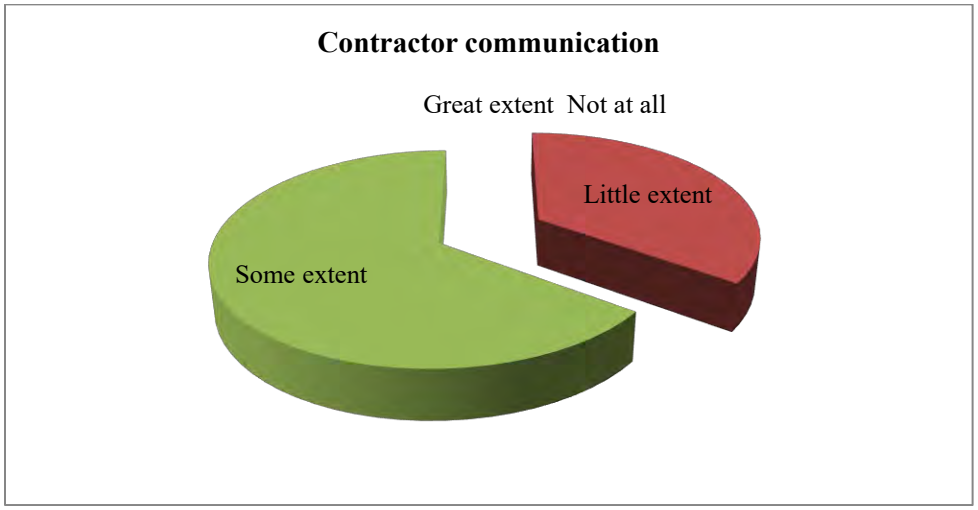
- To what extent did the client communicate known risks and opportunities in the procurement phase? Not at all/Little extent/ some extent/Great extent.

  Communication with the client for became aware about the known risk and opportunities of the project should be done. 50% participants of the sample size have assessed this matter for smooth management of the projects.



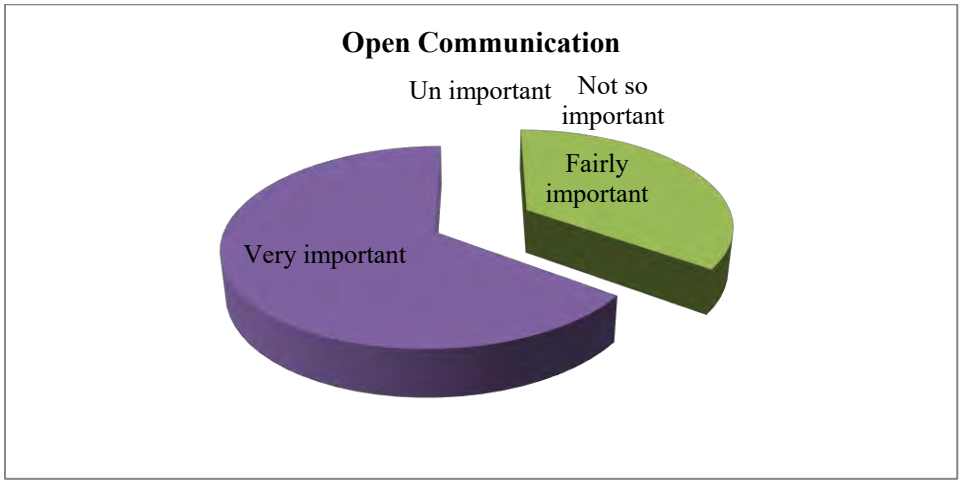
- To what extent did the contractor communicate known risks and opportunities in the procurement phase? Not at all/Little extent/ some extent/Great extent.

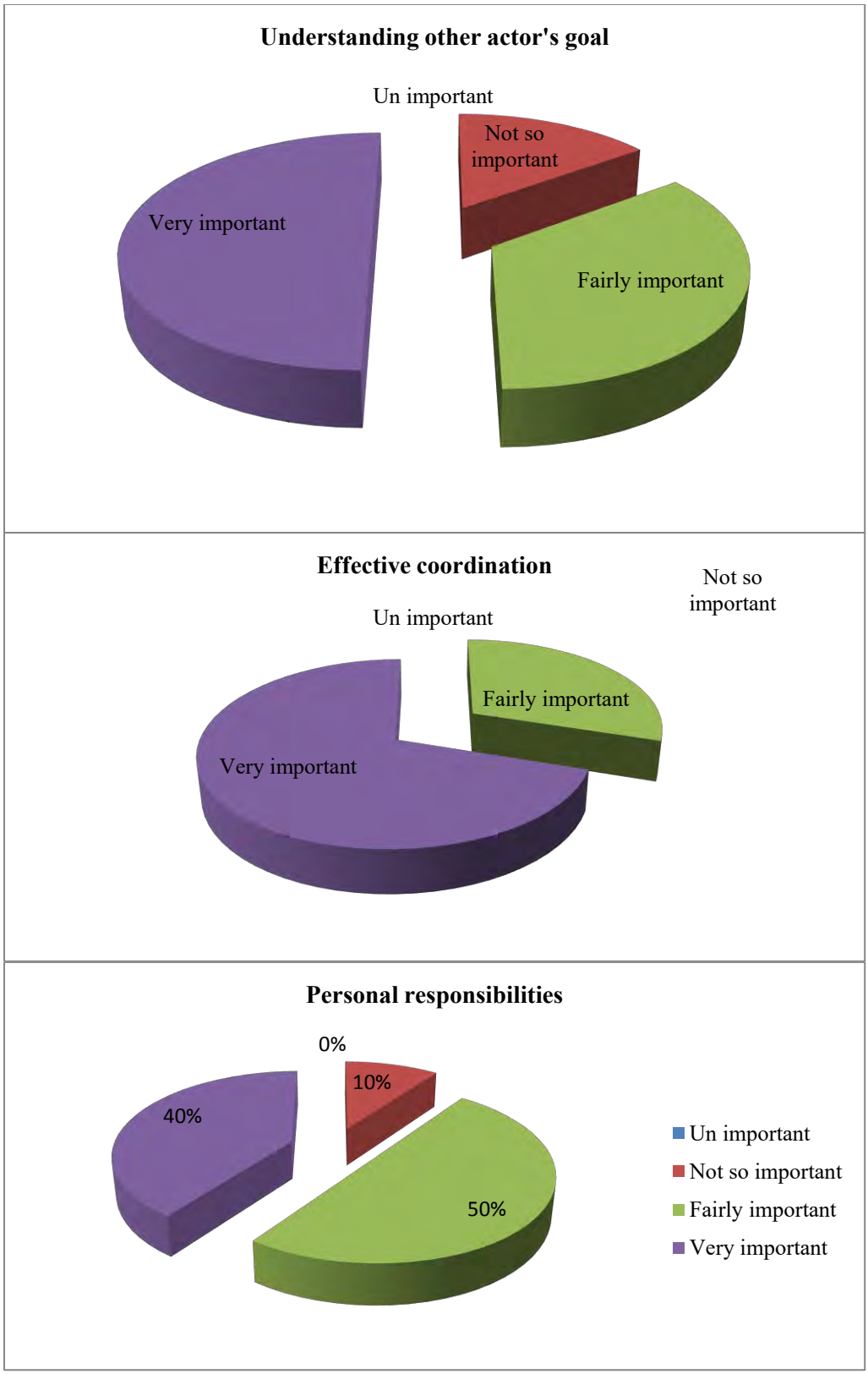
Communication with the contractor is hardly found in the projects of PWD. But major participants found that communication should be done for achieving the objectives of the projects.

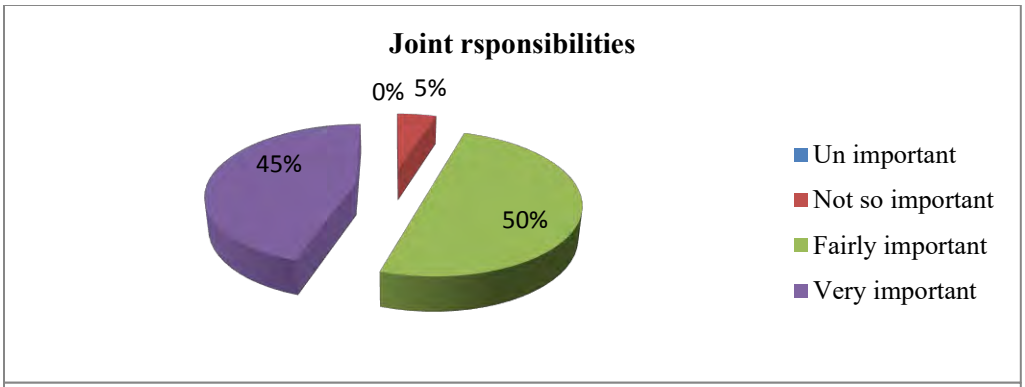


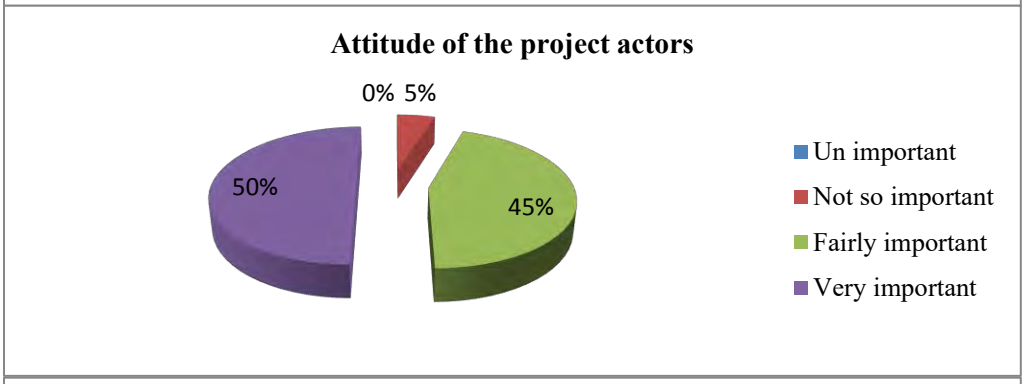
- Assessing important factors were in the project.

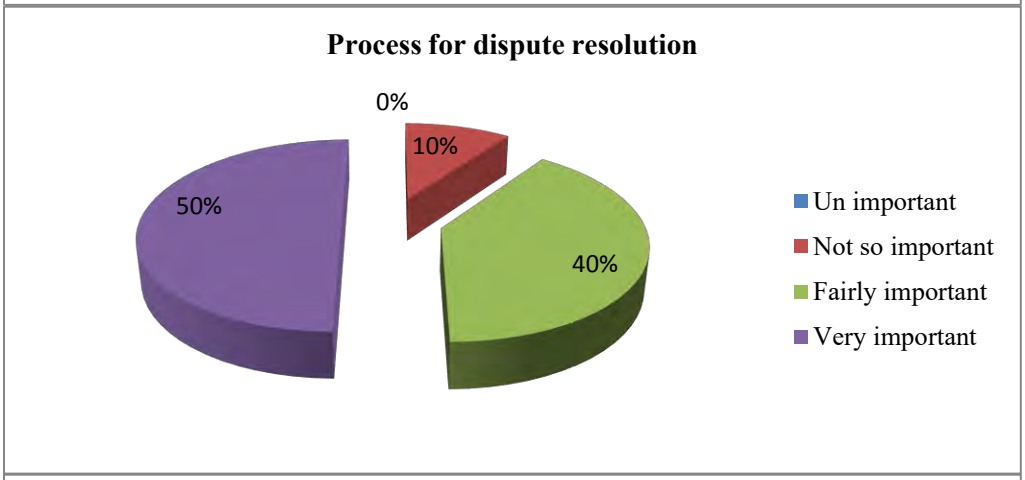
Important factors such as open communication, effective coordination, personal responsibilities, joints responsibilities, frequent meeting etc. has been assessed by the participants. Some portion of participants assessed them as very important/unimportant/fairly important or not so important etc. for the projects.

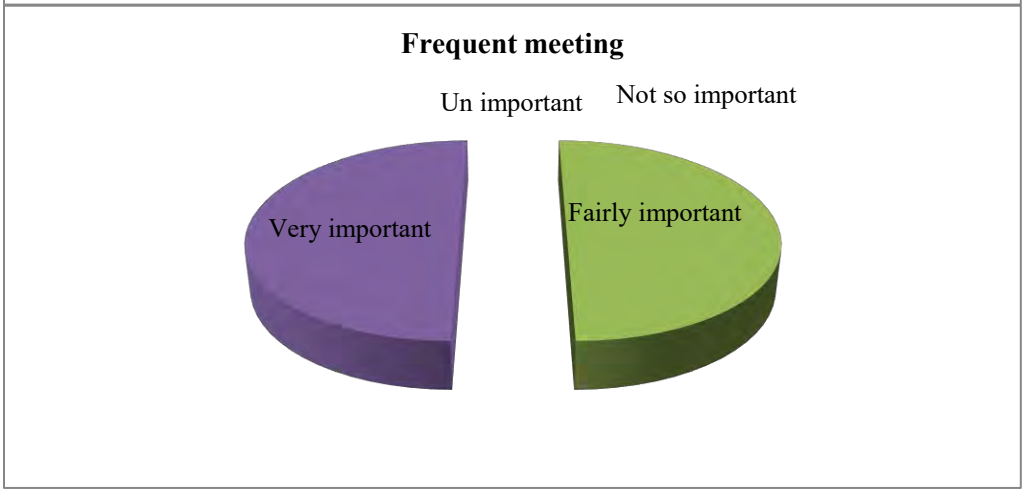


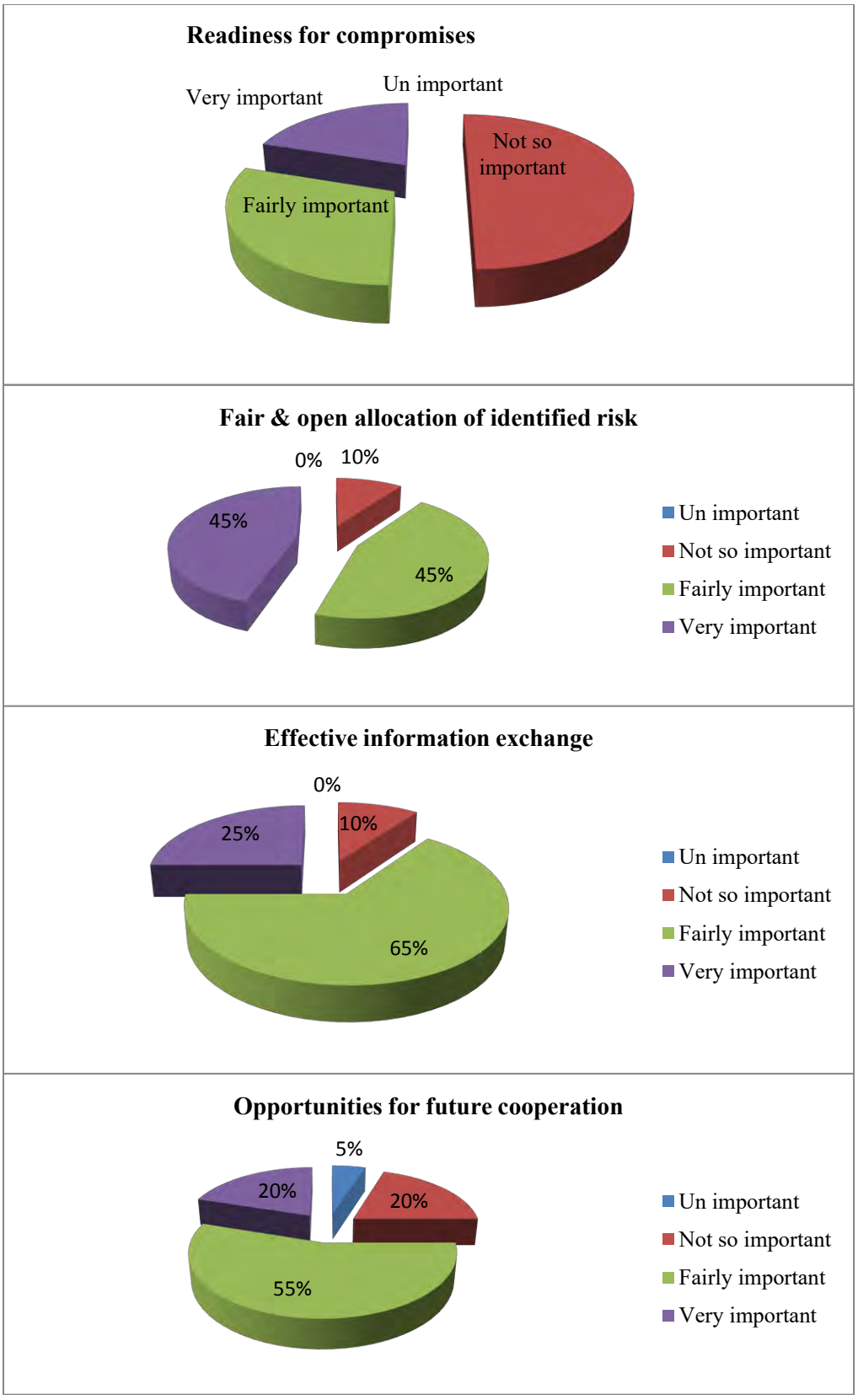

Understanding other actor's goal
Un important
Not so important
Very important
Fairly important
Effective coordination
Not so important
Un important
Fairly important
Very important
Personal responsibilities
0%
10%
40%
50%
Un important
Not so important
Fairly important
Very important

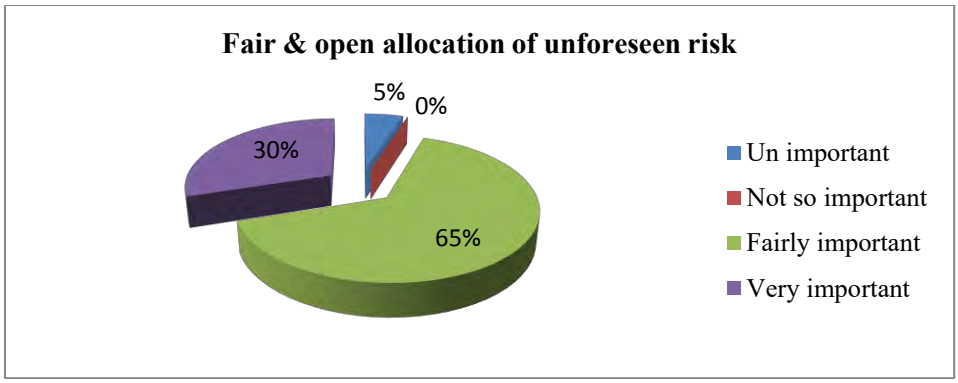

Joint rsponsibilities
0%
5%
45%
50%
Un important
Not so important
Fairly important
Very important


Attitude of the project actors
0%
5%
50%
45%
Un important
Not so important
Fairly important
Very important


Process for dispute resolution
0%
10%
50%
40%
Un important
Not so important
Fairly important
Very important


Frequent meeting
Un important
Not so important
Very important
Fairly important


Readiness for compromises
Very important
Un important
Not so important
Fairly important
Fair & open allocation of identified risk
0%
10%
45%
45%
Un important
Not so important
Fairly important
Very important
Effective information exchange
0%
10%
25%
65%
Un important
Not so important
Fairly important
Very important
Opportunities for future cooperation
5%
20%
20%
55%
Un important
Not so important
Fairly important
Very important


Fair & open allocation of unforeseen risk
5%
0%
30%
65%
Un important
Not so important
Fairly important
Very important

CHAPTER -5

CONCLUSION & RECOMMENDATION

5.1 CONCLUSION

There are two dimensions of risk in theory although it is perceived as a negative term. The participants participated in questionnaire has very limited knowledge about risk management but they evaluated this knowledge highly. They evaluate project implementation fairly good in terms several (time, cost & functionality) parameters. In each phase of the projects, Risk management is highly appreciated. Procuring Entity is primarily responsible for RM in Programme, Bidding & Estimation phase. Design Engineer is primary responsible for RM in Design Phase. In Construction phase Procuring Entity, Design Engineer & Contractor all have more or less equal responsibility in RMP. Professionals in the construction industry like PWD are using various techniques described in the literature concerning RM, but are not aware of it. Risks are being managed every day, but not in such a structured way as the literature describes.

In construction industry like PWD, Health & Safety risk and quality risk is very important than other types of risk. Procuring Entity has greater influence than Contractor & Design Engineer on RM. In PWD maximum project has completed as per drawing & design and there is no deviation in functionality. But projects are subjected to positive deviation in terms of time & Cost that means it requires more time and cost than before to complete. Delayed payment risk, document quality risk, Lack of resources is primarily managed by Procuring Entity. Contractors of PWD manages Bankruptcy, labor supply, Project delay, lack of quality of material, lack of quality in performance, capacity shortness of labor risks. Design Engineer provides the design of the structure quickly and manages the risk of unsuitable specification risk and if any design has been changes he takes the sole responsibilities of that risk. Maximum risk is allocated by Standard Tender Document. Use of Risk Register is comparatively less.

In PWD, Early collaboration among the project actors is comparatively less, but the participants have appreciated this collaboration highly for management of the projects. Participants have highly recommended some factors such as Open Communication,

Understanding others actor goals, personal responsibilities, Effective coordination, frequent meetings etc. for smooth management of the projects.

5.2 RECOMMENDATION

- ✓ Organization should use Risk Management Manual throughout the whole organization to manage risks.
- ✓ Risk Register can be used in each project to identify, assess and mitigate the risks.
- ✓ All tendering process should be done electronically to avoid contractual risk. Although some of the department of People's Republic of Bangladesh has been adopted Electronic Government Purchase (E-GP), but PWD is far behind on the way.
- ✓ Contractors should be aware of RMP. Even organization could train them to get them the knowledge of RM.
- ✓ In assessing the time limit for the completion of any construction project pragmatic procedure should be adapted. The situation of Force majeure should be taken into consideration. Country's political situation, since contributes a lot, so it should also be taken into cognizance. The Gantt chart & CPM be taken into consideration. In addition the significance of the methods be allowed to understand to the respective bidders.
- ✓ Detailed Site plan. Soil testing must be done at the primary stage of a project. Before floating of tenders detailed drawings of Architectural, Structural, Artistic, Sculptural, Sanitary water supply, waste disposal system be done and based on it cost estimates, according to sub-heads be determined.
- ✓ For making timely payment to the contractor, its smooth flow of cash allotment is required to be ensured. For this a mechanism is required to be developed.
- ✓ Liquidity damage clause be applied vigorously. To avert, periodic meeting between contractor and the authority should be held.
- ✓ For having better quality of machinery / equipment procurement (e.g. Medical, industrial etc.) brand name / country of origin/ manufacturing company's equivalency be allowed to mention.
- ✓ Retention money be refunded only after the expiry of its period. Defect remedy & maintenances be ensured in this process.

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A Questionnaire

01 September, 2016

Dear Respondent

Md. Imran Bin Kalam, MPSM student of BRAC University is conducting a dissertation "Risk Management in Procurement of Construction Project-A Context of PWD. The aim of this dissertation is to investigate the Risk that are associated with the construction projects of PWD, Bangladesh, the understanding of the Stakeholder about the probability and impact of those Risk and the participation of stakeholder in Risk Management Process. This dissertation is supervised by **Dr. Mohammed Abu Bakar Siddique**, Deputy Director, Central Procurement Technical Unit, Ministry of Planning, Dhaka, Bangladesh.

This questionnaire is an important part of data collection in the project. The questionnaire consists of three sections with a total of 28 questions. It takes approximately 30 minutes to answer the questionnaire.

Outline of the questionnaire:

Section 1 contains general questions about the respondent.

Section 2 explores the aspects of the risk management process through the different phases of the project.

Section 3 investigates relationships between the actors in the project, i.e. client, designer and/or contractor.

Each question is accompanied by an instruction on how to answer it. In order to get an accurate picture of the current risk management practice, it is important that the questionnaire be completed and returned. Answer the questionnaire manually. **The questionnaire will be treated as strictly confidential** and no reference will be made to companies or persons. By way of thanks for participation, the respondents will be informed about the preliminary results of the study.

NB! All questions should be answered from the project perspective, not from the general perspective.

Thank you in advance!

Md. Imran Bin Kalam
MPSM student, BRAC University
Dhaka, Bangladesh.
Cell. +880 1913472433
Email. Imran.binkalam@gmail.com

1. General Question:

1. Name: _____

2. Organisation: _____

3. Age: _____

4. How long have you worked in the construction industry? _____

5. What is your education? (Tick off your answer)

	Vocational	Diploma	University
Construction	☐	☐	☐
Economics	☐	☐	☐
Laws	☐	☐	☐

Others _____

6. Did you study risk management courses? **Yes** ☐ **No** ☐

If yes, What courses _____

7. How do you evaluate your knowledge of risk management?	**Low**	**Medium**	**High**
	☐	☐	☐

8. Name of the project: _____

8 a.Your role in theproject:

Procuring Entity	☐
PE-representative	☐
Project Manager	☐
Site Engineer	☐
Others, Namely	_____

2. Risk management in the different phases of the project

Any construction process can be divided into four main phases: programme, design, procurement and production. This section of the questionnaire explores the aspects of the risk management process through the different phases. Risk management in the project consists of risk identification, risk assessment and risk response. The aim of risk management is to maximise opportunities and minimise consequences of a risk event.

9. How do you evaluate the project implementation in terms of the following parameters?
(Tick off the most appropriate alternative for each parameter)

	Very bad	Fairly bad	Fairly good	Very good
Functionality	☐	☐	☐	☐
Time	☐	☐	☐	☐
Cost	☐	☐	☐	☐

10. In what phases of the project did you participate? (Tick off your answer)

Programme	☐
Design	☐
Bidding	☐
Cost Estimation	☐
Construction	☐

11. Were the following risk management processes carried out systematically in the project?

	Yes	**No**
Risk Identification	☐	☐
Risk Assessment	☐	☐
Risk Treatment	☐	☐

12. In what phases of the project were the risk management processes performed?
(Tick off one or more alternatives that are suitable in every process)

	Programme	Design	Bidding	Cost Estimation	Construction
Identification	☐	☐	☐	☐	☐
Assessment	☐	☐	☐	☐	☐
Treatment	☐	☐	☐	☐	☐

13. Did you participate in risk management? **Yes** ☐ **No** ☐

If yes, what is your role in risk management

14.What types of risk did you assess in the construction project?

- **Contractual Risk** ☐
- **Health & Safety risk** ☐
- **Force Majure** ☐
- **Financial Risk** ☐
- **Delivery Risk** ☐
- **Quality Risk** ☐
- **Demand Risk** ☐
- **Environmental Risk** ☐
- **Political Risk** ☐
- **Supply Risk** ☐

15. How large influence did the projects actor's have on risk management?
(Tick off the most appropriate alternative for each actor)

	Very small	Fairly small	Fairly large	Very large
Procuring Entity	☐	☐	☐	☐
Contractor	☐	☐	☐	☐
Design Engineer	☐	☐	☐	☐

16. Assess the importance of risk management in the different phases of the project.
(Tick off the most appropriate alternative for each phase)

	Unimportant	Not soImportant	Fairly Important	Very Important
Programme	☐	☐	☐	☐
Design	☐	☐	☐	☐
Cost Estimation	☐	☐	☐	☐
Bidding	☐	☐	☐	☐
Construction	☐	☐	☐	☐

17. Were there deviations in the project in terms of the following parameters?
(Tick off the most appropriate alternative for each parameter)

	Yes, Positive Deviation	Yes, Negative Deviation	No
Functionality	☐	☐	☐
Time	☐	☐	☐
Cost	☐	☐	☐

18. Have identified risks that resulted in problems occurred in the project? **Yes** **No**

☐ ☐

If yes, what impact on the project cost did they have?

Very small Fairly small Fairly large Very large

☐ ☐ ☐ ☐

If yes, Why the risk occurs?

If yes, How the problems were solved?

19. Have unforeseen risks that resulted in problems occurred in the project? **Yes** **No**

☐ ☐

If yes, what risks?

If yes, what impact on the project cost did they have?

Very small Fairly small Fairly large Very large

☐ ☐ ☐ ☐

If yes, Why the risk occurs?

If yes, How the problems were solved?

20. How were unforeseen risks caught in the project?

21. Who did carry out the following risk management processes in the project's different phases? (Tick off the most appropriate alternative for each process in every phase)

	Procuring Entity	Contractor	Design Engineer	Jointly	Someone else
Programme					
Risk Identification	☐	☐	☐	☐	☐
Risk Assessment	☐	☐	☐	☐	☐
Risk Response	☐	☐	☐	☐	☐
Design					
Risk Identification	☐	☐	☐	☐	☐
Risk Assessment	☐	☐	☐	☐	☐
Risk Response	☐	☐	☐	☐	☐
Cost Estimation					
Risk Identification	☐	☐	☐	☐	☐
Risk Assessment	☐	☐	☐	☐	☐
Risk Response	☐	☐	☐	☐	☐
Bidding					
Risk Identification	☐	☐	☐	☐	☐
Risk Assessment	☐	☐	☐	☐	☐
Risk Response	☐	☐	☐	☐	☐
Construction					
Risk Identification	☐	☐	☐	☐	☐
Risk Assessment	☐	☐	☐	☐	☐
Risk Response	☐	☐	☐	☐	☐

22. Who did have the best conditions to manage the following risks in the project? (Tick off

the most appropriate alternative for each risk)

	Procuring Entity	Contractor	Design Engineer	Jointly	Risk do not occur
1) Financial Risk	☐	☐	☐	☐	☐
-Price (changes in the contract amount due to variations in prices and salaries)	☐	☐	☐	☐	☐
-Delayed payments	☐	☐	☐	☐	☐
-Market (e.g. competition, recession)	☐	☐	☐	☐	☐
-Bankruptcy (subcontractors)	☐	☐	☐	☐	☐
2) Design risks	☐	☐	☐	☐	☐
- Unsuitable technical solutions or specification	☐	☐	☐	☐	☐
- Changes in design	☐	☐	☐	☐	☐
- Delays in design	☐	☐	☐	☐	☐
3)Organisational/contractual risks	☐	☐	☐	☐	☐
- Quality of contractual documents	☐	☐	☐	☐	☐
- Lack of resources during the projectexecution	☐	☐	☐	☐	☐
- Indistinct contractual relationship	☐	☐	☐	☐	☐
- Supply of labour	☐	☐	☐	☐	☐
- Collaboration problems	☐	☐	☐	☐	☐
4) Risks during construction	☐	☐	☐	☐	☐
- Changes in the project conditions	☐	☐	☐	☐	☐
- Delays	☐	☐	☐	☐	☐
- Lack of quality in project performance	☐	☐	☐	☐	☐
- Lack of material quality	☐	☐	☐	☐	☐
- Lack of materials	☐	☐	☐	☐	☐
- Capacity and productivity of labour	☐	☐	☐	☐	☐

5) Force majeure risks ☐ ☐ ☐ ☐ ☐

23. How were risks allocated in the project?	**Yes**	**No**
1) Through the general conditions of contract of STD	☐	☐
2) Through using Risk Register as a part of RM	☐	☐
3) Specific risks were transferred to other project actors	☐	☐

If yes, what risks?

3. Relationships between the project actors

This section investigates relationship between the project actors, i.e. client, contractor and consultant.

24. Did you earlier collaborate with other actors in the project?

No one	One actor	Most of the actors	All actors
☐	☐	☐	☐

25. How do you evaluate collaboration between the actors in the project?

Very Bad	Fairly Bad	Fairly Good	Very Good
☐	☐	☐	☐

Comments:

26. To what extent did the client communicate known risks and opportunities in the procurement phase?

Not at all	Little extent	Some extent	Great extent
☐	☐	☐	☐

27. To what extent did the contractor communicate known risks and opportunities in the procurement phase?

Not at all	Little extent	Some extent	Great extent
☐	☐	☐	☐

28. Assess how important the following factors were in the project.

(Tick off the most appropriate alternative for each factor)

	Un important	Not so important	Fairly important	Very Important
- Open communication between the actors	☐	☐	☐	☐
- Understanding of other actors' goals	☐	☐	☐	☐

- Effective coordination	☐	☐	☐	☐
- Attitudes of the project actors (trust and commitment)	☐	☐	☐	☐
- Joint responsibilities	☐	☐	☐	☐
- Personal responsibilities	☐	☐	☐	☐
- Established process for dispute resolution	☐	☐	☐	☐
- Frequent meetings	☐	☐	☐	☐
- Readiness for compromises	☐	☐	☐	☐
- Opportunities for future cooperation	☐	☐	☐	☐
- Effective information exchange between the actors	☐	☐	☐	☐
- Fair and open allocation of identified risks	☐	☐	☐	☐
-Fair and open allocation of unforeseen risks	☐	☐	☐	☐

Thank you for your participation!