RISK MANAGEMENT FRAMEWORK FOR FOREIGN FUNDED WATER PROJECTS: CLIENT'S PERSPECTIVE

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Degree of Master of Science in Project Management

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DECLARATION

I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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To my beloved parents

with love…

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ABSTRACT

Risk Management Framework for Foreign Funded Water Projects: Client's Perspective

Foreign funded projects operate under a special mechanism with the complex web of the different stakeholders. It faces different types of risk related to time and cost. Thus, it is important to control and manage the risk associated with foreign funded projects to ensure the achievement of project objectives on time. Therefore, this study focuses on risk analysis of water projects which a type of foreign funded projects in Sri Lanka. Accordingly, the aim of this study was to develop risk management framework for foreign funded water projects from client's perspective. In total, 49 risk factors were identified through a detailed literature review. The factors were tabulated in a questionnaire form and sent out to gather owner's perception on the rating of each risk factors regarding probability of occurrence and impact on foreign funded projects. A risk matrix having four risk levels as "low risk – (green)", "moderate risk – (yellow)", "high risk – (orange)" and "extreme high risk- (red)" is developed to evaluate significant risk factors. The analysis indicates that one factor is located in the green zone, twelve factors are located in the yellow zone, twenty two factors are located in the orange zone and thirteen factors are located in the red zone of the risk matrix. The predominant risk factors that are located in the red zone are considered for developing risk management framework. Risk response measures were identified through a literature review and respondent were asked to rank according to its effectiveness. Further effective risk response measures have also been proposed by the respondents for each of the identified risk factor. Based on the findings, a risk management framework was developed which will be benefit the risk management of foreign funded water projects.

Keywords: *foreign funded water projects, risk, risk identification, risk matrix, risk response measure.*

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LIST OF ABBREVIATIONS

ADB	-	Asian Development Bank
DAC	-	Development Assistance Committee
DANIDA	-	Danish International Development Agency
FF	-	Foreign Funded
FIDIC	-	International Federation of Consulting Engineers
GOSL	-	Government of Sri Lanka
ICTAD	-	Institute of Construction Training and Development
ID	-	International Development
JICA	-	Japan International Cooperation Agency
NWS&DB	-	National Water Supply and Drainage Board
OA	-	Official Assistance
ODA	-	Official Development Assistance
OECD	-	Organization for Economic Co-operation and Development
RII	-	Relative Importance Index
SPSS	-	Statistical package for social science
VH	-	Very High
VL	-	Very Low

CHAPTER 01

INTRODUCTION

1.1 Background

Construction projects are temporary endeavors with many unique features such as lengthy duration, complicated process, abominable environment, financial intensity and dynamic organization structures when compared to the other businesses (Zou, Zhang & Wang, 2007). Demand for the construction investments exist on three types of projects as residential, non-residential and infrastructure (Geadah, 2001). Among these, infrastructure investments are the projects that are been incorporated with energy, transport, water, telecommunication and social infrastructure (Grimsey & Lewis, 2002).

Infrastructure projects represent assets in a county, and play a critically important role in attracting foreign investment and supporting a nation's social, cultural and economic stability, productivity, development and prosperity (Loosemore, 2006). Due to limitation upon the public funds available for infrastructure, governments have led to invite external entities to enter into long term agreements for financing infrastructure projects (Grimsey & Lewis, 2002). Hence, governments tend to attain foreign aid for the major infrastructure construction developments in the country. However, once the fund aided under the foreign funding are not utilized fully, it will be an additional burden to the government. Therefore, large and complex infrastructure projects are plagued with a high degree of risk (Ghosh & Jintanapakanont, 2004).

Kartam and Kartam (2001) described risk under aforementioned situation as the probability of occurrence of some uncertain, unpredictable and even undesirable event/events that would change the prospects for the profitability on a given

investment. According to Rahman and Kumaraswamy (2002), risks are inherent in all construction projects and it can be transferred, accepted, managed, minimized, or shared, but cannot be ignored. Failure to adequately deal with risks associated with construction projects may cause cost overruns, delays in schedule and even poor quality in the final output (Wiguna & Scott, 2006). Therefore, managing risk in construction projects is recognized as very important process in order to achieve project objectives in terms of time, cost, quality, safety and sustainability (Zou et al., 2007).

Risk management is a formal and orderly process of systematically identifying, analysing and responding to risks throughout the lifecycle of a project to obtain the optimum degree of risk elimination, mitigation and/or control (Wang, Dulaimi, & Aguria, 2004). It is important to manage the multifaceted risks associated with construction projects not only to secure the work but also to make profit (Wang et al., 2004). Project risk management intends to increases the probability and impact of positive events, and decrease the probability and impact of negative events in the project (Project Management Institute [PMI], 2004). Therefore, the implementation of risk management would assure the achievement of project objectives (Hwang, Zhao, & Toh, 2013).

Extensive researches have been undertaken in the field of risk management and those studies revealed that benefits of risk management were tremendous in construction projects (Hwang et al., 2013). Wang et al. (2004) developed risk mitigation framework for international construction projects in developing countries by considering critical risk factors and mitigation measures. Grimsey & Lewis (2002) adopted risk framework to view project risk from the perspectives of the procuring entity, the project sponsors and the senior lenders. Further, Xu, Yang, Chan, Yeung, and Cheng (2011) explored the critical risk factors associated with public/private partnership (PPP) water projects and developed a risk sharing mechanism. Moreover, Priyadarshana (2010) has conducted a research on technical risks in water supply projects and analysed the allocation of risk factors among contracting parties.

Water infrastructure can be defined as a stock of facilities and installations needed to develop and manage water resources, including delivery, treatment, supply and distribution of water to its users as well as for the collection, removal, treatment and disposal of sewage and wastewater (United Nations Economic and Social Commission for Asia and the Pacific [UNESCAP], 2006). Shortage of water infrastructure denies access to safe water and decent sanitation. Thus, adequate and well-maintained water infrastructure is a necessary condition for economic growth and social equity.

In the context of Sri Lanka, water supply and drainage functions are carried out by the National Water Supply and Drainage Board (NWS&DB) and its mission is to serve the nation by providing sustainable water and sanitation solution, ensuring total user satisfaction by optimizing the resources in relation cost, quality and time (NWS&DB, 2009). Water supply projects were implemented with assistance from foreign funds such as Japan International Cooperation Agency (JICA), Asian Development Bank (ADB), Danish International Development Agency (DANIDA), and German etc. with counterpart funding by the Government of Sri Lanka (GOSL). There are number of water supply projects, completed and ongoing and as well as planned to be undertaken in near future under foreign funded basis. According to the statistics, the NW&SDB is provided with Rs 19,631 million as foreign funds for capital works on water supply and sewerage projects and Government of Sri Lanka contribute Rs 6,485 million as counterpart funds (NWS&DB, 2009). Though huge amount of money invested by foreign funding agencies yet the risk involvement is inherent in these projects and it is unavoidable. Therefore, it is vital to identify 'what are the critical risk factors associated with foreign funded water projects'. Furthermore, NWS&DB project reports reveals that many water projects encountered cost overrun and schedule delays and thereby exceed initial time and cost estimates. In addition to that, these extensive delays and cost overrun provide fertile ground for costly disputes and claims. Therefore, it is essential to adopt a proper risk management system to overcome above problem in foreign funded water supply projects.

1.2 Research Problem

As mentioned in the background, infrastructure projects which are crucial to economic growth and social equity, are inherent with several risks. Further when they are operated with foreign funding, risks related under such circumstances should be considered as the complex web of the many stakeholders involved. Despite the importance of considering risks, most of the projects are not properly addressed this concern.

Water projects in Sri Lanka take place in massive scale and all most all these projects are foreign funded. However, the completion reports of FF projects revealed that time overruns and cost overruns are existed in these projects. Researches on risk management on foreign funded water projects are very few and therefore FF water projects absence the insight of risk management.

Therefore, this research anticipates filling the research gap through exploring existing critical risk factors associated with foreign funded water projects in Sri Lanka and, developing an effective risk management framework to control those risks.

1.3 Aim & Objectives

The aim of this research is "**to develop a risk management framework for foreign funded water projects**" with following objectives.

- To identify the critical risk factors associated with foreign funded water projects
- To establish effective risk response measures for those risk factors
- To develop a risk management framework for managing risk in foreign funded water projects

1.4 Methodology

In order to achieve the above-mentioned aim and objectives following research methodology was adopted.

A comprehensive literature survey was carried out by referring a range of books, journals, articles, conference proceedings, related dissertations, government publications and World Wide Web to identify the risk management practice related to the research area. Based on the literature findings, interviews were conducted with the industry experts to obtain input towards the questionnaire design, especially towards identifying risk types, management actions for controlling these risks. Then, a detailed questionnaire survey was carried out to determine the significant risk factors with related to the foreign funded water projects and risk responses measures to deal with those risk factors. Sample was selected from the professionals who are involved in the foreign funded water projects in client side. The data collected through questionnaire survey was analyzed by using mean score method, risk matrix assessment and relative importance index. Finally, interviews were conducted in order to extract expert views to confirm the questionnaire findings.

1.5 Scope and Limitations

- This research deals only with the foreign funded water projects carrying out under separated contracts.

- As the National Water Supply and Drainage Board is the only client for the foreign funded water projects in Sri Lanka, when receiving the clients' perception in data collection, all the respondents were from NWS&DB.

1.6 Chapter Breakdown

Arrangement of chapter breakdown of this research can be depicted as follows;

Chapter 01 - Introduction

This chapter discusses the background to the research topic, research problem, aim and objectives, scope and limitations, methodology in brief and the organization of the report.

Chapter 02 – Literature Review

This chapter reviews the existing literature to identify the concept of risk, risk management, risk factors with related to the foreign funded projects and risk response measures.

Chapter 03 – Research Methodology

This chapter describes the research methodology adopted for this study including research approach, data collection and data analysis techniques in detail.

Chapter 04 – Data Analysis and Results

This chapter presents the analysis of the collected data and research findings.

Chapter 05 – Conclusion and Recommendations

This chapter concludes the achievements of research aim and the objectives and further includes recommendations and directions for further researches.

CHAPTER 02

LITERATURE REVIEW

2.1 Introduction

The construction industry is widely associated with a high degree of risk due to its unique nature. Therefore project objectives in terms of time, cost and quality can be adversely affected by risk. Hence, risk management is an important part of the decision-making process of all construction companies and it becomes an essential part of construction project.

This chapter addresses the risk and uncertainty in construction industry and how they affect the construction projects. Then, it is explained about the risk management and need of risk management in foreign funded projects. Further, it has been described the process of risk management in terms of risk identification, risk analysis and risk response. Finally, it is discussed about the water projects in Sri Lanka and extracted the risk factors related to the foreign funded water projects from literature.

2.2 Risk and Uncertainty

Risk has been characterized in various ways. According to the Oxford Advance Learner's dictionary (2000, p.1105) the word "risk" is defined as the ''chance of failure or the possibility of meeting danger or of suffering harm or loss'' that means the likelihood of something bad happening in sometime in the future. The concept of risk varies according to viewpoint, attitudes and experience of different people such as engineers, designers and contractors view risk from the technological perspective; lenders and developers tend to view it from the economic and financial side; health professionals, environmentalists, chemical engineers take a safety and environmental perspective. Therefore risk is generally seen as abstract concept whose measurement is very difficult (Baloi & Price, 2003).

In essence, decision making can be taken place in situations where certain, risk or uncertain (Flanagan & Norman, 1993). Events are said to be certain if the probability of their occurrence is 100% or totally uncertain if the probability of occurrence is 0% (Jaafari, 2001). According to the Loosemore, Raftery, Reilly and Higgon (2006), risk can be defined as 'a potential future event which is uncertain in likelihood and consequence and if occurs could affect your company's ability to achieve its project objectives'. However the term risk and uncertainty can be used in different ways and which was defined by Smith, Merna and Jobling (2006) as follows;

- *risk* exists when a decision is expressed in terms of a range of possible outcomes and when known probabilities can be attached to the outcomes
- *uncertainty* exists when there is more than one possible outcome of a course of action but the probability of each outcome is not known

Flanagan and Norman (1993) define uncertainty as a situation in which there is no historical data or previous historical information related to the situation being considered by the decision maker and in contrast, risk is the situation where success or failure can be determined in probabilistic quantities using historical data. Further they stated that risk can assess either intuitively or rationally through the probability of a particular event occurring. Accordingly the impact of a risk can be measured as the likelihood of a specific unwanted event and its unwanted consequences or loss (impact of risk = likelihood x consequence**)**. While uncertainty is not measurable, it can be estimated through subjective assessment techniques (Raftery, 1994). The distinction between risk and uncertainty can be illustrated schematically in Figure 2.1, where risk and uncertainty are viewed at either ends of the continuum.

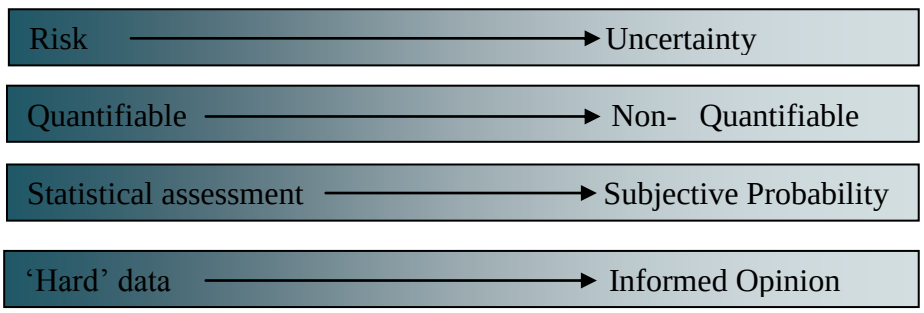

Figure 2.1: The risk-uncertainty continuum
Source: Loosemore et al., (2006)

Hillson (as cited in Olsson, 2007) link risk with uncertainty as, risk is measurable uncertainty; uncertainty is immeasurable risk. This implies that, when measurable, an uncertainty is to be considered as risk.

2.3 Risk in Construction Projects

A project can be defined as 'a unique set of coordinated activities, with a definite start and finish point, undertaken by an individual or organization to meet specific objectives with defined schedule, cost and performance parameters' (British Standard Institute 6079 as cited in Smith, 2002). Construction projects involve hundreds or even thousands of interacting activities to assure the achievement of project objectives (Flanagan & Norman, 1993). Thus, construction projects are exposed to risks at the time of their coming into existence (Schieg, 2006). Further Ahmed and Azhar (2004) stated that construction industry is subjected to more risk and uncertainty due to the process of taking a project from initial investment appraisal to completion is complex, bespoke and entails time-consuming design and production processes. However, the construction industry has a very poor reputation for managing risk as its complex and dynamic nature (Mills, 2001). Therefore risk is unavoidable component of all activities (Wang et al., 2004).

El-Sayegh (2008) strengthen above statement by emphasising the construction industry is subject to more risk and uncertainty than probably any other industry due to involvement of multitude of people with different skills and interests and the coordination of a wide range of disparate, yet interrelated, activities. Accordingly, construction projects are normally executed under an environment characterized by varying degree of risks and uncertainties (Andi, 2006).

Ghosh and Jintanapakanont (2004) have explained that the risk is a factor that can jeopardize the successful completion of a project by causing cost overruns, time overruns and under specification. Consequently Flanagan and Norman (1993) summarized effects of risk in construction projects as follows;

- Failure to keep within the cost budget/ forecast/ estimate/ tender
- Failure to keep within the time stipulated for the approvals, design, construction and occupancy
- Failure to meet the required technical standards for quality, function, fitness for purpose, safety and environment preservation

Risk is inherent in any construction project and difficult to deal with, and this requires a formal risk management process to manage all types of risks in both of theoretical and practical meanings (Wang et al., 2004). Accordingly, an effective risk management method can help in understanding not only what kinds of risks are faced, but also how to manage these risks at the stages of project life cycle (Zhi, 1995).

2.4 Risk Management

Risk management is 'a system which aims to identify and quantify all risks to which the business or project is exposed so that a conscious decision can be taken on how to manage the risks' (Flanagan & Norman, 1993). According to the Wang et al. (2004), risk management is a formal and orderly process of systematically identifying, analysing, and responding to risks throughout the life-cycle of a project to obtain the optimum degree of risk elimination, mitigation and/or control.

Traditionally risk management has been applied instinctively with risks remaining implicit and managed by judgment informed by experience. The systematic approach makes the risks clear, formally describing them and making them easier to manage (Godfrey, 1996). Therefore, project risk management allows individual risk events and overall project risk to be understood and managed proactively, optimizing project success by minimizing threats and maximizing opportunities (PMI, 2004). A risk management system should: establish an appropriate context; set goals and objectives; identify and analyse risks; influence risk decision making and monitor and review risk response (Akintoye & Macleod, 1997).

According to Godfrey (1996), systematic risk management helps to:

- identify, assess and rank risks making the risks explicit
- focus on the major risks of the project
- make informed decisions on the provision for adversity, e.g. mitigation measures
- minimise potential damage should the worst happen
- control the uncertain aspects of construction projects
- clarify and formalise the company's role and the roles of others in the risk management process
- identify the opportunities to enhance project performance.

Tummala and Burchett (1999) have stated that risk management process is an effective tool of confronting unknown risks, responding quickly in finding out what could go wrong and developing strategies to control risks for project success. Therefore proper risk management plan has been become more important part of overall project management.

2.5 Need of Risk Management in Foreign Funded Construction Projects

According to the Development Assistance Committee (DAC) of the Organization for Economic Co-operation and Development (OECD), foreign aid is defined as "financial flows, technical assistance, and commodities that are (1) designed to promote economic development and welfare as their main objective (thus excluding aid for military or other non-development purposes); and (2) are provided as either grants or subsidized loan".

Grants refer to the outright transfer payments either in money terms or technical assistance which do not have to be repaid. Loans refer to funds from one economic entity to another, which must be repaid with interest over a prescribed period of time. Loans may be 'hard' (those given at market rates of interest) or 'soft' (those given at concessionary or low rates of interest).

Based on the DAC classification, aid flows under following three broad categories;

- **Official Development Assistance** (ODA) - Aid provided by donor governments to low-and middle-income countries.
- **Official Assistance** (OA) - Aid provided by governments to richer countries with per capita incomes higher than approximately $9,0005 and to countries that were formerly part of the Soviet Union or its satellites.
- **Private Voluntary Assistance -** Includes grants from non-government organizations, religious groups, charities, foundations, and private companies.

Foreign aid can be multilateral or bilateral. Bilateral aid is directly provided from one country to another while multilateral aid comes from international organizations such as World Bank; the International Monetary Fund; the African, Asian, and Inter-American Development Banks, and various United Nations agencies such as the United Nations Development Programme.

According to the Ahsan and Gunawan (2010), the process of project environments for international development projects is far more complex than the domestic projects because there are many parties involved. Generally this kind of projects include the lender or donor, the Ministry of Finance of the host country, the client, stakeholders, a project management or co-ordination unit and a multitude of contractors who carry out physical implementation of most components and activities of the project (Ahsan & Gunawan, 2010). Following Figure 2.2 showed the International Development (ID) project network model and where solid arrows represent usual communication between involved parties and the dotted arrows represent likely communication between parties.

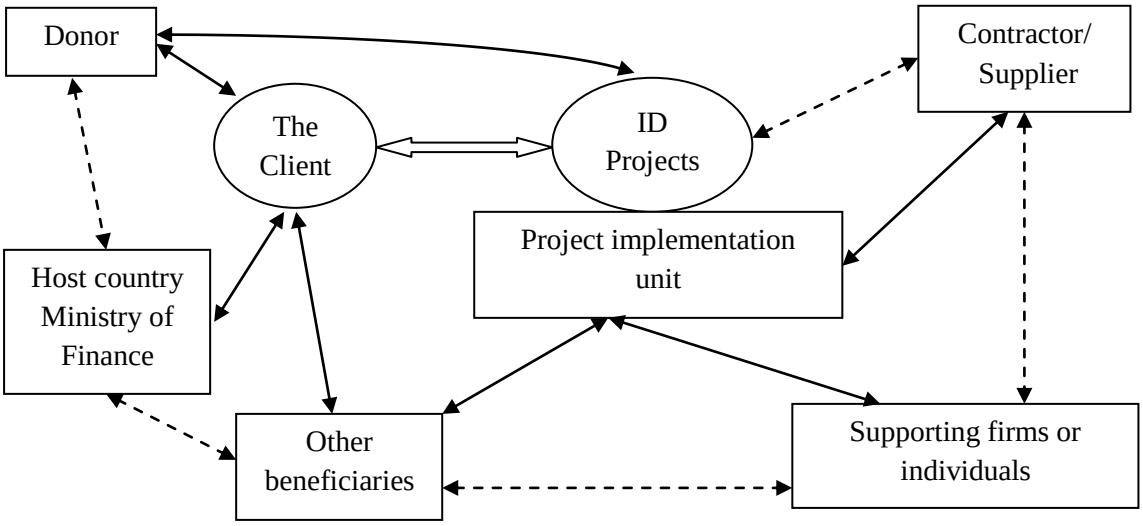

Figure 2.2: ID project network model

Source: Ahsan and Gunawan (2010)

Based on the explanation made by Kwak and Dewan (2001), international development projects create high risk in accomplishing project objectives as they influenced many internal and external, visible, and invisible factors. Some of the contributing factors are listed as follows in their research study;

- Influence of various stakeholders
- Cultural, socio-economical, technological, and political environment
- Lack of managerial and technological capabilities in the recipient countries
- Unclear project objectives
- Shortage of resources
- Lack of ownership
- Poor infrastructure for project development
- External driving forces such as inflation, currency exchange and international politics

This is where the need of management system becomes imperative to handle risk in efficient and effective manner.

Thompson and Perry (1992) have elaborated that the application of systematic risk management in construction projects has been recognized as an effective approach to minimizing risk impacts associated with projects. Thus it is vital to manage these risks merged in foreign funded construction project life cycle in order to achieve time, cost, and quality aspects of project.

2.6 Risk Management Process

Several authors have formulated different risk management approaches. Wang et al. (2004) described that a systematic approach to risk management in construction industry consists of three main stages as;

- Risk identification
- Risk analysis and evaluation
- Risk response

According to his explanation, risk management process begins with the initial identification of the relevant and potential risks associated with the construction project. It is of considerable importance since the process of risk analysis and response management may only be performed on identified potential risks. Risk analysis and evaluation is the intermediate process between risk identification and management. Similarly, Merna (2003) formulated risk management approach as shown in Figure 2.3 which is consisting of risk identification, risk analysis and risk response. Further he explained that the risk management system is dynamic and must be continuous over the project life cycle.

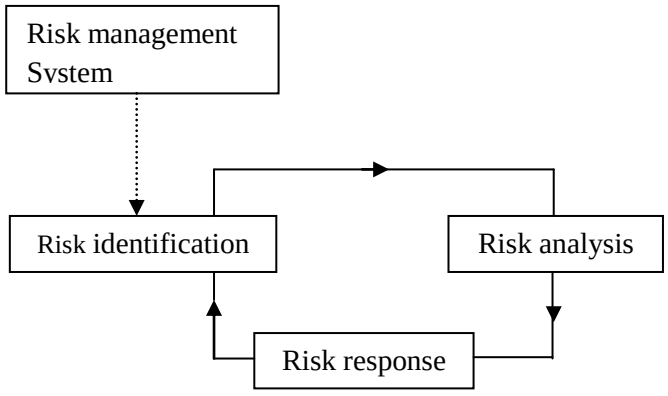

Figure 2.3: Risk management process

Source: Merna (2003)

According to the Flanagan and Norman (1993), process of risk management system was broken down into stages as risk identification, risk classification, risk analysis, risk attitudes and risk response. Figure 2.4 shows the sequence for dealing with risk.

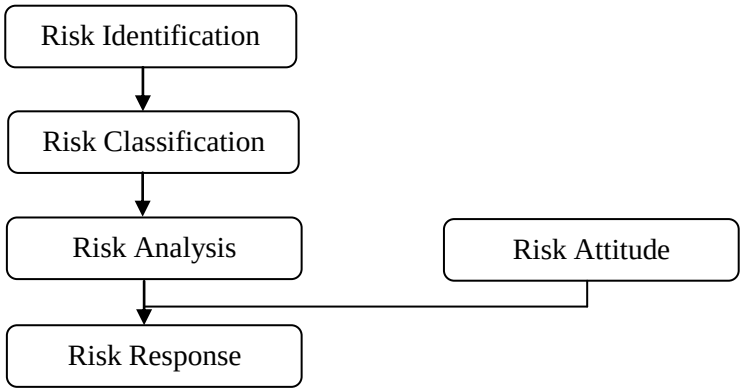

Figure 2.4: Risk management framework

Source: Flanagan and Norman (1993)

Schieg (2006) argued that risk management process consists of six stages and successfully installation in the project offers the chance to gain a clear understanding of the goals, duties and contents of the service and the feasibility of the project. The six stages are represented as follows in the Figure 2.5.

Figure 2.5: Elements of risk management

Source: Schieg (2006)

Further, Baker, Ponniah and Smith (1999)) has illustrated that comprehensive risk management process involved five steps as risk identification, risk estimation, risk evaluation, risk response and risk monitoring. If these five stages maintained properly, it yields a controlled risk environment. Moreover Tummala, Rao, Nkasu and Chuah (as cited in Tummala & Burchett, 1999) identified certain core elements in risk management process comprising with risk identification, risk measurement, risk assessment, risk evaluation, risk control and monitoring. However these approaches slightly differ from one another, one can identify certain core elements which are common all these approaches.

Many researches like Al-bahar and Crandall (1990); Dey (2001); Wang et al. (2004); Merna (2003); Raftery (1994) have also took three processes, comprising of risk identification, risk analysis and risk response.

For this research it has taken risk management process stated by above authors comprising of following stages as;

1. Risk identification
2. Risk analysis
3. Risk response

2.6.1 Risk Identification

Risk identification is the first stage of risk management process, in which potential risks associated with a construction project are, identified (Zou et al., 2007). Further it develops the basis for the next steps: analysis and control of risk management. To ensure the effective risk management, the identification process is very important; in fact, it is believed that the main benefits of risk management come from the identification rather than the analysis stage (Bajaj, Oluwoye & Lenard, 1997).

Al-Bahar and Crandall (as cited in Bajaj et al., 1997) defined risk identification as "the process of systematically and continuously identifying, categorizing, and assessing the initial significance of risks associated with a construction project".

Therefore this process reveals and determines the possible risks facing the resources of the organization (Tchankova, 2002). Consequently, risk identification must be carried in a way that is both forward-looking and in line with the progress of the project, since before the start of the project not all risks are completely recognizable and during the project implementation further risks may emerge Schieg (2006).

As mentioned above risk identification can be of considerable benefit, even if no other stages of risk management are undertaken (Smith, 2003). However it is a difficult task, because there are no unerring procedures which may be used to identify construction risks. It relies heavily on the experience and insight of the key project personnel (Bajaj et al., 1997). Raftery (1994) stated that analyst must be systematic, experienced and creative. The process of identified risks is carried out through the use of a variety of techniques suited to the type of project and resources available (Smith et al., 2006). Hillson (2002) has presented those techniques such as brainstorming and workshops, checklists and prompt lists, questionnaires and interviews, Delphi groups or Nominal Group Techniques, and various diagramming approaches (cause–effect diagrams, systems dynamics, influence diagrams, etc.). Furthermore he introduced three broader techniques like SWOT analysis, Constraints and assumptions analysis and Force field analysis to employ additional approaches to risk identification.

2.6.1.1 Construction Risks

Literature with regard to risks in foreign funded water supply projects is very limited. Therefore, an extensive literature survey was done with regard to the risks in construction projects in general and based on that risks related foreign funded water projects were identified.

El-Sayegh (2008) conducted survey to identify various risks associated with United Arab Emirates (UAE) construction industry and developed risk breakdown shown in Figure 2.6. According to the survey, he divided project risks into two groups as internal and external based on their source. Internal risks are those that are project related and usually fall under the control of the project management team. External risks are those risks that are beyond the control of the project management team (El-Sayegh, 2008).

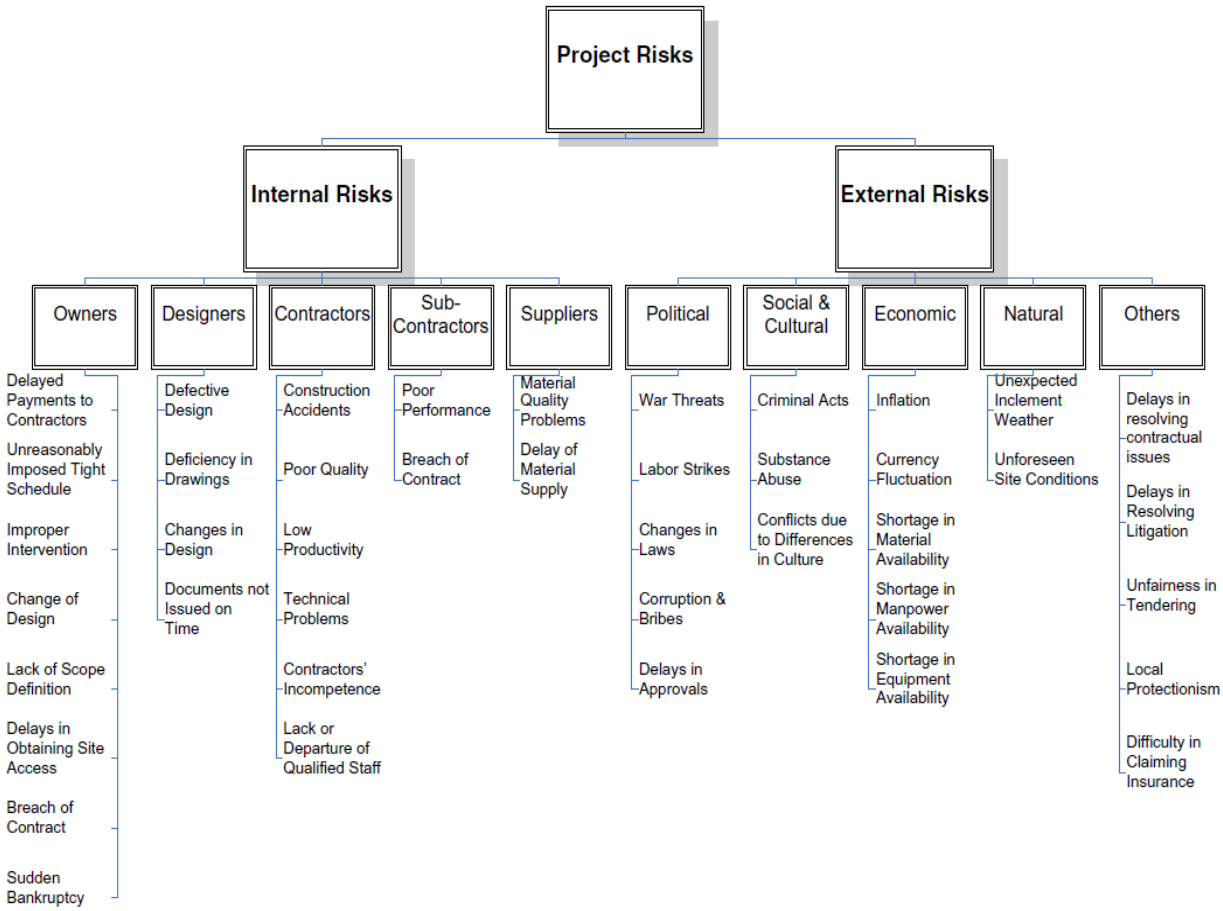

Figure 2.6: Risk breakdown structure

Source: El-Sayegh (2008)

According to El-Sayegh (2008) the internal risks include the risks of owners, designers, contractors, sub-contractors, and suppliers while the external risks include the risks of political, social and cultural, economic, natural and other risks (Figure 2.6).

In a case study done by Jaafari and Anderson (as cited in Mills, 2001) related to a design and construct contract project, the project risks were categorised into four groups namely: planning risks, design and construction risks, site related risks and market risks. The risks for each category are shown in Table 2.1.

Table 2.1: Project risk

Planning risk	**Design & Construction risk**	**Site related risk**	**Market risk**
Development approval	Quality of brief	Accessibility	Rental income
Building approval	Designer	Contaminated soil	Occupancy rate
LG contribution	Consultant's fees	Site flooding	Sale of building
	Design changes	Soil conditions	Yield
	Contracts & flaws		Interest rate
	Contractor performance		
	Subcontractor performance		
	Latent conditions		
	Inclement weather		
	Industrial disputes		
	Defective materials & workmanship		
	Expediting		
	Material shortage		
	Equipment & facilities		
	Poor quality control		
	Poor performance control		
	Neighbours		

Source: Jaafari and Anderson (as cited in Mills, 2001)

Edwards and Bowen (1998) categorized project and construction risks into natural and human risks using the risk source as a basis. Natural risks occur outside human agencies or systems, while human risks arise within humanly organized systems. This approach to risk categorization is illustrated in Figure 2.7.

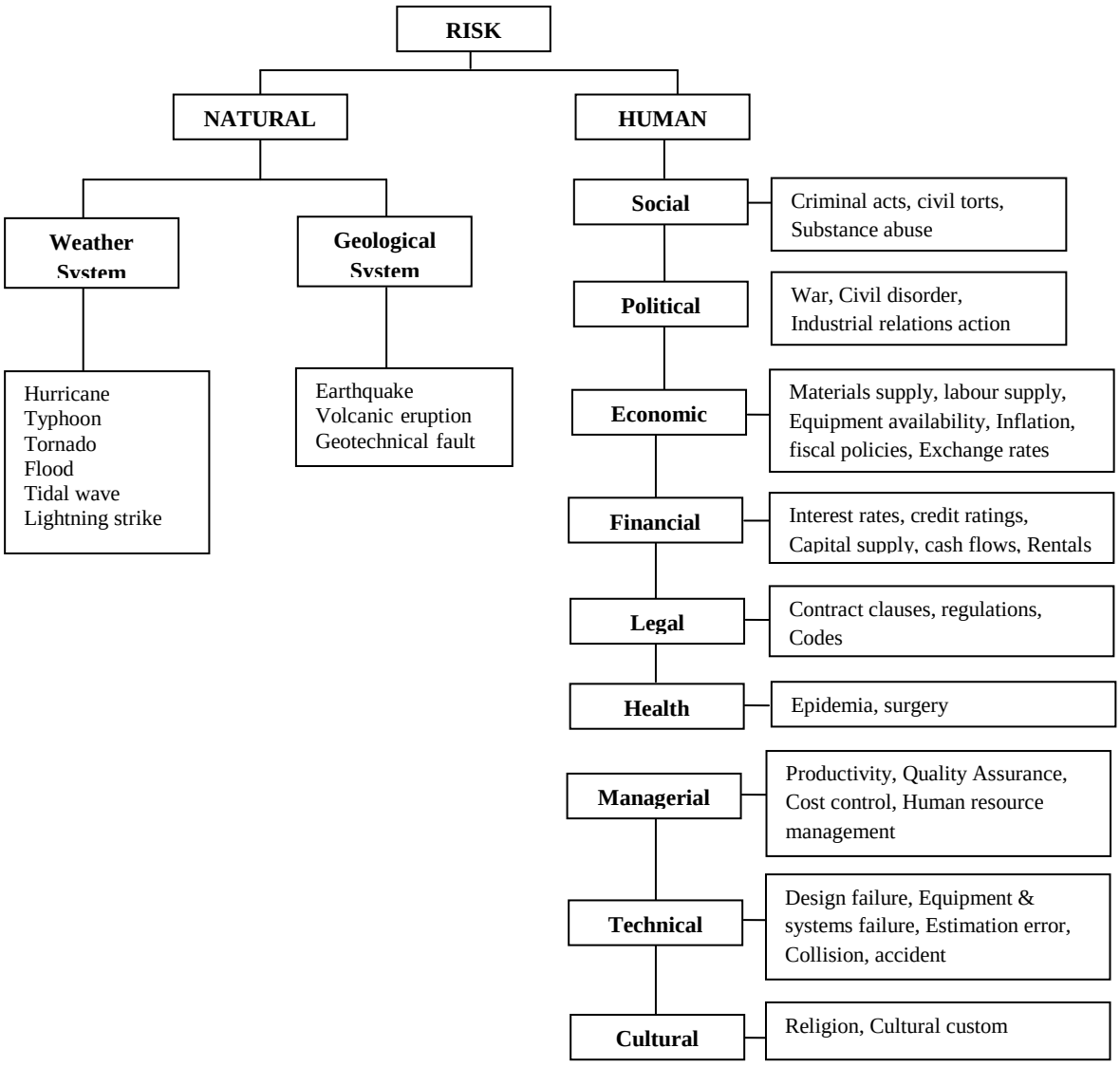

Figure 2.7: Categorized project and construction risks

Source: Edwards and Bowen (1998)

Mustafa and Al-Bahar (1991) proposed classification scheme that shows the different sources of risk in construction projects. The proposed classification scheme comprised with six risk categories such as acts of God risks; physical risks; financial and economical risks; political and environmental risks; design risks; job site-related risks. Risk classification scheme represented in Figure 2.8.

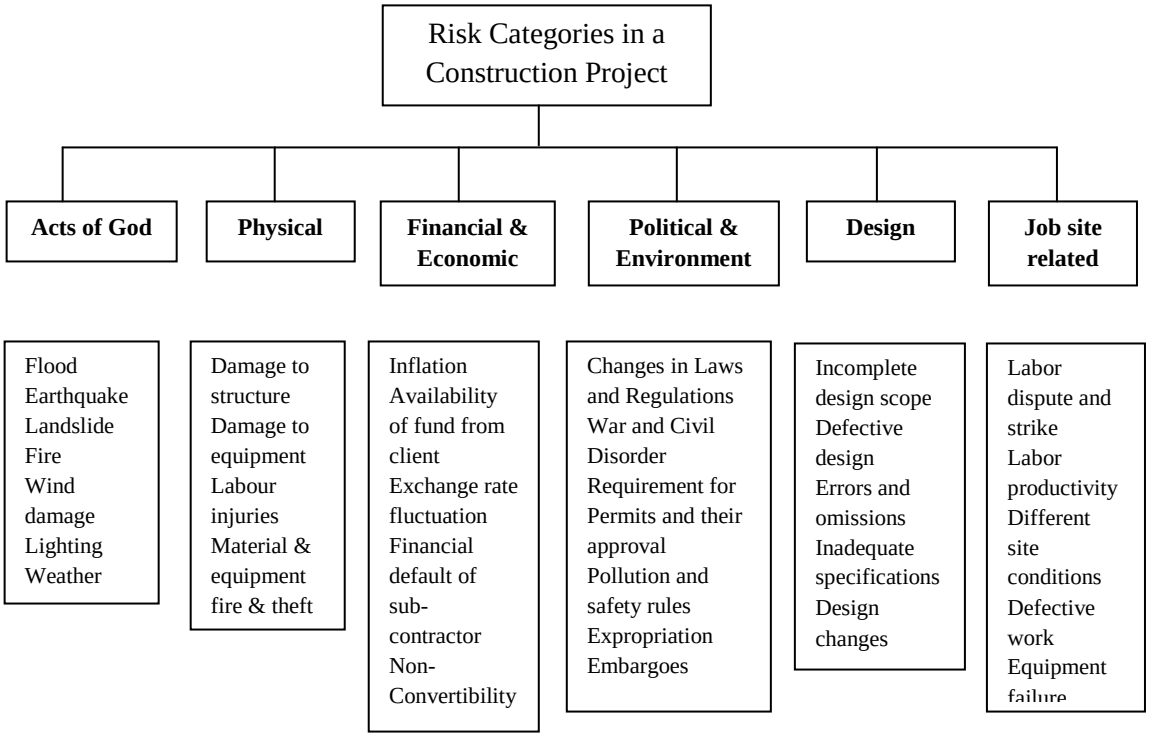

Figure 2.8: Risk classification scheme

Source: Mustafa and Al-Bahar (1991)

Tummala and Burchett (1999) did a similar classification of risks as above with regard to transmission line project. The categories of risks according to their study were: financial and economic, political and environment, design, site construction, physical and act of god.

Xu et al. (2011) identified and categorized the eleven critical risk factors affecting the PPP water projects and these risk factors were distilled and classified into three main categories as shown in Table 2.2.

Table 2.2: Risk classification in PPP water project

Macro level risk	Meso level risk	Micro level risk
Political risk	Market demand change risk	Inaccurate market forecast
Legal risk	Inflation risk	Contract risk
Government credit risk	Product price risk	Financing risk
		Supporting infrastructure risk
		Technical risk

Source: Adopted from Xu et al. (2011)

Further, Ashan and Gunawan (2010) have identified the major barriers to successful completion of ID projects related to lengthy procedure for contract evaluation and award, procurement delay, civil works and land acquisition delay, consultant recruitment delay, natural calamities and host country government procedures.

Since there are not many literature on risk of Foreign Funded (FF) water projects, available literature findings on risks of other construction projects can be considered for FF water projects due to the similarity of the construction project. Thus, by considering the classifications of various authors with regard to project risks, it can be classified the risks of the FF water projects as follows;

- Financial and economic risks
- Political and environmental related risks
- Managerial risks
- Technical risks
- Physical risks
- Acts of god
- Other risks

Financial and Economic Risks

Most risks which are associated with construction projects are financially related. Project funding is obviously a potential economic risk for contractors. Merna and Njiru (as cited in Bokharey, Vallyutham, Potty & Bakar, 2010) have defined financial risk as the impact on the financial performance of any entity exposed to risk. Inadequate sources of project funds by an owner or funding agent may create time delays and financing problems.

Based on the studies carried by Mustafa and Al-Bahar (1991) following risk factors were identified for FF water projects under financial and economic risk namely:

1. Inflation
2. Availability of fund from investor
3. Exchange rate fluctuation

Inflation and exchange rate fluctuation are two common situations in FF projects. Basically price escalation looked after by the price escalation formula under the standard forms of contracts (FIDIC, ICTAD etc). Sometimes the allocated financial contingency amount exceeded by the escalated amount.

Political and environmental related risks

According to the Mustafa and Al-Bahar (1991) political and environmental related risks may arise from the interactions between the contractor, the host government and the surrounding environment or society.

Following risk factors were extracted from the studies conducted by El-Sayegh (2008); Mustafa and Al-Bahar (1991); Tummala and Burchett (1999) and Xu et al. (2011) under the political and environmental related risks;

1. Change in laws and regulations
2. Requirement for permits and their approvals
3. Pollution

4. Political/ social instability
5. Corruption & bribes
6. Expropriation (Government takes private property)
7. Embargoes

In FF water projects, various approvals have to be taken with regard to environmental aspects and in co-ordination with other authorities. In view of the complex nature of the project, there had been instances where land had to be acquired and people had to be relocated whilst project implementation was in progress. The costs of land acquisition and compensation payments are having significant impact on cost. "political/social instability" and "corruption and bribes" also can be considered as relevant risk factors in FF water projects.

Managerial risk

Based on the studies on Kumaraswamy (as cited in Gamez, 2009) managerial risk referred to resource management to achieve cost, quality and time targets. Further Gamez (2009) extracted following managerial risk factors to his study by considering implementation agency's performance as a key element to project success.

1. Institutional changes
2. Procurement delay
3. Slow land acquisition by agency
4. Ineffective management of Agency
5. Local agencies miscommunication
6. Delay compiling data (Sponsor requirements) by agency
7. Limited implementation experience

Different stakeholders like host country finance ministry, executing agency, implementing agency etc are involved when implementing FF water projects. Therefore "institutional changes", "ineffective management of agency" "local agencies miscommunication" and "limited implementation experience" can be considered as relevant risk factors. "Procurement delay" means inability of

implementation agency to award contracts to designers, consultants or contractors in timely manner. This is a common occurrence in FF water projects as it is necessary to take funding agency concurrence to precede the project. On the other hand "delay in compiling data by agency" is common to FF water projects due to inadequate familiarity with sponsor's procurement guidelines and their requirements. Therefore, above factors were taken in to consideration for FF water projects.

Technical risk

Technical risk could be classified into design risk and construction related risks. The following technical related risks were identified based on the researches done by El-Sayegh (2008); Jaafari and Anderson (as cited in Mills, 2001); Mustafa and Al-Bahar (1991) and Tummala and Burchett (1999);

1. Incomplete design scope
2. Design changes
3. Design errors and omissions
4. Inadequate specification
5. Deficiency in drawing
6. Labour disputes and strikes
7. Defective work
8. Different site condition
9. Inappropriate technology selection
10. Contractors' incompetence
11. Lack or departure of qualified staff
12. Shortage in material availability
13. Shortage in manpower availability
14. Shortage in equipment availability

There are instances where the defined scope is not complete and additions to scope can occur. Further, water demand calculations are done without considering future expansion of water supply and drainage schemes. Therefore 'design changes', 'errors and omissions', 'inadequate specification' and 'defective design' are common in FF

water projects. On the other hand construction related risks like different site condition, contractors' incompetence, lack or departure of qualified staff and shortage of material, labour and equipment caused the negative impact of successful completion of FF projects.

Physical Risk

Mustafa and Al-Bahar (1991) have explained the physical risks which are associated with damage of a property or asset that the contractor owns or has under his possession.

Following risk factors were extracted from the studies conducted by Mustafa and Al-Bahar (1991) and Tummala and Burchett (1999) under the physical risks;

1. Damage to structure or property
2. Damage to equipment and material
3. Occupational safety and health issues
4. Theft

In FF water projects, especially when the construction work is ongoing, structure or property damage can occur. Even it is not common, theft is also a factor that should be considered as risk factor.

Act of God risk

The risk of acts of god describe events that are unpredictable and beyond anyone's direct control. These events occur as a result of nature and are often referred to as natural phenomena (Mustafa & Al-Bahar, 1991).

According to the literature, most of the authors like El-Sayegh (2008); Mustafa and Al-Bahar (1991) and Tummala and Burchett (1999) identified following risk factors under act of god;

1. Flood
2. Landside
3. Fire
4. Extreme weather condition

Other risks

In the study of El-Sayegh (2008) and Rahaman and Kumaraswamy (2002), it was mentioned some important risks that may affect to the successful completion of project. Therefore, following factors were considered under other risks category.

1. Delays in resolving contractual issues
2. Delays in resolving disputes
3. Delayed payments on contracts
4. Unfairness in tendering

2.6.2 Risk Analysis

Once the risks has been identified, it is important for perceived risks to be evaluated, decomposed, and subjected to some form of assessment in order to understand the magnitude of the risks facing the organization (Wyk, Bowen, & Akintoye, 2008). Thus, risk analysis and evaluation has become intermediate process between risk identification and response. It helps in estimating potential impacts of risk and in making decisions regarding which risks to retain and which risks transferring to other parties (Ahmed & Azhar, 2004).

Thompson and Perry (1992) suggested that risk analysis can be done in qualitative and quantitative manner. Figure 2.9 shows the available techniques for both qualitative and quantitative risk analysis.

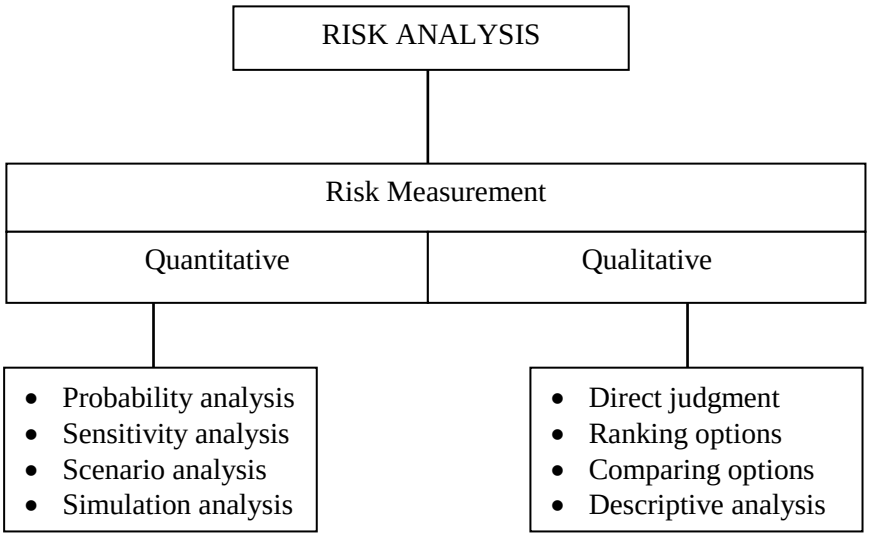

Figure 2.9: Various risk analysis techniques

Source: Ward and Chapman, (1997)

The quantitative methods rely on probability distribution of risks and may give more objective results than the qualitative methods, if sufficient current data is available. On the other hand, qualitative methods depend on the personal judgment and past experiences of the analyst and the results may vary from person to person (Chapman & Ward, 2003).

It is important to note that the choice of method to be used should be governed by the appropriateness to the project and the circumstances at the time of undertaking the risk analysis (Smith et al., 2006). According to the Thompson and Perry (1992), the choice of risk analysis technique to be used will depend upon following factors;

- The type and size of project
- The information available
- The cost of the analysis and the time available to carry it out
- The experience and expertise of the analysts

Flanagan and Norman (1993) have been proposed six-step approach for a systematic risk analysis as shown in following Figure 2.10.

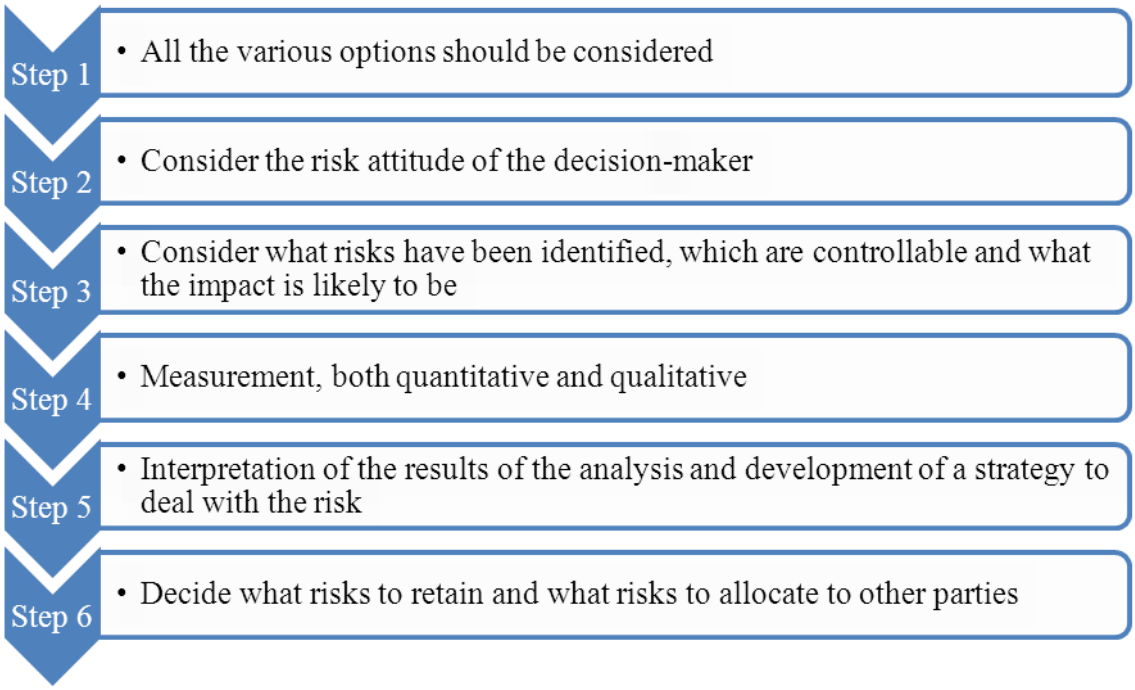

Figure 2.10: Systematic risk analysis approach

Source: Flanagan and Norman (1993)

By carrying out a risk analysis, the possible effects of risks occurring can be seen in terms of the project outcome (Smith, 1999). Hence, the process of analysis risk is vital as it gives an understanding and awareness of the impact of risks on problems.

2.6.3 Risk Response

Once the risks of a project have been identified and analysed, an appropriate risk response strategies must be adopted to deal with the risks in the project implementation (Zou et al., 2007). Risk handling/response process identifies, evaluates, selects, and implements strategies in order to reduce the likelihood of occurrence of risk events and/or lower the negative impact of those risks to an acceptable level (Fan, Lin & Sheu, 2008). Similarly, PMI (2004) elaborated that the risk response planning is the process of developing options, and determining actions to enhance opportunities and reduce threats to the project's objectives. It follows the qualitative and quantitative risk analysis process (PMI, 2004). Planned risk responses

must be appropriate to the significance of the risk, cost effective, timely, and realistic within the project context, agreed upon by all parties involved, and owned by a responsible person (Bakr, Hagla, & Rawash, 2012). Further, Fan et al. (2008) stated that the risk response process includes the documentation of which actions should be taken, when they should be taken, who is responsible, and the associated handling costs. Thus, risk response planning phase exists to develop responses to identified risks which are appropriate, achievable and affordable (Hillson, 2002).

In the literature of risk management, several risk response strategies are available. Accordingly, most commonly identified risk response techniques are;

- Risk avoidance
- Risk transfer
- Risk retention
- Risk mitigation

Risk Avoidance

According to the PMI (2004), risk avoidance involves changing the project management plan to eliminate the threat posed by an adverse risk, to isolate the project objectives from the risk's impact, or to relax the objective that is in jeopardy, such as a contractor not placing a bid or the owner not proceeding with project funding, or extending the schedule or reducing scope.

Risk Transfer

Risk transfer is seeking to move the consequence of a risk to a third party together with ownership of the response (Burtonshaw-Gunn, 2009). Transferring the risk does not eliminate it; it simple gives another party responsible for its management.

This is the most effective way of dealing with financial risk exposure. Risk transference nearly always involves payment of a risk premium to the party taking on the risk. Transference tools can be quite diverse and include, but are not limited to, the use of insurance, performance bonds, warranties, guarantees, etc. Contracts may be used to transfer liability for specified risks to another party PMI (2004).

Risk Mitigate

Risk mitigation implies reducing the size of the risk in order to make it more acceptable to the project or organisation, by reducing the probability and/or the impact (Hillson, 2002). It is a technique within the overall risk management process, and is confined to the improvements of a company's physical, procedural, educational, and training devices (Ahmed & Azar, 2004). Thus, taking early action to reduce the probability and/or impact of a risk occurring on the project is often more effective than trying to repair the damage after the risk has occurred PMI (2004). Adopting less complex processes, conducting more tests, or choosing a more stable supplier are examples of mitigation actions.

Risk Acceptance

The acceptance strategy is adopted in situations where it is impossible to eliminate all risk from a project or is unable to identify any other suitable response strategy. It may be adopted for either threats or opportunities (PMI, 2004). In some situations, the only option available is to retain a risk. The party that is holding a risk might be the only one that can manage the risk or accept the consequences should the risk be realised. This strategy can be either passive or active (Baker et al., 2010). While passive acceptance requires no action, leaving the project team to deal with the risk as they occur, active acceptance may require deliberate management strategy like developing contingency plan to handling with risks (Baker et al., 2010).

2.7 Foreign Funded Water Projects in Sri Lanka

Water has always played an essential role in human societies while providing important economic, health, and environmental benefits. Therefore development activities in the water sector are essential to upgrade the socio-economic standards of beneficiaries. The demand for pipe borne water has increased significantly in line with rapid expansion in commercial and industrial activities and urbanisation.

The water supply and drainage functions are carried out by the National Water Supply & Drainage Board which functions under the Ministry of Water Supply &

Drainage. This ministry was established in 2007 separately for the subject area of water supply & drainage. The National Water Supply & Drainage Board had its beginning as a sub department under the public works department with responsibility for water supply and drainage systems of Sri Lanka. From 1965, it functioned as a division under various ministries until January 1975 when it was converted to a Statutory Board by an Act of Parliament.

There are 312 major, minor and small water supply schemes in operation under the NWS&DBs' purview. According to the statistics, 84.1% of the population has safe access to drinking water of which 43.5% is through piped water supply system (NWS&DB, 2011).

The NWSDB was provided with Rs. 19,484 million as foreign funds for capital works on water supply and sewerage projects (NWS&DB, 2011). The GOSL contribution was Rs. 7,148 million as counterpart funds (NWS&DB, 2011). In addition, Rs. 2,050 million of local consolidated funds were allocated for small and medium water supply projects (NWS&DB, 2011). For the reconstruction of tsunami affected water supply systems, a sum of Rs. 881 million in foreign funds and Rs. 275 million in local counterpart funds were provided. Following Figure 2.11 represent the fund allocation made by donors and related GOSL.

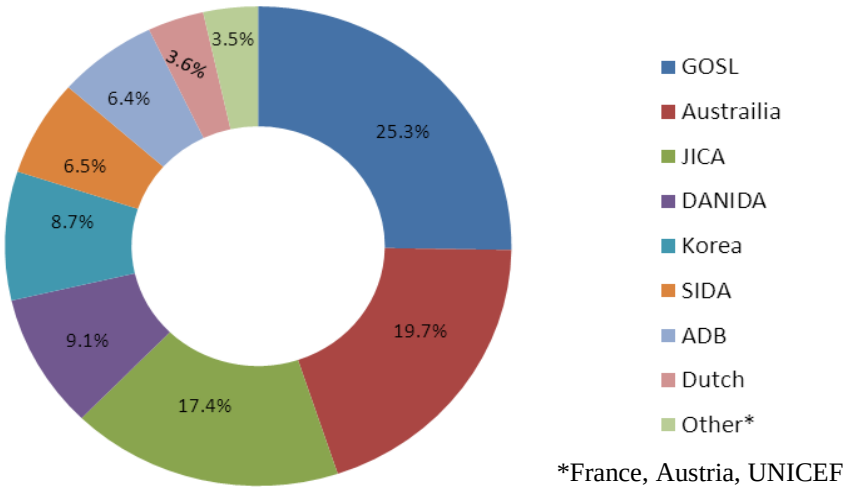

Figure 2.11: Fund allocation in NW&DB

Source: NWS&DB (2011)

The total estimated cost for foreign funded projects during last 10 years can be summarized as follows;

Table 2.3: Foreign funded water projects

Funding Agency	Project Name	Total Estimated Cost Rs. in Mn
JICA	Greater Kandy Water Supply Project Phase I Stage II	1,464
	Kaluganga Water Supply Project Phase I – Stage II & Non Revenue Water Reduction in Colombo City	10,846
	Towns North of Colombo Water Supply Project Stage II	6,490
	Greater Colombo Water Rehabilitation Project	4,785
	Eastern Province Water Supply Development	6,526
	Anuradhapura North Water Supply Project	11,515
	Kilinochchi Water Supply Rehabilitation Project	1,823
ADB	Secondary Town & Rural Community Based Water Supply & Sanitation Project	29,680
	Dry Zone urban Water and Sanitation Project	20,743
	Jaffna Peninsula Water Supply & Sanitation	18,328
	Colombo Water Supply & Service Improvement Project	28,800
DANIDA	Towns South of Kandy Water Supply Project	9,626
	Nuwara-eliya District Group Water Supply Project	4,269
	Kelani Right Bank WTP Project	10,150
Australia	Eastern Coastal Towns of Ampara WS Phase II	11,078
	Eastern Coastal Towns of Ampara District Water Supply Project-Stage III	18,012
Spanish	Water treatment facility for Moratuwa, Panadura and Negambo	2,690

Funding Agency	Project Name	Total Estimated Cost Rs. in Mn
Korea	Kirindi Oya Water Supply Project	2,105
	Ruhunupura Water Supply Development Project Stage I	13,131
Netherlands	Augmentation of Negambo WSP	7,288
French Development Agency	Franced Funded Tsunami Project	4,220
Belgium	Kolonna & Balangoda Water Supply Project	4,658
India	Greater Dambulla Water Supply Project	9,593
Spain	Greater Ratnerpura Water Supply Project	9,928
Unicredit Bank, Austria AG	Mahiyangana Water Supply Project	2,744
Export Bank of the United States & HNB	Implementation of Badulla, Haliela & Ella Integrated Water Supply Project	10,397
Hungarian	Labugama-Kalatuwawa Treatment Plants Rehabilitation Project	7,302

Source: NWS&DB

When taking into consideration of above information, it is proved that most of water projects are financed by foreign funding agencies.

However it is noted that the most of the FF water projects encountered schedule delays and cost over runs due to the various reasons. The major causes of delays are related to host country government procedures, lengthy contract and procurement, land acquisition, construction works and natural calamities. On the other hand costs over runs are occurred due to the price escalations, physical changes to original scope and changes in laws and regulations. Therefore it is imperative to identify and understand the impact of the inherent risks in order to implement appropriate risk response strategies to cope with them.

2.8 Summary

Risk is inherent in any construction project and none of project can find out without risk circumstances. Therefore it is required formal risk management process to manage all type of risks involve in project. Thus, risk management is a systematical process of identifying, analyzing and responding to risk events throughout the life cycle of a project to obtain the optimum or acceptable degree of risk elimination or control. In practice, there are various approaches to risk management. However the fundamental steps involve in risk management are risk identification, risk analysis and risk response.

In order to manage the risk properly, risk identification is the first stage of risk management process. Then those identified risk may be analysed and an appropriate response can be determined. Mainly, there are four categories of risk response measures: risk avoidance, risk transfer, risk retention and risk mitigation.

In this chapter, it has been identified seven categories of risk related to foreign funded water projects namely financial & economic risks, political and environmental related risks, managerial related risks, technical risks, physical risks, acts of god and other risks.

CHAPTER 03

RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the methodology adopted for this research study. It illustrates the research process and subsequently describes the research design including research approach, data collection and analyzing techniques in detail.

3.2 Research Process

Research process consists of a series of steps in the desired sequence that is necessary for the effective execution the research (Kothari, 2004). Research process for this particular research illustrates using following Figure 3.1.

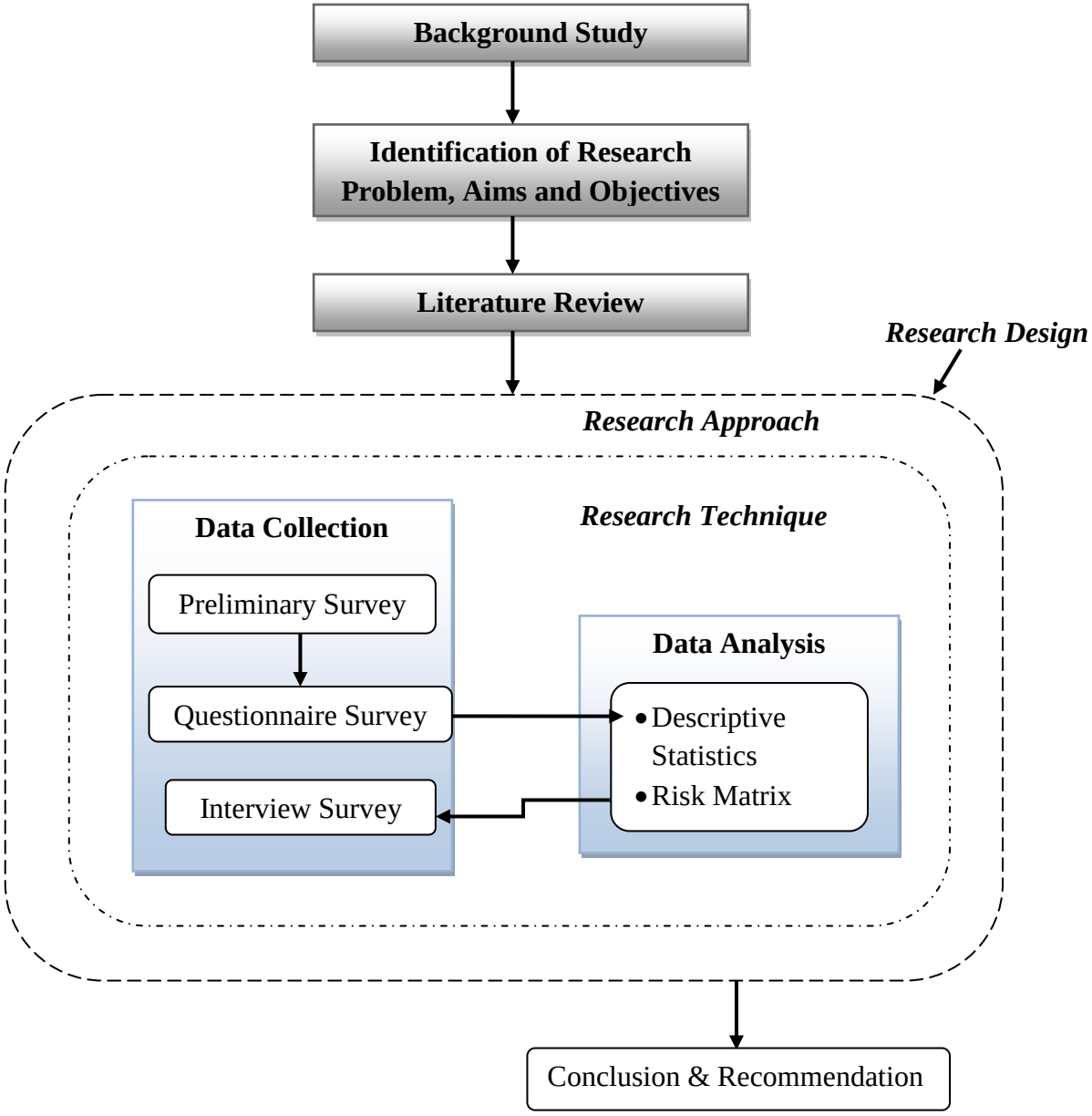

Figure 3.1: Research Process

3.3 Research Design

Research design set up systematic procedure to address the research problems as unambiguously as possible. It may be either quantitative approach with emphasize on gathering of numerical data and focus on numbers or qualitative approach with emphasize on analysis of complex data in terms of its content or native interpretation (Taylor, 2010). The following sections describe the research design of this research study.

3.3.1 Research approach

Research approaches are classified mainly into two categories namely quantitative approach and qualitative approach. Survey researches and experimental researches are coming under quantitative approach where case study, ethnography, action research and grounded theory approach can be taken under qualitative approaches (Taylor, 2010).

By considering the nature of research problem, it is obviously important to identify the significant risk factors affecting to the FF water projects in Sri Lanka and identify risk response measures to overcome such risks. Therefore, survey research approach was selected as the most appropriate for this research study. It involves collecting data from a fraction of population (sample) and generalising the findings to the population with quantitative descriptions (Kraemer, 2002).

3.3.1.1 Survey approach

According to Yin (2009), research problem is the leading criterion of selecting among the various types of research approaches. Kraemer (2002) stated that survey research is especially well-suited for answering questions about "what", "how much" and "how many". In addition he mentioned that the survey approach is appropriate when:

a) the independent and dependent variables are not possible or not desirable to control
b) the phenomena should be studied in its natural setting
c) the phenomenon which is studied is occurring or has occurred in the recent past.

According to the research problem, it was significant to quantitatively investigate and identify risk factors which are affecting to the FF water projects and figure out risk response measures to overcome the problems. Above mention characteristics of survey approach are consistent with the characteristics of this research proving that survey approach is suitable to this research.

Accordingly, it was decided to carry out a questionnaire survey to find out the risk factors with related to the FF water projects. Following the analysis of questionnaire, interviews were designed to carry out with individual experts in order to confirm the questionnaire survey findings and to find out the risk response measures for each critical risk factor.

3.3.2 Data collection

3.3.2.1 Preliminary survey

After preparing the draft questionnaire based on the literature findings, a preliminary survey was conducted in order to find out the current prevailing condition of the risk in foreign funded water projects and to identify risk factors relate to foreign funded water projects other than factors identified by the literature survey. For the fulfillment of objectives of the research five experts over 15 years' experience were selected in the field of FF water projects and identified risk factors from the literature survey were discussed with them and from their opinion most relevant risk factors in the Sri Lankan context were identified.

Identified risk factors which are relevant to Sri Lankan context are listed in below Table 3.1;

Table 3.1 : Risk factors with relate to FF water projects in Sri Lanka

Risk Category	Risk Factors
Financial & Economic Risks	Inflation
	Exchange rate fluctuation
	Loan interest
	Availability of funds
	Lack of counter-part funds or delay in allocation
	Disbursement difficulties

Risk Category	Risk Factors
Political & Environmental Risks	Change in laws and regulations
	Requirement for permits and their approvals
	Change in country priority (*when the government changes the priorities or lose the motivation to keep supporting the project*)
	Pollution *(Environmental policies)*
	Political/social instability (*civil unrest, strikes ec)*
	Corruption & bribes
	Expropriation (*Government take private property*)
	Embargoes (*Trade barriers*)
Managerial Risk	Institutional changes (*Restructuring of implementing agencies, key staff, changes in ministries and coordination personnel*)
	Slow land acquisition by agency
	Procurement delay (*Inability of implementation agency to award contracts to designers, consultants or contractors in a timely manner)*
	Ineffective management of Agency (*lack of effective leadership, weak administrative capacity; poor monitoring, poor financial management and accountability of agency staff*)
	Local agencies miscommunication *(Disconnect between agencies in the host country, creating either duplication and conflicting efforts, or areas with lack of responsible party)*
	Delay compiling data (Sponsor requirements) by agency *(Inadequate familiarity with sponsor's procurement guidelines. Problems with progress reports, performance indicators, insufficient understanding of loan system etc.)*
	Limited implementation experience (*Lack of experience in international bidding process and contracting, Inexperience staff employed*)

Risk Category	Risk Factors
Technical Risk	Incomplete design scope
	Design changes
	Design errors and omissions
	Inadequacy of specifications
	Deficiency in drawing
	Labour disputes and strikes
	Defective work
	Different site condition
	Technology selection
	Contractor incompetence
	Lack or departure of qualified staff
	Shortage in material availability
	Shortage in manpower availability
	Shortage in equipment availability
Physical Risk	Damage to structure or property
	Damage to equipment & material
	Labour injuries & death
	Equipment damage
	Theft
Act of God	Flood
	Landslide
	Fire
	Extreme weather condition
Other Risks	Delays in resolving contractual issues
	Delays in resolving disputes
	Delayed payments on contracts
	Unfairness in tendering

The other task of the preliminary survey was to identify the risk response measures practiced in Sri Lanka. The identified risk response measures through the literature survey categorized under risk avoidance, risk transfer, risk retention and risk mitigation. Those response measures were discussed with respondents and listed below in Table 3.2.

Table 3.2 : Risk response measures

Risk Transfer	**Risk Retention**
Transfer risk to contractor	Accept the risk at risk
Transfer risk to insurance company	Accept the risk and have a contingency plan
Risk Avoidance	**Risk Mitigation**
Placing conditions on bid	Adhere to proper design norms
Plan alternative methods/options as stand-by	Adhere to proper construction practices
Pre bid negotiations	Adhere to proper site management practices
Reducing scope	Personnel training and education
Extending the schedule	Physical protection to reduce risk
Assigning more talented resources to ensure the project completion	Detailed site investigation reports submitted with the bid document
Make proper time estimation and produce a proper programme by referring to previous and ongoing similar projects	Brainstorming to identify new risks
	Review of scope
	Adopting less complex processes
	Provide close supervision to subordinates
	Coordinate closely with contractors
	Thorough review of specification

3.3.2.2 Questionnaire survey

Target population

The target population for this research study is professionals from client's side including Project Managers, Engineers and Quantity Surveyors who have been participated in foreign funded water projects in Sri Lanka.

Sample selection

The sample for the survey was selected randomly from the list of project managers, engineers and quantity surveyors who are involved in foreign funded water projects. The contacts for these professionals were collected from Water Supply Project Unit of National Water Supply and Drainage Board.

This research study approached to the key persons

- having more than 10 years of experience,
- have been involved in foreign funded water projects

Sample size

The sample size is very important in reflecting the characteristics of the population and in order to use parametric statistics, the size of the sample must be sufficiently large (Taylor, 2010). As thumb rule, it should be at least 30. By considering all these factors and the time limitation the sample size of this research study was 40 selected from project managers, engineers and quantity surveyors in FF water projects.

Questionnaire design

The list of relevant risk factors for FF water projects was developed based on the detailed literature review and preliminary survey. Then, the questionnaire was structured to get the owners' perception with relate to foreign funded water projects in Sri Lanka.

The questionnaire consisted of three sections namely 'Section A', 'Section B' and 'Section C'.

Section A – Demographic characteristics

The Section A was intended to gather information about the respondents' profile. Accordingly, the questions asked in this section includes the respondent name (Q1), respondent designation (Q2), respondent experience in construction industry (Q3) and years of experience in foreign funded project (Q4).

Section B – Impact and probability of risk

The Section B was designed to gather perception on the rating of each risk factors regarding probability of occurrence and impact on foreign funded water projects. The questionnaires have used 5 point Likert Scale where 1- Very Low, 2-Low, 3-Medium, 4-High and 5-Very High.

Section C – Risk response measures

In Section C of the questionnaire, the respondents were asked to rate the effectiveness of usage of risk response measures identified in literature review and preliminary survey by using 5 point Likert Scale where 1- Very Low, 2-Low, 3-Medium, 4-High and 5-Very High.

Conducting the questionnaire survey

The final questionnaire was delivered to professionals associated with FF water projects by hand as well as through electronic mail. The completed responses were collected by personally and received through emails and regular postal mails.

3.3.2.3 Interview survey

Following the analysis of questionnaire survey, an interview survey was conducted in order to ensure the risk response measures for most significant risk events identified in FF water projects. The interviews were conducted in un-structured type. As effectiveness of risk response measures were identified from Section C of the

questionnaire survey, interviews were conducted to further confirm the risk response measures. The number of interviews was decided based on the accomplishment of the research objective and the time limitation. Accordingly, the three numbers of interviews were conducted.

Selection of interviewees

The interviewees were selected according to the following selection criteria.

- Experts to have more than 25 years of experience in water projects
- Experts to have extensive working experience in foreign funded water projects

3.3.3 Data analysis

3.3.3.1 Reliability calculation of used data

Cronbach's alpaha

In statistic cronbach's alpha is used to assess the internal consistency or reliability of a psychometric test score for sample of respondents (www.en.wikipedia.org, 2015; Garson, 2002).

$$\alpha = \frac{K\bar{c}}{(\bar{v} + (K-1)\bar{c})}$$

Where;

K - number of components (items or testlets)
$\bar{v}$ - average variance of each component (item)
$\bar{c}$ - average of all covariance between the components across the current sample of persons

A commonly accepted rule of thumb for describing internal consistency is as follows;

Table 3.3: Internal Consistency - Cronbach's alpha

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

Source: www.en.wikipedia.org (2015)

To find out the internal consistency of data, cronbach's alpha was calculated using SPSS (Statistical Package for Social Science) version 21.

3.3.3.2 Identification of critical risk factors

Descriptive analysis

Descriptive statistics involves the arrangement, summary, and presentation of data, to enable meaningful interpretation, and to support decision making through graphical techniques such as graphs, charts, percentages, tables and descriptive measures including mode, median, mean, range etc (Taylor, 2010).

Section A (demographic characteristics) of the questionnaire was analysed using graphical analysis techniques. The used technique was pie chart.

Mean Score Method

Mean score method was used to compute the risk of each factor. The formula used for this method is as follows (Tiware & Kulkarni, 2013);

Mean Score = Σ (f * s / N)

Where, f - frequency of the respondent
s - score given by the respondent
N - total number of responses

Accordingly above formula was adopted to analyse the Section B of the questionnaire to find the mean score of each risk factor's probability and impact.

Risk matrix

Risk matrix is defined as "a mechanism to characterize and rank process risks that are typically identified through one or more multifunctional reviews" (Markowski & Mannan, 2008).

Risk matrices are used to rank the risk events by using 4x4 or 5x5 matrices having event consequences along one axis and event frequency along the other axis (Elmontsri, 2014). According to the Panthi, Ahmed and Azhar (n.d) risk matrix is an effective to develop risk response strategies when risk events have been identified and assessed based on the probability and the impact. Further it helps one to get insight into the relative risk of various scenarios that might be encountered in a considered system.

According to the Ristic (2013) an effective risk matrices have following characteristic.

- Simple to use
- Easy to understand and can get a clear idea of its applicability
- No need to worry about extensive knowledge of quantitative risk analysis methods
- Clearly defined tolerable and intolerable risk level
- Provide clear guidance to take action in order to mitigate the intolerable risk levels into tolerable risk level

Following Figure 3.2 shows the standard 5x5 risk matrix with impact ranging from VL (Very Low) to VH (Very High) on the horizontal axis and probability from VL to VH on the vertical axis which is used to determine the risk zone for each risk factor where the probability and impact are combined to be able to prioritize risk (Tiware & Kulkarni, 2013). Similar kind of matrix has been used by Mahamid (2011) in his study to rank the risk factors affecting time delay in road construction projects.

Impact

Probability	Very low (1)	Low (2)	Medium (3)	High (4)	Very High (5)
Very low (1)	1	2	3	4	5
Low (2)	2	4	6	8	10
Medium (3)	3	6	9	12	15
High (4)	4	8	12	16	20
Very High (5)	5	10	15	20	25

Figure 3.2: Risk Matrix

Source: Tiware & Kulkarni (2013)

Once the mean score was calculated to obtain the impact and probability score of a risk, a score is assigned to that risk, multiplying the impact by the probability. Following scale (Table 3.4) used to determine the impact of each risk factor and its probability of occurrence towards the FF water projects.

Table 3.4: Scale used to identify risk factor's impact and probability

Scale	**Priority Level**	**Risk Zone**
1 – 3	Low Risk	Green
4– 6	Moderate Risk	Yellow
8 – 12	High Risk	Orange
15 – 25	Extreme Risk	Red

In above matrix there are four zones and these zones (Figure 3.3) having following characteristic (Mahamid, 2011).

Green zone	-	Risks in this zones are low level, and can be ignored
Yellow zone	-	Risks in this zone are of average and can cope with some reasonable steps and developing risk management strategies in time, even though there is no hurry to eliminate those risks early.
Orange zone	-	Risks in this zone are of moderate importance and call for immediate action or risk management strategies. If these issues cannot be resolved immediately, strict timelines must be established to ensure that these issues get resolved before the create hurdles in the progress.
Red zone	-	Risks in this zone are of critical importance. These are the top priorities, and are risk that a close attention should be paid to them.

Figure 3.3 : Risk zones

3.3.3.3 Identification of effectiveness of risk response measures

Relative importance index

Relative importance index (RII) was used to establish the relative importance of risk response measures identified with relate to the FF water projects. The RII for each risk response was calculated using following equation (El-Sayegh, 2008).

$$\text{Relative importance index, RII} = \frac{\sum_{i=1}^{5} WiXi}{\sum_{i=1}^{5} Xi}$$

Where;

Wi - weight assigned to the *i*th response; *Wi=1,2,3,4* and *5* for *i=1,2,3,4* and *5* respectively.

Xi - frequency of the *i*th response

i -response category index; *i = 1,2,3,4* and *5* for very low, low, medium, high and very high, respectively.

The relative importance index for all the risk response measures were calculated using the equation above and rank the responses accordingly.

3.4 Summary

This chapter described and justified the research methodology adopted to achieve the aim and objectives of study. Through an extensive literature survey, it was studied the risk factors and risk response measures with relate to the foreign funded projects. Identified risk factors from the literature survey were further discussed with experts of FF water projects having experience over 15 years and the risk response measures were also identified.

The research methodology used was survey approach with data collection through questionnaire survey and unstructured interviews for further confirmation of results. The reliability of collected data was tested by using cronbach's alpha. Mean score method and risk matrix was used to identify the critical risk factors with relate to FF water projects. And effectiveness of risk response measures was analyzed by using RII method.

CHAPTER 04

DATA ANALYSIS AND RESULTS

4.1 Introduction

The previous chapter three described the research methodology adopted for collecting and analyzing data. This chapter analyses the collected data of the questionnaire survey in accordance with the aforesaid methodology.

This chapter contains main five sections. First section summarizes the findings of the preliminary survey. Second section is for the analysis of respondent information in questionnaire survey. Next section includes the analysis of probability and impact of each risk factors using risk matrix to identify the predominant risk factors with relate to foreign funded water projects. Fourth section analyzes the risk response measures and last section confirms the questionnaire findings through literature and expert review.

4.2 The Questionnaire Survey

4.2.1 Response rate

The questionnaire survey was carried out by delivering forty (40) questionnaires to project managers, engineers, quantity surveyors who were selected as mentioned in section 3.3.2.2 (Questionnaire survey). Out of 40 distributed questionnaires, thirty-four (34) questionnaires were returned however, one of them was not properly completed, thus only 33 were used for the analysis. As illustrated in Figure 4.1, the response rate of reasonably completed questionnaires is 82.5%.

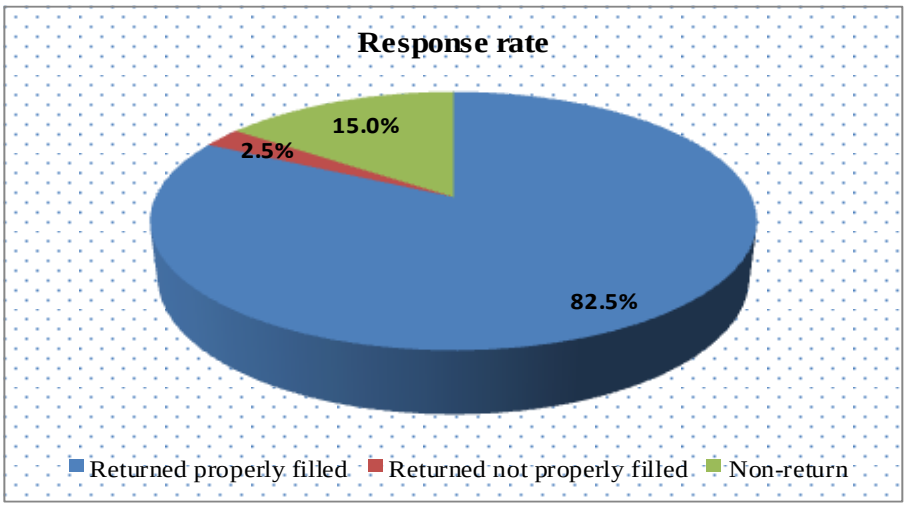

Figure 4.1: Response rate

4.2.2 Reliability of the used data

As explained in previous chapter Cronbach's Alpha was calculated using SPSS for measure the internal consistency (reliability) of the data set collected from the questionnaire survey. Cronbach's alpha was calculated separately for probability of occurrence and impact of risk factors. Summary of the test results are shown in following Table 4.1.

Table 4.1 : Reliability test result summary for probability of occurrences and impact

Reliability Statistics

	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
Probability of occurrences	0.931	0.933	49
Impact	0.933	0.935	49

According to the above test results both Cronbach's alpha values are greater than 0.9. Gliem and Gliem (2003) mentioned if the Cronbach's alpha coefficient is closer to 1.0 gives the greater internal consistency of the items in scale.

4.3 The Interview Survey

4.3.1 Interviewee Information

The detail of the interviewees participated in the interview survey is indicated in Table 4.2 below.

Table 4.2: Detail of the interviewees

Interview number	Designation of the interviewee	Years of experience of the interviewee	Number of FF water projects involved
Interview I	Deputy General Manager	30 years	10
Interview II	Deputy General Manager	28 years	5
Interview III	Assistant General Manager	30 years	6

4.4 Critical Risk Factors in Foreign Funded Water Projects

Based on the survey results, mean score was calculated for each risk factor based on probability of occurrence and impact. Once the mean score was calculated to obtain the impact and probability score of a risk, a score is assigned in the risk matrix, multiplying the impact by the probability. Risk factors were then plotted in a risk matrix chart as mentioned in section 3.3.3.2. The results are presented in following tables and figures.

4.4.1 Financial & economic risks

Table 4.3 indicates the risk score for factors under financial and economic risk category where six factors are considered under this group.

Table 4.3: Risk score of financial and economic risks

No	Risk Factor	Probability	Impact	Risk Score
		Mean Score (P)	Mean Score (Q)	Mean Score (P x Q)
R1	Inflation	4	4	16
R2	Exchange rate fluctuation	4	4	16
R3	Loan interest	2	3	6
R4	Availability of funds	2	3	6
R5	Lack of counter-part funds or delay in allocation	3	5	15
R6	Disbursement difficulties	2	3	6

Following Table 4.4 and Figure 4.2 illustrated the risk matrix for above factors. The results indicate that three factors are located in the yellow zone and three factors are located in red zone.

Table 4.4: Risk matrix for factors under financial and economic risks

Probability	Very low (1)	Low (2)	Medium (3)	High (4)	Very High (5)
Very low (1)					
Low (2)			R3, R4, R6		
Medium (3)					R5
High (4)				R1, R2	
Very High (5)					

Impact

Low Risk		
Moderate Risk	-	R3 - Loan interest R4 - Availability of funds R6 - Disbursement difficulties
High Risk	-	
Extreme Risk	-	R1 - Inflation R2 - Exchange rate fluctuation R5 - Lack of counter-part funds or delay in allocation

Figure 4.2: Risk zones for factors under financial and economic risks

4.4.2 Political & environmental risks

Table 4.5 indicates the risk score for factors under political & environmental risk category where eight factors are considered under this group.

Table 4.5: Risk matrix for factors under political & environmental risks

No	Risk Factor	Probability	Impact	Risk Score
		Mean Score (P)	Mean Score (Q)	Mean Score (P x Q)
R7	Change in laws and regulations of the host country	4	4	16
R8	Changes in laws and regulations in foreign policies	2	3	6
R9	Requirement for permits and their approvals	4	4	16
R10	Change in country priority	2	3	6
R11	Pollution	4	4	16
R12	Political/social instability	3	3	9
R13	Corruption & bribes	3	3	9
R14	Expropriation	3	4	12
R15	Embargoes	1	2	2

Following Table 4.6 and Figure 4.3 illustrated the risk matrix for above factors. The results indicate that one factor located in green zone, three factors are located in the yellow zone, two factors are located in the orange zone and three factors are located in red zone.

Table 4.6: Risk matrix for factors under political & environmental risks

Probability \ Impact	Very low (1)	Low (2)	Medium (3)	High (4)	Very High (5)
Very low (1)		R15			
Low (2)			R8, R10		
Medium (3)			R12, R13	R14	
High (4)				R7, R9, R11	
Very High (5)					

Low Risk	-	R15 - Embargoes
Moderate Risk	-	R8 - Changes in laws and regulations in foreign policies R10 - Change in country priority
High Risk	-	R12 - Political/social instability R13 - Corruption & bribes R14 - Expropriation
Extreme Risk	-	R7 - Change in laws and regulations of the host country R9 - Requirement for permits and their approvals R11 - Pollution and safety rules

Figure 4.3: Risk zones for factors under political & environmental risks

4.4.3 Managerial risk

Table 4.7 indicates the risk score for factors under managerial risk category where seven risk factors are considered under this group.

Table 4.7: Risk matrix for factors under managerial risks

No	Risk Factor	Probability	Impact	Risk Score
		Mean Score (P)	Mean Score (Q)	Mean Score (P x Q)
R16	Institutional changes	3	4	12
R17	Procurement delay	4	5	20
R18	Slow land acquisition by agency	4	4	16
R19	Ineffective management of Agency	3	4	12
R20	Local agencies miscommunication	3	3	9
R21	Delay compiling data (Sponsor requirements) by agency	3	3	9
R22	Limited implementation experience	3	3	9

Following Table 4.8 and Figure 4.4 illustrated the risk matrix for above factors. The results indicate that five factors are located in the orange zone and two factors are located in red zone.

Table 4.8: Risk matrix for factors under managerial risks

Probability	Very low (1)	Low (2)	Medium (3)	High (4)	Very High (5)
Very low (1)					
Low (2)					
Medium (3)			R9, R21, R22	R16, R19	
High (4)				R18	R17
Very High (5)					

Impact

Low Risk		
Moderate Risk	-	
High Risk	-	R16 - Institutional changes R19 - Ineffective management of Agency R20 - Local agencies miscommunication R21 - Delay compiling data (Sponsor requirements) by agency R22 - Limited implementation experience
Extreme Risk	-	R17 - Procurement delay R18 - Slow land acquisition by agency

Figure 4.4: Risk zones for factors under managerial risks

4.4.4 Technical risk

Table 4.9 indicates the risk score for factors under technical risk category where fourteen risk factors are considered under this group.

Table 4.9: Risk matrix for factors under technical risks

No	Risk Factor	Probability	Impact	Risk Score
		Mean Score (P)	Mean Score (Q)	Mean Score (P x Q)
R23	Incomplete design scope	2	4	8
R24	Design changes	4	5	20
R25	Design errors and omissions	3	3	9
R26	Inadequacy of specifications	3	3	9
R27	Deficiency in drawing	3	3	9
R28	Labour disputes and strikes	2	3	6
R29	Defective work	2	4	8
R30	Different site condition	4	4	16
R31	Technology selection	3	3	9
R32	Contractor incompetence	3	5	15
R33	Lack or departure of qualified staff	3	4	12
R34	Shortage in material availability	2	3	6
R35	Shortage in manpower availability	3	3	9
R36	Shortage in equipment availability	2	3	6

Following Table 4.10 and Figure 4.5 illustrated the risk matrix for above factors. The results indicate that three factors are located in the yellow zone, nine factors are located in the orange zone and two factors are located in red zone.

Table 4.10: Risk matrix for factors under technical risks

Probability	Very low (1)	Low (2)	Medium (3)	High (4)	Very High (5)
Very low (1)					
Low (2)			R28, R34, R36	R29, R23	
Medium (3)			R25, R26, R27, R31, R35	R33	R32
High (4)				R30	R24
Very High (5)					

Impact

Low Risk		
Moderate Risk	-	R28 - Labour disputes and strikes R34 - Shortage in material availability R36 - Shortage in equipment availability
High Risk	-	R23 - Incomplete design scope R25 - Design errors and omissions R26 - Inadequacy of specifications R27 - Deficiency in drawing R29 – Defective work R31 - Technology selection R33 - Lack or departure of qualified staff R35 - Shortage in manpower availability
Extreme Risk		R24 - Design changes R30 - Different site condition R32 - Contractor incompetence

Figure 4.5: Risk zones for factors under technical risks

4.4.5 Physical risk

Table 4.11 indicates the risk score for factors under physical risk category where five risk factors are considered under this group.

Table 4.11: Risk matrix for factors under physical risks

No	Risk Factor	Probability	Impact	Risk Score
		Mean Score (P)	Mean Score (Q)	Mean Score (P x Q)
R37	Damage to structure or property	3	5	15
R38	Damage to equipment & material	3	3	9
R39	Occupational safety & health issues	3	4	12
R40	Equipment damage	2	2	4
R41	Theft	2	2	4

Following Table 4.12 and Figure 4.6 illustrated the risk matrix for above factors. The results indicate that two factors are located in the yellow zone, two factors are located in the orange zone and one factor is located in red zone.

Table 4.12: Risk matrix for factors under physical risks

Probability	Very low (1)	Low (2)	Medium (3)	High (4)	Very High (5)
Very low (1)					
Low (2)		R40, R41			
Medium (3)			R38	R39	R37
High (4)					
Very High (5)					

Impact

Low Risk		
Moderate Risk	-	R40 - Equipment damage R41 - Theft
High Risk	-	R38 - Damage to equipment & material R39 - Occupational safety & health issues
Extreme Risk	-	R37 - Damage to structure or property

Figure 4.6: Risk zones for factors under physical risks

4.4.6 Act of god

Table 4.13 indicates the risk score for factors under act of god risk category where four risk factors are considered under this group.

Table 4.13: Risk matrix for factors under act of god

No	Risk Factor	Probability	Impact	Risk Score
		Mean Score (P)	Mean Score (Q)	Mean Score (P x Q)
R42	Flood	3	4	12
R43	Landslide	2	3	6
R44	Fire	2	3	6
R45	Extreme weather condition	4	4	16

Following Table 4.14 and Figure 4.7 illustrated the risk matrix for above factors. The results indicate that two factors are located in the yellow zone, one factor is located in the orange zone and one factor is located in red zone.

Table 4.14: Risk matrix for factors under act of god risks

Probability	Very low (1)	Low (2)	Medium (3)	High (4)	Very High (5)
Very low (1)					
Low (2)			R43, R44		
Medium (3)				R42	
High (4)				R45	
Very High (5)					

Impact

Low Risk	-	
Moderate Risk	-	R43 - Landslide R44 - Fire
High Risk	-	R42 - Flood
Extreme Risk	-	R45 - Extreme weather condition

Figure 4.7: Risk zones for factors under act of god risks

4.4.7 Other risk

Table 4.15 indicates the risk score for factors under other risk category where four risk factors are considered under this group.

Table 4.15: Risk matrix for factors under act of god risks

No	Risk Factor	Probability	Impact	Risk Score
		Mean Score (P)	Mean Score (Q)	Mean Score (P x Q)
R46	Delays in resolving contractual issues	3	4	12
R47	Delays in resolving disputes	3	3	9
R48	Delayed payments on contracts	3	4	12
R49	Unfairness in tendering	3	3	9

Following Table 4.16 and Figure 4.8 illustrated the risk matrix for above factors. The results indicate that all factors are located in the orange zone.

Table 4.16: Risk matrix for factors under other risk

Probability	Very low (1)	Low (2)	Medium (3)	High (4)	Very High (5)
Very low (1)					
Low (2)					
Medium (3)			R47, R49	R46, R48	
High (4)					
Very High (5)					

Impact

Low Risk		
Moderate Risk	-	
High Risk	-	R46 - Delays in resolving contractual issues
		R47 - Delays in resolving disputes
		R48 - Delayed payments on contracts
		R49 - Unfairness in tendering
Extreme Risk	-	

Figure 4.8: Risk zones for factors under other risks

From above risk matrix assessment, thirteen risk factors could be observed as predominant risk factors which were laid in red zone with risk level of extreme high. These risk factors are shown in following Table 4.17

Table 4.17: Predominant Risk Factors

No	Risk Factor
R1	Inflation
R2	Exchange rate fluctuation
R5	Lack of counter-part funds or delay in allocation
R7	Change in laws and regulations
R9	Requirement for permits and their approvals
R11	Pollution
R17	Procurement delay
R18	Slow land acquisition by agency
R24	Design changes
R30	Different site condition
R32	Contractor incompetence
R37	Damage to structure or property
R45	Extreme weather condition

"Inflation" was one of the risk factor identified by the respondents under extreme risk category. Even though the project has a price contingency provision, there were some projects which has experienced in increasing the project cost due to inflationary effect. Except for significant increase in prices of construction material, particularly steel, sand, cement and petrochemicals and allied products there were some situations where project cost overrun due to price escalation because of delay in commencing and completing the project as schedule.

"Exchange rate fluctuation" was another risk factor identified under extreme risk category. Government of Sri Lanka and foreign funding agencies signed the loan agreements in foreign currencies. Thus, the loan disbursed according to the prevailing exchange rate. When the rupee value is appreciated or depreciated the converted amount might got increase or decrease rather than expected.

In foreign funded projects there is a counter-part fund from government of Sri Lanka also. The availability of counterpart funds for project implementation became so scares due to limited funds. Sometimes treasury was not issued money on time in that case client had to make arrangement with the funding agency, with the concurrence of treasury and central bank of Sri Lanka. Therefore "lack of counter-part funds or delay in allocation of host country fund" became important risk factor that must be considered under financial risk category.

According to the risk assessment matrix "change in laws and regulations of host country" recognized as extreme risk factor under political and environmental risk category. From time to time government has been changing the taxes of country as example Value Added Tax (VAT), Custom Duty, Cess, Port and Airport Development Levy (PAL). When the government changes their laws and regulations it will affect to the projects.

"Requirement for permits and their approvals" risk has been considered as one of the significant risk that could have significant impact on water projects. As an example there were restrictions placed on working hours on several of the roads in which new pipes were to be laid. These included permitting works only at night or Sundays. These restrictions were imposed by relevant authorities with the intention of minimizing traffic delays, but were relaxed in some places during school holidays and weekends. Therefore it should be noted that the delay in permits and their approval from agencies such as Road Development Authority (RDA), Ceylon Electricity Board, Telecommunications, Municipal Councils etc. drastically affected to the schedule of project.

"Pollution risk" was one of another risk selected by respondents under extreme risk category. As every construction project, water projects also pose significant risk to the environment. Construction practices that fail to control pollution can cause damages to the environment like water, air, noise and land etc. There were instances in client organization which experienced in delay in project completion due to environmental issues. As example a delay occurred because local residents objected

to the noise and vibration of pile driving. Work was reprogrammed as a result, and the contractor obtained 'silent' pile driving equipment.

In foreign funded water projects, 'procurement delay' is a major problem. Funding agencies concurrence should be taken during consultant selection process and procurement process. Adopted procurement procedure should be adhered to funding agencies requirements. Situations where there had been delays in bid evaluation; and rebidding carried out due to high prices quoted, were also observed. Stringent qualification requirements included in bid invitations, partly to meet donor requirements have resulted in limited competition. There had been situations where re-bidding to obtain better prices have failed. Sometimes the contracts could not be tendered and awarded at desired times because of changes in the schedules due to the necessity to extend some tender opening dates, re-tendering and delayed contract signing periods.

"Land acquisition risk" has been considered as one of the major risk that could have significant impact on the time and cost of the project. Responded explained that the land acquisition process would delay due to various stakeholders such as land owners, government, politicians etc. There had been instances where land had to be acquired and people had to relocate whilst project implementation was in progress. These situations were unforeseen. The additional costs involved in meeting the cost of land acquisition and compensation payments are not reflected in the original cost estimate.

When a design change occurs, it creates the way to claims in terms of time and/or cost and the client is affected. Following examples illustrated how the water projects experienced in design changes in their projects. Some of the pipe line routes were changed (a) to minimize disruptions to traffic, (b) poor soil conditions (c) problems associated with land acquisition. And also some structures re-designed due to weak soil condition, unavailability of material like that.

"Different site condition" was recognized as extreme risk category from risk assessment matrix. In water projects, most of the occasions unforeseen sub soil conditions, inadequate bearing capacity of soil, presence of high water table in the project area, excessive utilities in roads are encountered and these lead to variations affecting the project cost and extension of time for completion.

There were situations encountered by the client like slow progress and projects held up due to incompetence of contractors. This could be happened due to contractor's financial status as well as technical capabilities. Therefore "contractor incompetence" risk creates significant risk in water projects.

"Damage to structure or property" is one of important risk encountered during the project progressing. Time spent by contractors in settling issues with owners of properties damaged as a result of laying of pipes or driving of piles caused delay in project progress as well as they were intended to forward claims to the client.

According to the risk assessment matrix "extreme weather condition" recognized as extreme risk factor under act of god risk category. This risk factor become critical as it cannot be controlled by parties and the consequence of this risk is very high.

4.5 Risk Response Measures

Based on survey result, relative importance index was calculated for each risk response measures. Then the response measures have been ordered in descending with respect to their importance, from best practiced measures to the lowest under each category.

Following Table 4.18 shows the results of the RII and ranking order for risk avoidance measures where the client identified "assigning more talented resources to ensure the project completion" as most effective method under risk avoidance category.

Table 4.18: Ranking of risk avoidance methods

No	Risk Avoidance Methods	RII	Rank
M-7	Assigning more talented resources to ensure the project completion	3.83	1
M-8	Make proper time estimation and produce a proper programme by referring to previous and ongoing similar	3.73	2
M-2	Placing condition on bids	3.57	3
M-3	Plan alternative methods/options as stand-by	3.23	4
M-4	Pre bid negotiations	3.20	5
M-1	Tendering a high bid	2.53	6
M-5	Reducing scope	2.40	7
M-6	Extending the schedule	2.37	8

The graphical illustration of above results can be shown as following Figure 4.9.

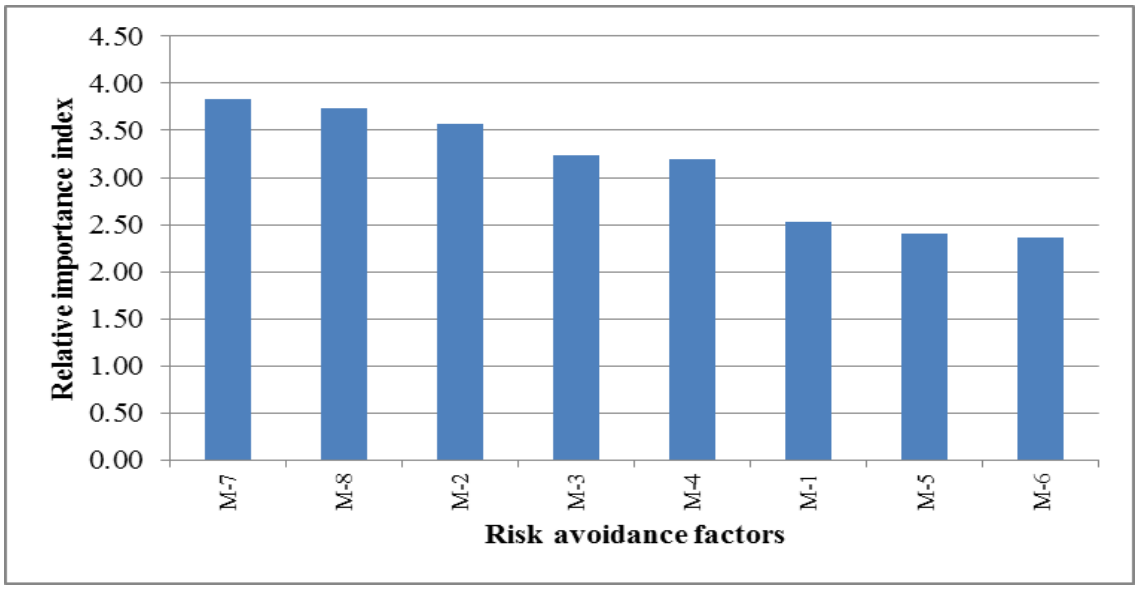

Figure 4.9: Effectiveness of risk avoidance methods

Following Table 4.19 and Figure 4.10 shows the results of the RII and ranking in descending order for risk transfer methods.

Table 4.19: Ranking of risk transfer methods

No	Risk Transfer Methods	RII	Rank
M-10	Transfer risk to insurance company	3.47	1
M-9	Transfer risk to contractor	3.00	2

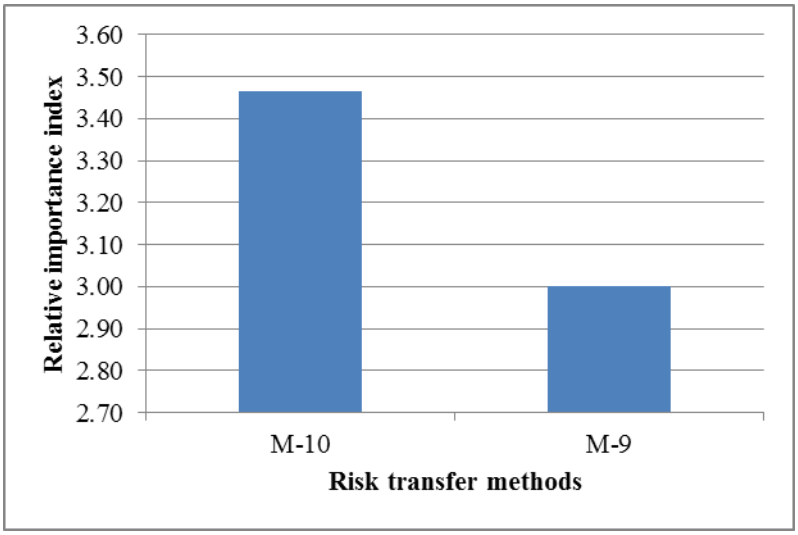

Figure 4.10: Effectiveness of risk transfer methods

Following Table 4.20 shows the results of the RII and ranking order for risk retention methods.

Table 4.20: Ranking of risk retention methods

No	Risk Retention Methods	RII	Rank
M-12	Accept the risk and have a contingency plan	3.50	1
M-11	Accept the risk at risk	2.57	2

The graphical illustration of above results can be shown as following Figure 4.11. According to the results it shows accept the risk and have a contingency plan is the most preferred risk retention method proposed by the client.

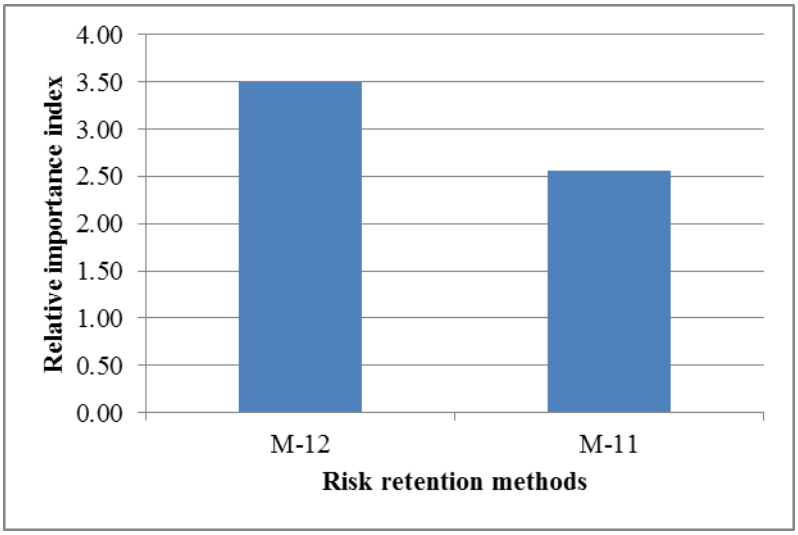

Figure 4.11: Effectiveness of risk transfer methods

Following Table 4.21 shows the results of the RII and ranking order for risk mitigation methods.

Table 4.21: Ranking of risk mitigation methods

No	Risk Mitigation Methods	RII	Rank
M-15	Adhere to proper site management practices	4.00	1
M-23	Coordinate closely with contractors	4.00	2
M-14	Adhere to construction practice	3.93	3
M-16	Personnel training and education	3.77	4
M-24	Detailed site investigation reports submitted with the bid document	3.77	5
M-19	Thorough review of specification	3.67	6
M-13	Adhere to proper design norms	3.63	7
M-18	Brainstorming to identify new risks	3.47	8
M-20	Review of scope	3.37	9
M-22	Provide close supervision to subordinates	3.37	10
M-25	Understanding of perception of payment obligation in relation with global standards	3.10	11
M-21	Adopting less complex processes	3.00	12
M-17	Physical protection to reduce risk	2.97	13

The graphical illustration of above results can be shown as following Figure 4.12.

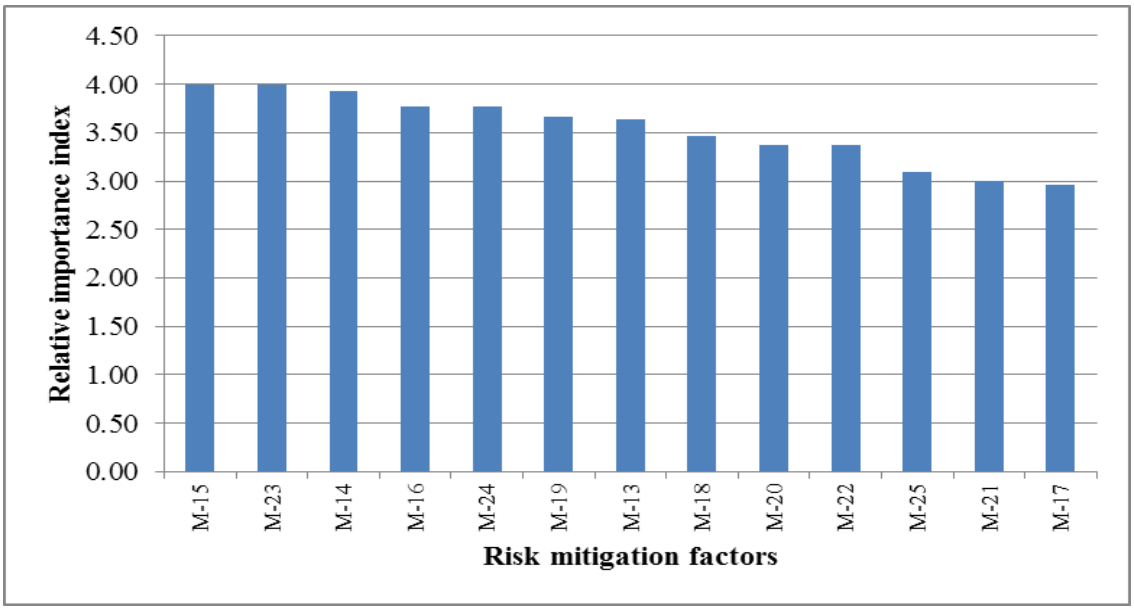

Figure 4.12: Effectiveness of risk mitigation methods

Out of 49 risk factors which were identified through the preliminary survey, the risk factors with 'Extreme High Risk' category as of Table 4.17 have been taken to study for risk response measures.

Following the analysis of risk responses measures as above, an interview survey was conducted to extract the expert views in order to identify the best response measures to each risk factor. Every response of interviewees for each risk factor was considered for developing risk management frame work.

Generally foreign funded water projects are planning for more than one year period. As a country like Sri Lanka, there is enough possibility for change in the inflation rate throughout the period. Therefore it is essential to have an accurate forecast on the inflation rate. Respondent suggested that allocating price contingency amount in the estimate as best practiced response measure to cover the increase in the construction cost due to inflation. Allocation percentage for price contingency can be predicted by looking at the previous years' country inflation trend. On the other hand

respondent suggested that minimizing the period from the date of bid closing to contract awarding and adhere to the project life cycle (initiation, planning, execution and closeout) lead to mitigate the risk of inflation.

In foreign funded projects, GOSL and donor agency sign the loan agreement with use of foreign currency. However the NWS&DB as an implementing agency enter into the contracts with the contractors using local currency except some supply contracts with foreign currency. When disburse the loan the applicable exchange rate is the prevailing exchange rate at the time. On the other hand when repaying the loan to the donor the applicable exchange rate is the prevailing exchange rate at the time of repayment. Under the high inflation situation, the value of cash flow received from the loan amount will decrease as the country's currency depreciates in the foreign exchange market. Therefore the risk of fluctuating exchange rate lies with the employer. To deal with the exchange rate fluctuation risk respondent suggested that having a contingency plan as the best risk response measure. And further there are some contracts for importation of materials as example DI pipes and fittings. In these types of contracts, respondent suggested that use same currency (loan currency) to award of the contract as best response measure to address the above risk.

In foreign funded water projects there is a counter-part fund from government of Sri Lanka also. Taxes, duties, VAT and land acquisition costs etc. have to bear by the GOSL. As an implementing agency client organization is the institute executes the project. Even though they make reservation from the treasury at the outset of the project, sometimes treasury will not issue sufficient money on time in executing stage. Then the client has to arrange their own funds to deal with the above situation. However it is limited. Prepare a proper financial plan for fund requirement is one of the response measures for dealing with the lack of counter-part funds or delay in allocation of host country fund. However it is difficult to mitigate the said risk if the treasury does not have enough money even though there is financial plan.

Change in laws and regulations risk is beyond the control of the parties. Once the government changes the laws, legislations and regulations of the country, employer

should have mechanism to deal with the risk. The respondent suggested that accept the risk and have a contingency plan is most practicable response method. And also complete the project through proper time management and identification and find legal and reasonable way to deal with the VAT and custom duties (VAT and duties exemption projects) could be used as relief methods for dealing with change in laws and regulations risk.

Most of the projects has experienced in schedule delay due to inability of obtaining required permits and their approvals in time. Once the project started there are several stakeholders like Road Development Authority, Electricity Board, Telecommunication, Sri Lanka police etc. are involved to the project in different ways. Accordingly client needs to obtain approvals from relevant authorities. Therefore identification of institutional aspects and better co-ordination among the various agencies will help to manage the said risk. And further, maintaining good relationship with the stakeholders and making sufficient awareness of them support to completion of project without hindrance.

Water infrastructure projects are directly exposed to the pollution risk. Respondent suggested that develop an environmental plan including measures intended to minimize the disruption caused by the contract works. Environmental plan can develop complying with the environmental laws/ standards and regulations. As an example respondent suggested that include specification required the contractor to prevent excessive noise, dust and other nuisance in constructing the works. Then the project manager was permitted, under the clause, to stop the contractor from working and/or rectify the matters if he failed to comply with this requirement. Further, contracts can specify the contractual penalty for failure to achieve the required standards. Apart from that adhere to proper site management practice and employ a ‘liaison officer’ to co-ordinate with the police/ local authorities etc. will be supported to manage the risk.

Procurement delay is one of the challenging risk factor encountered by foreign funded water projects. This type of delays are often caused due to long bid evaluation

period including inability of implementation agency to award contracts to designers, consultants or contractors in a timely manner and operational delays of implementing organization. In foreign funded projects, implementing agency needs to take concurrence of funding agency during consultant selection process and procurement process. Therefore it is necessary to follow the relevant funding agency guidelines and GOSL guidelines properly to avoid the unnecessary delay. And also said risk can be managed by preparing a realistic procurement plan and conducting a pre-qualification in assessing contractor's and consultants' capabilities based on their past experience.

According to the respondent's point of view, land acquisition risk is the one of the significant risk which can be expected in water projects. Timely acquisition of land is very important to ensure entire schedule of the project. Land acquisition process will normally take minimum one and half years. In order to minimize the risk, the government of Sri Lanka has to improve the existing land law to expedite the land acquisition process. On the other hand respondent suggested that conducting public awareness campaigns and identifying land needs in advance and acquire them without staying last moment will help to manage above risk.

Design change risk will affect to the project completion in terms of time and cost wise. Therefore the respondent pointed out adhere to proper design norms, carrying out the proper investigations and take guarantee on the works from the consultants (Insurance cover) as response measures to the said risk.

Different site condition risk has always been considered as one of the significant risk that could have a significant impact on the project cost and extension of time for completion. Respondent proposed best practiced risk management measures as accept the risk and allocate physical contingency amount in the total cost estimate and conducting detailed site investigation and submitted with the tender documents.

Selecting a contractor for a project is a lengthy procedure as it requires fulfilling the donor requirement as well as GOSL. Project delay caused due to incompetence of the

contractors to carry out the work with correct approach. As well as it is additional cost to the project to select another contractor to carry out the works. Therefore respondent pointed out this risk can be managed by adopting proper qualification and evaluation criteria in the pre contract stage. And also after selecting a contractor it is good to co-ordinate closely with them by giving technical advices to areas which have to be developed. It helps both parties to go for win –win situation.

Damage to structure or property is one of important risk encountered during the project progressing. Respondent pointed out this risk can be managed through adopting proper construction practice and transfer risk to insurance company.
Adverse weather risk is beyond the control of the parties hence respondent proposed allocation of contingency plan as best risk response methods.

4.6 Risk Management Framework

In the previous sections, most predominant risk factors and best proposed risk response measures were identified. By considering the results of the previous sections, risk management framework was developed for most predominant risk factors shown in Table 4.17 and it is shown in Figure 4.13.

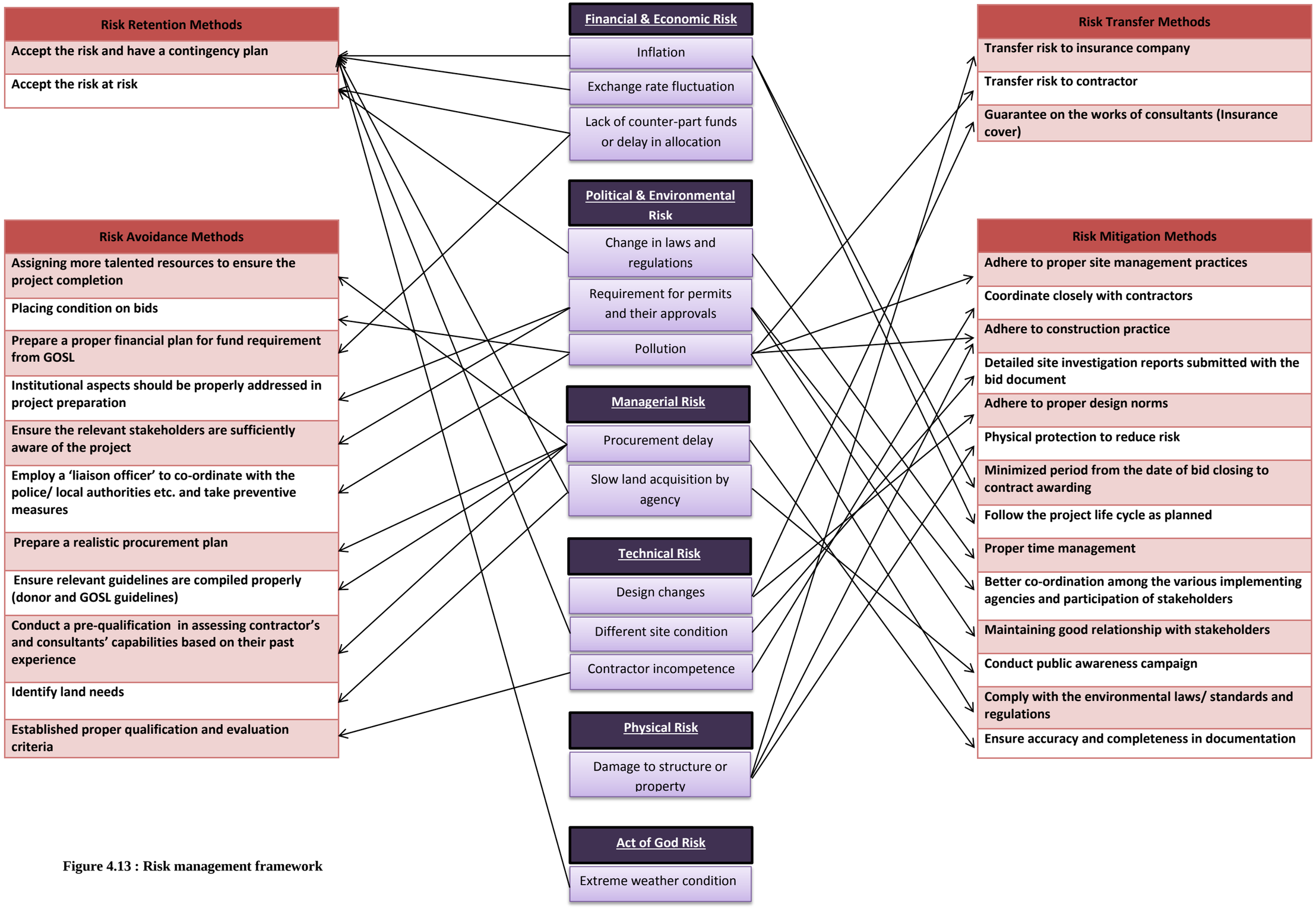

Figure 4.13 : Risk management framework

4.7 Summary

There were forty nine risk factors identified from the literature survey. Based on the questionnaire analysis, only thirteen risks factors were observed as the predominant risk factors in foreign funded water projects in Sri Lanka. Those factors are inflation risk, exchange rate fluctuation risk, lack of counter-part funds or delay in allocation risk, change in laws and regulations risk, requirement for permits and their approvals risk, pollution risk, procurement delay risk, slow land acquisition by agency risk, design changes risk, different site condition risk, contractor incompetence risk, damage to structure or property risk and extreme weather condition risk. Risk management framework was developed for above identified risk factors based on the analysis of risk response measures in questionnaire and expert opinion obtained from the interview.

CHAPTER 05

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

Most of the water supply projects in Sri Lanka were implemented with the assistance from foreign funds and counterpart funding by the Government of Sri Lanka. Though huge amount of money invested by foreign funding agencies yet the risk involvement is inherent in these projects and it is unavoidable. In order to manage those risk effectively, a comprehensive method for managing risk during the project life cycle should be applied. The aim of this research was to develop a risk management framework for foreign funded water projects in Sri Lanka from the client's perspective. The research methodology used to achieve the aim was survey approach with data collection through questionnaire survey and unstructured interviews for further confirmation of results.

In order to accomplish the above aim, first attempt was to identify the critical risk factors associated with foreign funded water projects, which was set as first objective of the research. There were forty nine risk factors identified from the literature review under the categories of financial and economic risk, political and environmental risk, managerial risk, technical risk, physical risk, act of god and other risk. The identified risk factors were further studied through a questionnaire survey. The analysis of the identified forty nine risk factors using 5x5 risk matrix indicates that one factor is located in the green zone, twelve factors are located in the yellow zone, twenty two factors are located in the orange zone and thirteen factors are located in the red zone of the risk matrix. The predominant risk factors that are located in the red zone are: Inflation, Exchange rate fluctuation, Lack of counter-part funds or delay in allocation, Change in laws and regulations of the host country,

Requirement for permits and their approvals, Pollution, Procurement delay, Slow land acquisition by agency, Design changes, Different site condition, Contractor incompetence, Damage to structure or property and Extreme weather condition. As above factors are having extreme high risk those factors were studied further to develop the risk management framework.

The second objective of this research was to establish effective use of risk response measures for those risk factors. Risk response measures have been identified from the literature review and preliminary survey under the categories of risk avoidance, risk retention, risk mitigation and risk acceptance. There were twenty five risk response measures and those were evaluated based on its effectiveness. Then the response measures have been ordered in descending with respect to their importance, from best practiced measures to the lowest under each category of risk avoidance, risk acceptance risk transfer and risk mitigation.

Last objective of this research was to develop a risk management framework for handling risk in foreign funded water projects from the client's perspective. For each of the identified risks, effective response measures were provided. Consequently, the expert views also integrated into the response measures of each risk. Based on the findings on risk factors and risk response measures, the risk management frame work was developed for the predominant risk factors in foreign funded water projects in Sri Lanka.

5.2 Recommendation

Considering the finding of this research, following can be recommended as implementations to the foreign funded water projects carrying out by the client organization.

- The developed risk management framework can be used as a guideline to future projects to identify significant risk factors and risk response measures.

- Client can provide risk management awareness programs to the professionals in FF water projects, thus introducing risk management strategies would help to deal with risk and ensure the better performance achievement in future projects.

5.3 Limitation

- As the National Water Supply and Drainage Board is the only client for the foreign funded water projects in Sri Lanka, when receiving the clients' perception in data collection, all the respondents were from NWSDB.
- This research deals only with the foreign funded water projects carrying out under separated contracts.

5.4 Further Research

1) The present research was done to develop risk management framework for foreign funded water projects in Sri Lanka from client's perspective. Further researches on all other involved parties such as contractor and government can be done.

2) A research can be carried out to find out the barriers to the implementation of risk response measures to the FF water projects.

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APPENDIX – A

QUESTIONNAIRE

Section A: Demographic Characteristics

Q1. Your Name (Optional):

…….....

Q2. Your Designation / Position: …….....

Q3. Your experience in the construction industry: ……..(Number of years)

Q4. How many foreign funded projects have you involved……

Section B: Impact and probability of risks

In your opinion please indicate the probability and impact of the following risk factors that may exist in **Foreign Funded Water Projects**. Please note that 'probability' and 'impact' denotes the following meanings

Probability- Likelihood of occurrence of each risk

Impact- If the risk occurs, its magnitude of consequence to the foreign funded water projects in terms of time, cost, quality, safety and environmental sustainability.

No	Risk factors in foreign funded water projects	Probability					Impact				
		1	2	3	4	5	1	2	3	4	5
		Very low	Low	Medium	High	Very High	Very low	Low	Medium	High	Very High
1	**Financial & Economic risks**										
1.1	Inflation										
1.2	Exchange rate fluctuation										
1.3	Loan interest										
1.4	Availability of funds										
1.5	Lack of counter-part funds or delay in allocation *(Delay or insufficient allocation of host country fund)*										
1.6	Disbursement difficulties										
2	**Political & Environmental risks**										
2.1	Change in laws and regulations of the host country										
2.2	Changes in laws and regulations in foreign policies										
2.3	Requirement for permits and their approvals										
2.4	Change in country priority (*when the government changes the priorities or lose the motivation to keep supporting the project*)										
2.5	Pollution *(Environmental policies)*										
2.6	Political/social instability (*civil unrest, strikes etc.)*										
2.7	Corruption & bribes										
2.8	Expropriation (*Gov. take private property*)										
2.9	Embargoes (*Trade barriers*)										
3	**Managerial risk**										
3.1	Institutional changes (*Restructuring of implementing agencies, key staff, changes in ministries and coordination personnel*)										
3.2	Slow land acquisition by agency										

No	Risk factors in foreign funded water projects	Probability					Impact				
		1	2	3	4	5	1	2	3	4	5
		Very Low	Low	Medium	High	Very High	Very Low	Low	Medium	High	Very High
3.3	Procurement delay (*Inability of implementation agency to award contracts to designers, consultants or contractors in a timely manner*)										
3.4	Ineffective management of Agency (*lack of effective leadership, weak administrative capacity; poor monitoring, poor financial management and accountability of agency staff*)										
3.5	Local agencies miscommunication *(Disconnect between agencies in the host country, creating either duplication and conflicting efforts, or areas with lack of responsible party)*										
3.6	Delay compiling data (Sponsor requirements) by agency *(Inadequate familiarity with sponsor's procurement guidelines. Problems with progress reports, performance indicators, insufficient understanding of loan system etc.)*										
3.7	Limited implementation experience (*Lack of experience in international bidding process and contracting, Inexperience staff employed*)										
4	**Technical risk**										
4.1	Incomplete design scope										
4.2	Design changes										
4.3	Design errors and omissions										
4.4	Inadequacy of specifications										
4.5	Deficiency in drawing										
4.6	Labour disputes and strikes										
4.7	Defective work										
4.8	Different site condition										

No	Risk factors in foreign funded water projects	Probability					Impact				
		1	2	3	4	5	1	2	3	4	5
		Very Low	Low	Medium	High	Very High	Very Low	Low	Medium	High	Very High
4.9	Inappropriate technology selection										
4.10	Contractor incompetence										
4.11	Lack or departure of qualified staff										
4.12	Shortage in material availability										
4.13	Shortage in manpower availability										
4.14	Shortage in equipment availability										
5	**Physical risk**										
5.1	Damage to structure or property										
5.2	Damage to equipment & material										
5.3	Occupational safety and health issues (*Labour injuries & death*)										
5.4	Equipment damage										
5.5	Theft										
6	**Act of God**										
6.1	Flood										
6.2	Landslide										
6.3	Fire										
6.4	Extreme weather condition										
7	**Other risks**										
7.1	Delays in resolving contractual issues										
7.2	Delays in resolving disputes										
7.3	Delayed payments on contracts										
7.4	Unfairness in tendering										

Section C: Risk response measures

Please indicate the effectiveness of following risk response measures related to the **Foreign Funded Water Projects**. And you may indicate relevant risk event which could be covered by the each risk response.

No	Risk Response Measures	Effectiveness					Remarks (Which risk event could be addressed by the each risk response measures)
		1	2	3	4	5	
		Very low	Low	Medium	High	Very High	
1	**Risk Avoidance**						
1.1	Tendering a high bid						
1.2	Placing conditions on bid						
1.3	Plan alternative methods/options as stand-by						
1.4	Pre bid negotiations						
1.5	Reducing scope						
1.6	Extending the schedule						
1.7	Assigning more talented resources to ensure the project completion						
1.8	Make proper time estimation and produce a proper programme by referring to previous and ongoing similar projects						
2	**Risk Transfer**						
2.1	Transfer risk to contractor						
2.2	Transfer risk to insurance company						

3	**Risk Retention**						
3.1	Accept the risk						
3.2	Accept the risk and have a contingency plan						
4	**Risk Mitigation**						
4.1	Adhere to proper design norms						
4.2	Adhere to proper construction practices						
4.3	Adhere to proper site management practices						
4.4	Personnel training and education						
4.5	Physical protection to reduce risk						
4.6	Brainstorming to identify new risks						
4.7	Thorough review of specification						
4.8	Review of scope						
4.9	Adopting less complex processes						
4.10	Provide close supervision to subordinates						
4.11	Coordinate closely with contractors						
4.12	Detailed site investigation reports submitted with the bid document						
4.13	Understanding of perception of payment obligation in relation with global standards						